


Article

Rethinking Rural Transformation Caused by Comprehensive Land Consolidation: Insight from Program of Whole Village Restructuring in Jiangsu Province, China

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Abstract: China has made great progress in its economy and urbanization in the past 30 years, but rural development has lagged behind the cities and the gap between urban and rural areas continues to widen. The Chinese government implemented the “Building New Countryside Plan” in 2006, which used a new policy of increasing the urban land quota linked with decreasing rural construction land to promote rural transformation and the coordinated development of the urban–rural area. In order to evaluate the effectiveness of rural transformation caused by comprehensive land consolidation and to improve the future practical operability of the policy, a field survey on 42 projects in Jiangsu Province was conducted from March–August 2016. The results of this study showed that: (1) Comprehensive land consolidation had a significant role in promoting rural transformation based on the premise of excluding the average growth rate and 88.1% of the project’s farmers’ income achieved a faster increase than other areas; (2) the increase in the farmer’s income was mainly attributed to non-agricultural income as non-agricultural employment was still a precondition for rural transformation and the degree of local industrialization and educational levels received by farmers were limited for rural transformation; (3) the transfer fees of the land quota were the key factor to maintain the financial balance between demolition and resettlement, but local land quota demand and government capacity in financial operations affected rural restructuring; and (4) the absence of rural social welfare systems significantly affected the land transfer rate. The above conclusions are helpful in understanding the dynamic mechanism of rural transformation, enriching the academic literature in related fields, and are of practical significance for rural revitalization in developing countries.

Keywords: land use; rural development; inclusive growth; policy performance; urban-rural integration

1. Introduction

China has made remarkable achievements in rural socioeconomic development since the Reform and Open-up, which was a policy of shifting from a planned to a market economy and attracting foreign investment in 1978. Over 200 million rural residents have broken away from poverty [1–4]. Due to the long-term implementation of industrial and urban priority strategies, rural areas, agriculture, and farmers are in a disadvantaged position. There are prominent problems such as a dominant rural

labor force consisting of the elderly and the less physically-abled, increasing non-agriculturalization of farmland, emptying of rural areas, and difficulty in transporting the agricultural population [5]. Currently, there are still about 600 million people living in rural China [6]. The absolute income gap between urban and rural residents is still enlarging. The per capita net income of China's rural residents has increased from 134.0 CNY to 9892.6 CNY between 1978–2016. However, the per capita net income of urban residents was 343.0 CNY in 1978 and 33,616.2 CNY in 2016 [7]. In 2006, the Chinese government began to arrange the "Building New Countryside Plan", which was a program of promoting rural economic development, improving rural living conditions, and reducing the gap between urban and rural areas in rural China [3,8–10]. Although the support of agriculture, the countryside, and farmers has continued to increase, the stagnation of the rural economy has not been fundamentally reversed. Rural transformation in China lacks a strong institutional opportunity and economic driver.

In 2006, the Ministry of Land and Resources in China began to implement a new policy, i.e., increasing urban land quota linked with decreasing rural construction land. The policy aimed to drive rural transformation while developing cities improve land tenure transfer and pilot a whole village renewal in economically developed regions in China [11–14]. This policy has not only provided a strong legal support for rural transformation in theory, but has also provided an economic driver for rural transformation in practice [15,16]. So far, the pilot projects of comprehensive land consolidation have been implemented for more than 10 years [17]. It provides a 60,000 hectares of land quota for urban development each year, but whether it has effectively promoted rural transformation has never been assessed. However, it is related to farmers' livelihood and long-term stability in rural China [18]. The approach, progress and social impact of comprehensive land consolidation has drawn much attention from both academicians and policy makers. The assessment and understanding of the effectiveness of comprehensive land consolidation for promoting rural transformation is critical for further policy optimization.

In many countries, land consolidation is employed as an effective tool for reducing farmland fragmentation and agricultural production costs and increasing agricultural market competitiveness [19–22]. Farmland fragmentation includes not only physical segmentation due to natural terrain such as rivers and hills, but also fragmentation of property rights [23–25]. Land inheritance rights of private property often also aggravate land fragmentation in Europe and America [24,25]. After land privatization reform in Eastern Europe and Africa, land consolidation was generally implemented to optimize farmland property rights and reduce land fragmentation [26–28]. Additionally, in Europe, Africa and South Asia, achievements in farmland irrigation systems and road networks caused by land consolidation have significantly reduced the time and distance of farming, saved agricultural production costs, and improved agricultural productivity [22,28–31]. Lerman and Cimpoieş believe that land consolidation effectively promotes large-scale agri-business operations, thus increasing the income of the rural population as a whole [32]. In 2003, the FAO expanded the connotation of comprehensive land consolidation [33], which was expected to improve the rural living environment and bridge the gap between urban and rural areas. This is similar to the current idea of comprehensive land consolidation in China. However, enhancing attractiveness was the most direct goal of rural transformation in Europe and America, which made more young people willing to stay in rural areas and reduce rural population output [34]. This is completely different from rural transformation goals and the basic national conditions in China. At present, China still has a rural population of 600 million. Farmers cannot have enough farmland to earn income comparable to that of urban residents. We should not expect that the per capita arable land of less than 0.3 hectares could bring about a rich life for 600 million farmers. Therefore, shifting some rural people to the cities is an inevitable requirement for China's rural transformation.

Chinese scholars consider that the land consolidation has multiple effects and a close relationship with rural transformation. The previous research had revealed that land consolidation has effects such as the added rate of cultivated land [35], cultivated land quality [36], potential productivity [37], investment efficiency [38], farmland landscape pattern [39], and institutional design in China [40–42]. Recently, focal interests have turned to ecological costs [2], integration rural-urban development [11,43],

and land quota linked with poverty regions [4]. As for the relationship between land consolidation and rural transformation, Tan et al. identified a strong correlation between non-agricultural income in rural China and a higher land transfer rate [44]. Long et al. believe that rural production, rural life, and ecological space are conducive to beneficial and harmonious exchanges and communication between rural and urban areas [3]. Liu et al. defined rural development transformation as the process of transforming conventional rural industries, employment channels, and consumption structures as well as opening up urban–rural barriers to create a new unity, the essence of which is to advance a radical reform of industrial-agricultural and urban–rural relations [45]. Li et al. believed that the increase in urban construction land and the decrease of rural construction land facilitated more efficient urban–rural construction land allocation and balanced regional development planning [5]. Zhang et al. argued that labor productivity in rural restructuring was greater than capital productivity in terms of its impact on agricultural production [46]. However, there are also some medias that have reported that some local governments have lacked transparency and regularity in the management of the land consolidation project [17], resulting in negative effects such as farmers have been forced to leave their farmlands and old houses and relocated to new residential areas [18].

Previous studies show that the promotion of comprehensive land consolidation for rural transformation is a scientific and practical problem. Although scholars have already raised concerns about related policies, there still lacks empirical study to understand the processes and effectiveness of comprehensive land consolidation for promoting rural transformation. Considering that the comprehensive land consolidation in China is still in at the exploratory stage, assessments and improvements of related policy and governance are imperative. Therefore, it is necessary to systematically investigate and evaluate these pilot projects. A field survey of 42 projects in the program of whole village restructuring in Jiangsu Province, China was conducted from March–August 2016. The aims of this study are as follows: (1) Clarify the drivers and pathways of rural transformation caused by comprehensive land consolidation; (2) assess the actual effectiveness of the program of whole village restructuring for promoting rural transformation in Jiangsu Province, China; (3) identify the key factors of rural transformation caused by comprehensive land consolidation; and (4) build a policy framework to guide future comprehensive land consolidation towards better promoting rural transformation in China.

2. Data and Methods

2.1. The Study Area

Jiangsu Province is located on the east coast of China (116°18′–121°57′ E and 30°45′–35°20′ N). A transitional zone from warm to subtropical, Jiangsu Province has an average temperature of 13–16 °C and an annual precipitation of 850–1350 mm. Plains and water bodies account for 90% of the province's total area, with scattered low mountains in the north and south. In 2015, the permanent resident population was 77.7 million and the urbanization rate was approximately 66.5%. The local gross domestic product for that year was 7011.6 billion CNY [6]. Although Jiangsu Province is one of China's most economically developed provinces, intra-provincial economic development is not balanced. The ratio of per capita GDP between the South, Central, and North Jiangsu is 4:2:1. However, whether it is the developed South Jiangsu or the backwards North Jiangsu, urban and industrial expansion still have large demands for land quota. By the end of 2015, the per capita farmland area was only 0.06 ha. Maintaining no decrease in farmland and food security is extremely stressful. Increasing the urban land quota linked with decreasing rural construction land policy caused by comprehensive land consolidation is the only legitimate means to replace urban–rural construction land and keep farmland from decreasing according to current laws and regulations in China.

2.2. Data Collection and Processing

From March to June 2016, a field survey was conducted on 42 whole village restructuring projects implemented from 2009–2012 by collecting socio-economic data from the local statistics department. Data on 18 indicators (including the location of the project, income, GDP, demographics, education, land resources, and reclamation village area) were selected from local government, police stations, and the land consolidation and rehabilitation center of Jiangsu Province. Due to intra-provincial differences in economic level, project durations, and lagged impacts of comprehensive land consolidation after 2–3 years, six typical samples implemented before 2011 were selected from South, Central, and North Jiangsu Province (Figure 1). For the sake of data comparability and consistency, the years 2009 and 2015 were chosen as the time points of this study.

The administrative village is the basic unit of socio-economic statistics in rural China. Whole village restructuring projects were prohibited from breaking administrative boundaries. Therefore, the sampling data could be obtained through a simple summary of one or several villages. Collected raw data were pretreated to facilitate redundancy analysis. For example, the factor of educational level was divided into three major categories of schooling years—less than 6 years, 6–9 years, and more than 9 years—instead of the traditional five categories (illiteracy, primary school, junior middle school, senior high school, and junior college and above). Income was divided into agricultural and non-agricultural income.

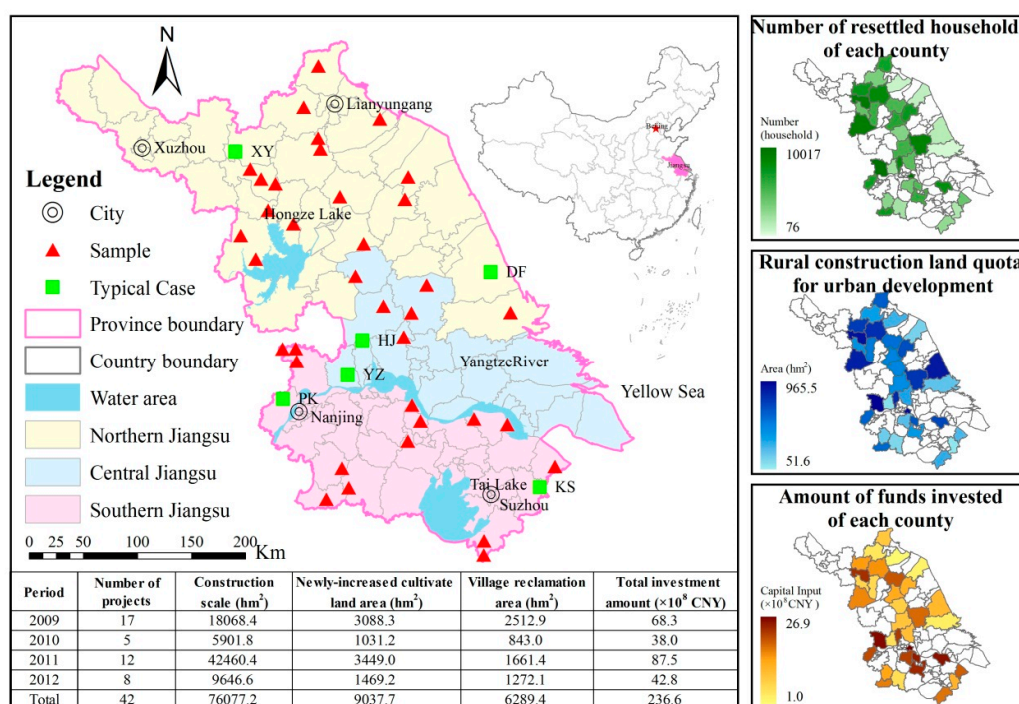


Figure 1. Location of the study area and basic sample data.

2.3. Methods

2.3.1. Using Scientific Abstract Method to Map the Drivers and Pathways of Rural Transformation Caused by Comprehensive Land Consolidation

The scientific abstract method is a logical reasoning method that can abstract external, accidental, and non-essential connections from a large number of social and economic phenomena and find out the inherent, necessary, and essential connections of the above phenomena. According to Long's conceptualization model [47] and field surveys, we defined the pathways of rural restructuring and drivers of rural transformation. Graphs and data of man-land interrelations were used to explain the

pathways and drivers of rural transformation caused by whole village restructuring projects in Jiangsu Province, China.

2.3.2. Indicators of Rural Transformation Caused by Comprehensive Land Consolidation

Income, employment, and welfare are key indicators of rural transformation. According to objects of whole village restructuring projects in Jiangsu Province, the greater the farmers' income, non-agricultural employment rate, and the coverage rate by the social security system and basic medical insurance system within the project area, the better the effect of rural transformation. The farmers' income, non-agricultural employment rate, and the coverage rate by the social security system and basic medical insurance system cannot be attributed to whole village restructuring projects alone; overall economic growth in Jiangsu Province also plays a role. Therefore, we introduced the income change index, employment change index, and welfare change index, which eliminated the effects of the overall economic growth of Jiangsu Province. Descriptions of the three indices associated with the effects of whole village restructuring on rural transformation are shown in Table 1.

Table 1. Evaluation indicators of rural transformation caused by comprehensive land consolidation.

Indicator	Abbreviation	Definitions	Meaning
Income change index	ICI	$ICI = \frac{\frac{P_{2015}^i - P_{2009}^i}{C_{2015}^i} - \frac{P_{2009}^i}{C_{2009}^i}}{\frac{P_{2009}^i}{C_{2009}^i}}$	The larger the index, the higher the relative income change of farmers within the project area compared to the average income of farmers in the region (Supplementary Materials Table S1)
Employment change index	ECI	$ECI = \frac{Y_{2015}^i}{X_{2015}^i} / \frac{Y_{2009}^i}{X_{2009}^i}$	The larger the index, the higher the relative change in the proportion of people shifting to non-agricultural sectors in the project areas compared to the average in the region
Welfare change index	WCI	$WCI = \frac{a(M_{2015}^i - M_{2009}^i) + b(N_{2015}^i - N_{2009}^i)}{P_i}$	The higher the index, the more people joining the social security system and basic medical insurance system

Note: P_{2009}^i and P_{2015}^i are the farmer's per capita income of rural residents within the i th project in 2009 and 2015, respectively, and C_{2009}^i and C_{2015}^i are the farmer's per capita income of the county where the i th project was located in 2009 and 2015, respectively. X_{2009}^i and X_{2015}^i are the number of rural residents engaged in the agricultural sector in the i th project in 2009 and 2015, respectively; and Y_{2009}^i and Y_{2015}^i are the number of rural residents engaged in non-agricultural sectors in the i th project in 2009 and 2015, respectively. M_{2009}^i and M_{2015}^i are the number of rural residents joining the social insurance system for the i th project in 2009 and 2015, respectively; N_{2009}^i and N_{2015}^i are the number of rural residents joining the basic medical insurance system for the i th project in 2009 and 2015, respectively; P_i is the total population in the i th project in 2015; and a and b are constants, the values of which are taken as 0.7 and 0.3 according to China's well-off society standard, respectively.

2.3.3. Using Redundancy Analysis to Identify the Key Factors of Rural Transformation

Redundancy analysis (RDA) was used to explore the relationship between rural transformation and socioeconomic variables measured at whole village restructuring projects in Jiangsu Province, China. RDA, a common method used for relating species to environmental variables, is considered a constrained version of principal component analysis (PCA) [48]. As variation was expected to be continuous, we employed ordination, rather than cluster analysis, using CANOCO version 4.5 and detrended correspondence analysis of socioeconomic data after comprehensive land consolidation indicated that the linear ordination method of RDA was most appropriate as the length of gradient was short (<2 standard deviation), indicating that the socioeconomic data were homogeneous [49,50]. Previous studies have shown that PCA could help find key factors from a complex socioeconomic system described by multiple factors such as land management [51]. These key factors are crucial to understanding rural transformation caused by comprehensive land consolidation. In this study,

three indices, namely, income change index, employment change index, and welfare change index were denoted as the species to depict the progress of rural transformation. Meanwhile, 18 indicators were treated as explanatory variables for rural transformation. Significant socioeconomic variables underwent preliminary screening using the Monte Carlo permutation test. A sharp angle between the arrow of the species and the arrow of the socioeconomic variable indicated a positive correlation; if the angle was blunt, a negative correlation was indicated. A right angle means that no correlation was indicated between the two. The socioeconomic variables of six typical projects are shown in Table 2 (Supplementary Materials Table S2).

Table 2. Socioeconomic variables of six typical whole village restructuring projects in 2015.

Category	Socioeconomic Variable	Abbreviation	Typical Project ID					
			DF	HJ	KS	PK	XY	YZ
Location	Economic zone	EZ	North	Central	South	South	North	Central
	Distance to town (Km)	DT	9.6	2.6	3.6	15.0	19.8	8.9
	Distance to city (Km)	DC	45.4	25.8	21.4	37.0	41.5	28.5
Income	Per capita income (CNY)	PCI	18,917.9	23,451.8	37,984.5	26,854.3	15,321.2	22,311.4
	Nonfarm income	NFI	7382.2	15,783.1	35,021.7	19,362.0	5760.8	14,388.9
	Farm income	FI	11,535.7	7668.7	2962.8	7492.3	9560.4	7922.5
Economic level	Per capita GDP (10 ⁴ CNY)	PCP	7.6	10.7	18.7	9.7	5.6	7.2
	Gross industrial output (10 ⁹ CNY)	GIO	214.4	257.9	1695.7	354.6	212.4	186.44
Demographics	Number of households	NH	532	3744	776	2906	3014	1133
	Total Population	TP	2181	13,853	2716	10,463	11,453	4192
	Farm laborers	FL	770	1930	54	893	4419	859
	Nonfarm laborers	NFL	767	6260	1727	5978	3782	1909
Education	Pct. Less than 6 years	PLY	15.7	12.5	8.4	10.0	23.10	13.6
	Pct. 6–9 years	PAY	49.7	44.4	35.9	35.6	47.2	38.6
	Pct. More than 9 years	PMY	34.6	43.1	55.7	54.4	29.7	47.8
Land resources	Per capita farmland area (hm ²)	PFA	1.45	0.12	0.13	0.09	0.11	0.09
	Pct. land tenure transfer	PLT	45.6	62.4	100.0	86.4	42.9	76.8
	Avg. construction land area per households (hm ²)	ACL	0.07	0.07	0.06	0.07	0.08	0.07

3. Results

3.1. Mapping Drivers of Rural Transformation and Pathways of Rural Restructuring

According to field surveys and Long's conceptualization model [47], the incentives of rural transformation were abstracted as the economic driver, population driver, and land use driver (Figure 2). First, the economic driver mainly comes from a new policy of increasing urban land quota linked with the decreasing rural construction land. The amount of land quota is the difference between the demolished village area and centralized resettlement area. The local government obtained the capital by transferring the land quota for rural restructuring. Second, the population driver mainly comes from the urban lifestyle. With centralized resettlement, the farmers' living and consumption patterns gradually urbanized. Third, the land use driver mainly comes from comprehensive land consolidation. High-standard farmland facilitates mechanized farming, which can release more labor forces. The urbanization of surplus rural labor also promoted land tenure transfer, which in turn improved mechanized farming and the agricultural production mode.

Current rural restructuring was carried out around urban land quota linked with decreasing rural construction land. Duo to rapid urbanization and industrialization, the local governments need more land quota for urban development. As long as the resettlement costs are less than the fees of the land quota transfer, the local government would have the incentive to carry out whole village restructuring projects for land quota in Jiangsu Province. In fact, the gap between the resettlement costs and the fees of land quota transfer makes it possible for local governments to obtain economic benefits in Jiangsu (Table 3, Supplementary Materials Table S3). For example, the man-land interrelations of typical project XY were resolved in Figure 3. A total of 422 households opted for cash compensation and relocated to cities, and 2592 households opted for a centralization resettlement community area of 35.1 ha. Only

510 households were engaged in farming, and the other 2082 households became migrant workers who worked in the cities and lived in a centralized community. (Figure 3). Therefore, the rural resident land area of about 196.0 ha could be saved to the land quota, which could earn 680 million CNY. These funds are sufficient for village demolition and rural restructuring (Table 3). Due to the purpose of poverty reduction, a few whole village restructuring projects could not maintain the financial balance in northern Jiangsu Province and provincial or local finances subsidized these deficits.

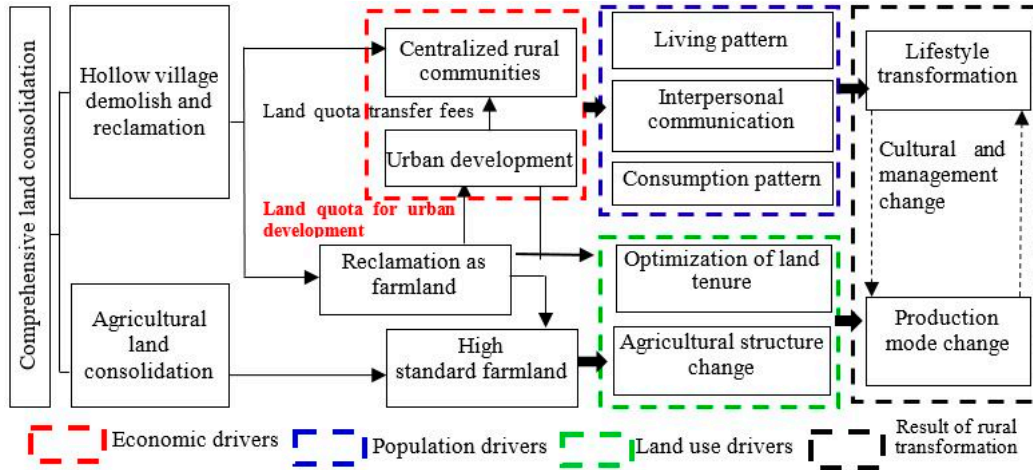


Figure 2. Drivers of rural transformation caused by comprehensive land consolidation in China.

Table 3. Resettlement cost and land quota transfer income of whole village restructuring projects in Jiangsu Province.

Category	Variable	Total	Typical Project ID					
			DF	HJ	KS	PK	XY	YZ
Household	Number of demolished households	88,412	532	3744	776	2906	3014	1133
	Townhouse resettlement households	11,410	50	450	0	480	500	250
	Apartment resettlement households	58,894	423	2883	395	1699	2092	645
	Cash compensation households	18,108	59	411	381	727	422	238
Land (hm ²)	Village reclamation area	6289.4	35.9	267.1	74.1	195.7	231.1	45.0
	Resettlement area	934.9	6.1	38.2	12.7	30.0	35.1	4.7
	Rural-urban land quota area	5354.5	29.8	228.9	61.3	165.7	196.0	40.3
Funds (10 ⁹ CNY)	Cost of relocation and resettlement	187.0	1.2	6.7	3.6	7.0	4.5	1.9
	Cash compensation expense	27.4	0.1	1.0	1.0	1.3	0.3	0.3
	Land quota transfer income	266.3	1.2	13.1	6.6	17.0	6.8	2.8
Financial balance		+	-	+	+	+	+	+

Notes: + denotes financial balance was achieved; – denotes financial balance was not achieved.

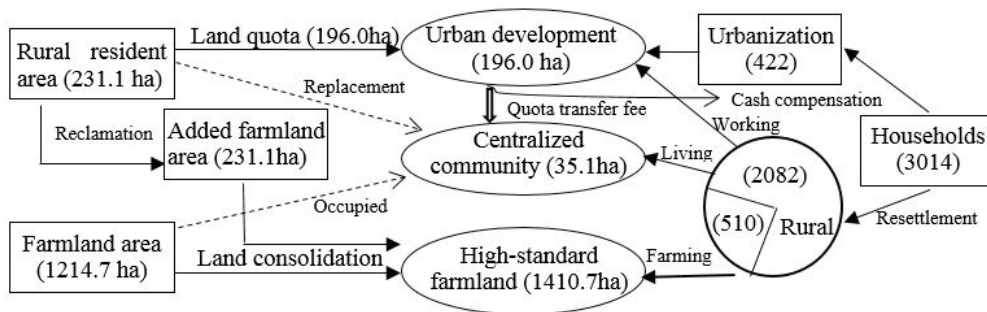


Figure 3. Network chart of man-land interrelations of typical project XY.

3.2. Assessing Actual Effectiveness of Whole Village Restructuring Projects for Rural Transformation

As shown in Figure 4A, the per capita income of the rural residents in the 42 projects increased from 8600.6 CNY in 2009 to 20,527.0 CNY in 2015, an increase of 138.7%. Non-agricultural income contributed to about 86.5% of this increase. Approximately 88.1% of the projects had an income change index above 0, indicating the whole village restructuring project played a positive role in promoting income increases for rural residents. A few projects had significant growth effects. At the same time, 11.9% of projects had an income change index below 0 (Figure 4B). The income change index differed significantly between the economic regions. The projects in South Jiangu appeared in the first and fourth quadrants, which indicated that the increase of non-agricultural income played a dominant role. A few projects in North Jiangu appeared in the third quadrant, meaning that both non-agricultural and agricultural incomes shrank in relation to the local average (Figure 4C). Employment change indices were above 0 for all projects, indicating a positive role of whole village restructuring projects in promoting non-agricultural employment (Figure 4D). From 2009 to 2015, non-agricultural employment increased by 26 percentage points, which was the main reason for the increase of non-agricultural income (Figure 4A).

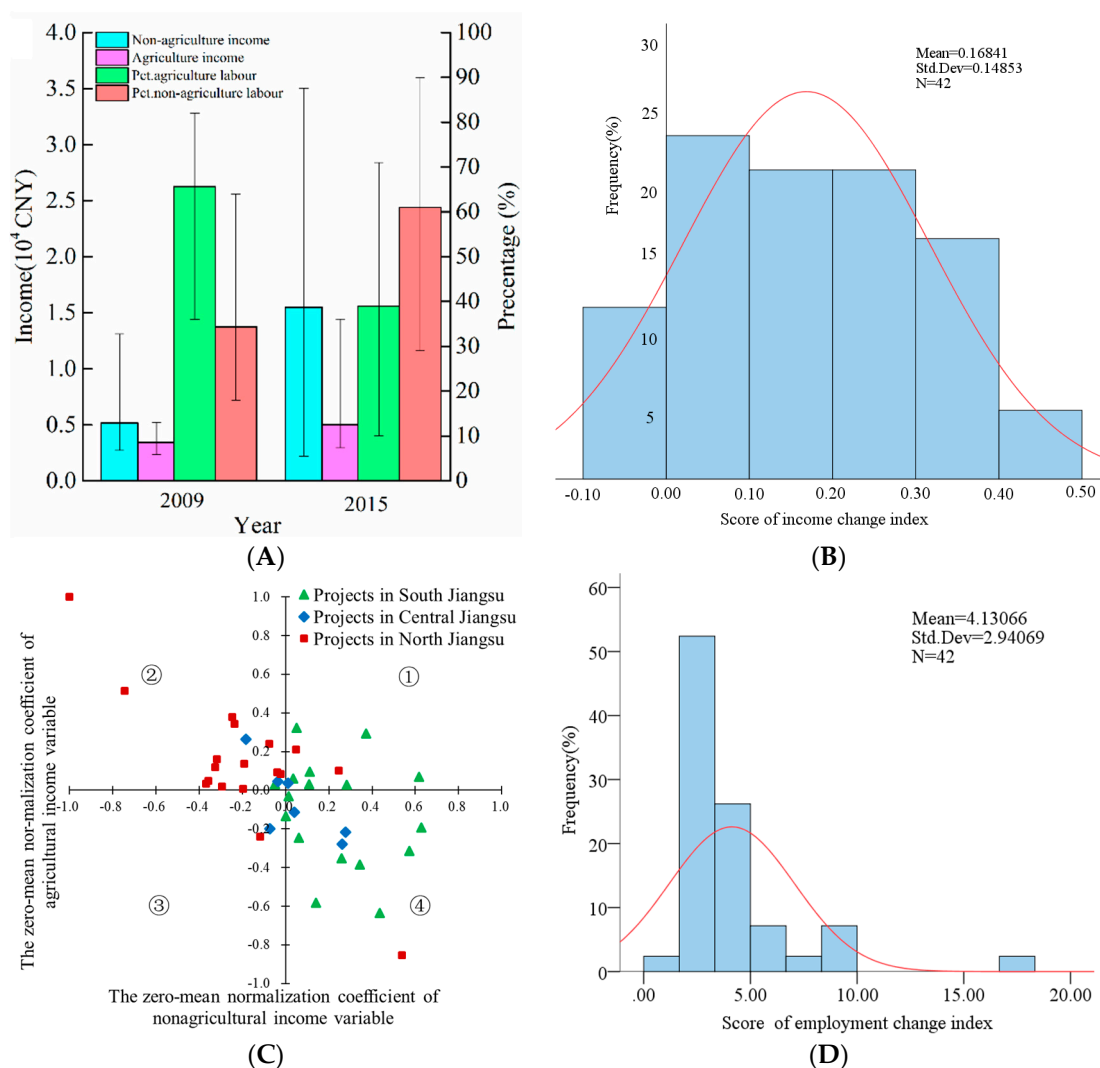


Figure 4. The changes of income and employment (A); frequency of Income change index (B); distribution of the zero-mean normalization coefficient of non-agricultural-agricultural income variable (C) and frequency of Employment change index (D) before and after whole village restructuring projects in Jiangu Province.

The current social security system in China is totally intended for urban residents, who are entitled to basic assistance after retirement or in cases of disease, childbirth, unemployment, or occupational injury [52]. Farmers, especially owner-peasants, are self-employed and generally do not make insurance payments. They have long been excluded from the social security system. If the local government could provide pensions and health care for farmers within the whole village restructuring project area, then their implementation would be very welcome. However, the reality is not so optimistic. Welfare change indices for most projects were about 0.3, as critical illness insurance under new rural cooperative medical insurance became mandatory in Jiangsu Province since 2014. Some projects in South Jiangsu, where local finance is wealthy, provided a social security fund for farmers above 60 years old. In contrast, no such insurance payments were available in North Jiangsu, where local finance is poor (Figure 5).

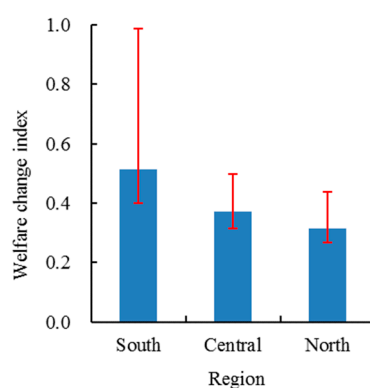


Figure 5. The change of welfare change index after whole village restructuring projects in 3 economic region.

3.3. Identify the Key Factors of Rural Transformation Caused by Comprehensive Land Consolidation

According to data available for the analysis of species and socioeconomics, the lengths of the gradient in axis 1 were only 0.9348, which means that canonical correspondence analysis was not suitable [49]. So, RDA was used through direct gradient analysis to seek the indirect gradient of socioeconomic variables to explain rural transformation. Table 4 shows that the variables of DT, NFI, PCG, GIO, NFL, PMY, PLT, and ACL were selected for RDA in all 42 whole village restructuring projects. The variables of NFI, GIO, NFL, PMY, PLT, and ACL were selected for RDA in South Jiangsu while DT was significant for Central and North Jiangsu. The variables of PMY and GIO were removed from RDA in Central and North Jiangsu. The socioeconomic variables related to rural transformation differed significantly between South, Central, and North Jiangsu and across the entire province. The significant socioeconomic variables in RDA explain 68.2% of rural transformation in Jiangsu Province, China (Table 5).

Figure 6 shows the correlations between the three indices and their potential influencing factors. Socioeconomic variable factors affecting rural transformation on the provincial level were mainly related to land use policies (e.g., PLT and ACL), local economic development level (e.g., NFI, PCG, and GIO), education level (e.g., PMY), and location (e.g., DT). Depending on the length of the arrow representing each environmental variable, a fit between the socioeconomic variable and the indices of rural transformation was calculated. On this basis, socioeconomic variables were ranked by the degree of correlation as follows: ACL, GIO, NFI, and PLT. The variable of GIO, NFI, and PLT showed high correlations with axis 1, which described the characteristic changes of indices in most of the projects (Figure 6A). The arrow of NFI was the longest, which suggested that NFI was the most important explanatory variable among the socioeconomic variables for rural transformation. Moreover, the angles between the representative projects, origin of coordinate, and arrow of *ICI* increased from South Jiangsu to Central and North Jiangsu. PMY apparently distinguished the projects in Central and North Jiangsu on axis 2 (Figure 6B).

Table 4. P and F values of socioeconomic variables in Monte Carlo permutation test of different regions.

Variable	South Jiangsu		Central Jiangsu		North Jiangsu		Total	
	F	P	F	P	F	P	F	P
EZ	1.124	0.243	1.977	0.158	2.133	0.096	1.972	0.157
DT	2.348	0.147	5.788	0.010 *	5.435	0.014 *	5.487	0.012 *
DC	1.578	0.175	1.313	0.221	0.879	0.387	1.173	0.285
PCI	1.978	0.173	1.568	0.169	1.734	0.148	1.794	0.183
NFI	18.793	0.002 *	15.191	0.002 *	12.475	0.004 *	25.541	0.002 *
PCG	2.965	0.121	4.017	0.014 *	4.534	0.015 *	4.479	0.014 *
GIO	12.712	0.004 *	4.533	0.012 *	2.457	0.085	18.675	0.002 *
NH	1.127	0.236	1.712	0.184	1.235	0.238	1.583	0.178
TP	0.732	0.502	0.540	0.544	0.877	0.403	0.680	0.504
FL	1.456	0.187	1.809	0.166	1.948	0.136	1.916	0.151
NFL	18.421	0.002 *	8.521	0.004 *	7.643	0.010 *	9.780	0.006 *
PLY	2.120	0.158	1.326	0.213	1.231	0.243	1.675	0.189
PAY	0.872	0.426	0.862	0.385	0.687	0.512	0.788	0.397
PMY	4.781	0.014 *	2.568	0.142	8.438	0.010 *	6.533	0.011 *
PFA	1.354	0.193	1.237	0.247	1.023	0.265	1.127	0.312
PLT	15.370	0.002 *	12.450	0.002 *	15.533	0.002 *	11.543	0.004 *
ACL	12.560	0.004 *	15.336	0.002 *	18.564	0.002 *	18.768	0.002 *

Note: Abbreviation of Environmental variable see Table 1; * $p < 0.05$.

Table 5. RDA result of three eigenvalues change in rural transformation across all variables.

Axes	1	2	3	4	Total Variance
Eigenvalues	0.528	0.137	0.014	0.005	1.000
Species-environment correlations	0.909	0.637	0.468	0.311	
Cumulative percentage variance of species data (%)	52.3	66.4	67.6	68.2	
Cumulative percentage variance of species-environment relation (%)	79.8	96.4	99.2	100.0	
Sum of all eigenvalues					1.000
Sum of all canonical eigenvalues					0.682

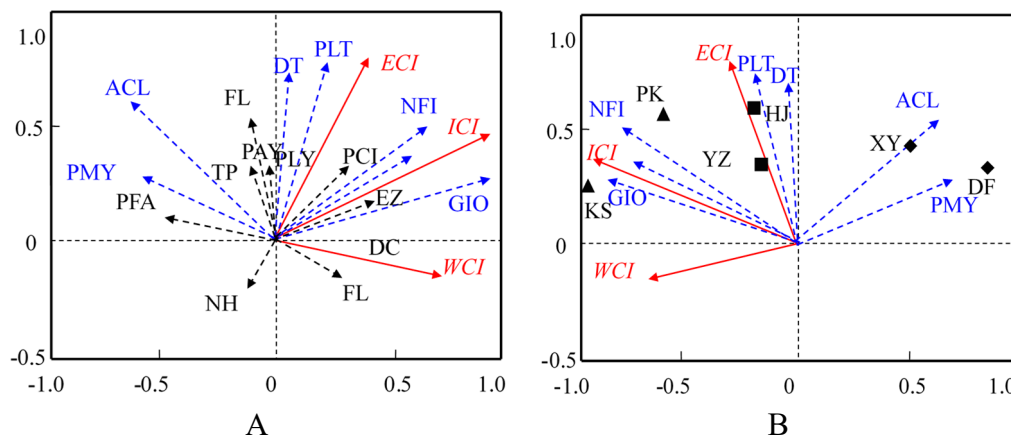


Figure 6. Redundancy analysis ordination plot showing the relationship between eigenvalues of rural transformation and all socioeconomic factors (A) or key factors (B).

4. Discussion

4.1. The Effectiveness of Comprehensive Land Consolidation to Promote Rural Transformation in China

Land consolidation as an effective tool to promote rural transformation has been widely used in Eastern Europe, South Asia, and Africa [19–22,32]. However, China has a special national situation, which is 600 million farmers with only 120 million hectares of farmland [6]. It is unreasonable to

expect rural households to achieve higher incomes by plowing a patch of 1.0 hectare or less [53]. Therefore, encouraging some farmers to voluntarily renounce farming and seek non-agricultural employment in cities is crucial to rural transformation in China. This is totally different from rural transformation in Europe. Rural transformation in Europe aimed to improve rural attractiveness and reduce the migration of young people from rural areas to the cities [34]. However, rural transformation in China aimed to reduce the gap between urban and rural areas and transfer surplus farmers to the cities [14,16,54]. European rural transformation occurred as a step by step process after World War II [55–58], but rural transformation caused by comprehensive land consolidation in China was completed almost instantaneously. It has been long considered that rural restructuring relied heavily on land consolidation and that a “bottom-up” restructuring initiative should be combined with a “top-down” initiative to drive the process in China [16,59]. In fact, only “top-down” enforcement can ensure the success of rural transformation and a “bottom-up” voluntary resettlement may take 30 years or more in rural China.

A powerful driver combined with a population driver and land use driver has been promoting rural transformation through whole village restructuring projects in Jiangsu Province. More benefits are anticipated as a result of comprehensive land consolidation in China such as farmland protection, land tenure transfer, and more surplus labors for urban industry. From field surveys of whole village restructuring projects, rural restructuring through the policy of increasing the urban land quota linked with decreasing rural construction land is effective. Although these drivers of rural transformation are more or less problematic, they have actually changed the backwardness of the countryside and improved living conditions and public infrastructures in Jiangsu Province. First, financed by the fees of land quota transfer, small, scattered and disorganized rural villages were demolished and replaced with centralized rural communities. This step helped to bridge the urban–rural gap, promoting urban–rural integration and inclusive development. Second, level farmland and improved agricultural production facilities increased agricultural productivity. Third, it promoted the direct urbanization of some rural residents to facilitate the land transfer rate. This will protect the land tenure of owner-peasants and facilitate large-scale agri-business operations.

4.2. Associated Risks of Comprehensive Land Consolidation for Rural Transformation in China

Rural transformation is forced by comprehensive land consolidation in China. In Europe and other countries, this process is generally propelled by market incentives [21]. Therefore, this process of rural restructuring in China may contain huge risks. The first risk is the policy-associated risk. Some scholars have articulated their concerns that the policy of urban land quota may be another tool for depriving farmers, rather than a tool for rural transformation [17,18,60]. The second risk is economic. To promote urban development, local governments use land quota to acquire collateralized loans. The greater the urban land quota, the higher the local debt risk. Once there is policy adjustment, many local governments may sink into bankruptcy and affect rural restructuring. In fact, some whole village restructuring projects in North Jiangsu encountered a shortage of funds, and some rural residents were not properly resettled, living in rented accommodation for extended periods of time. Meanwhile, RDA showed that local gross industrial output value and non-agricultural income correlated positively with species that characterize rural transformation. Therefore, whether local industrial enterprises have sufficient job opportunities for the rural surplus labor force is crucial for rural transformation in Jiangsu Province. This phenomenon is unique to China and is not observed elsewhere. Cheng et al. found that township enterprises absorbed a large proportion of the rural labor force, and the goal of large-scale farm business operations was realized when some farmers sought non-agricultural employment [51]. As shown in Table 4 and Figure 5, a higher land transfer rate was more conducive to rural transformation, which implies the necessity of expanding the scale of agricultural operations. The typical project DF succeeded in dramatically increasing per capita income by increasing the agricultural operation scale. However, the typical project DF, a state-owned farm, may have been an exceptional site as the per capita farmland area was over 10 times higher than the

other projects. The third risk is social stability. Urbanization in Western countries may be a voluntary choice for farmers and is a slow process. However, the land tenure transfer of comprehensive land consolidation is enforced rather than voluntary in China. Less-educated Chinese farmers, who are used to a rural lifestyle, have difficulty adapting to urban life and making a living in cities [61–64]. In fact, protests have occurred in North Jiangsu and other backwards rural areas in China. Therefore, a practical rethinking of whole village restructuring projects in Jiangsu Province is necessary for future rural transformation in China.

4.3. Towards an Innovative Implementation Framework for Future Comprehensive Land Consolidation

Rural transformation involves social, economic, technical, and policy-making aspects. Funds are not the only prerequisite for a successful transformation [60]. “Top-down” policy guidance at the national level and “bottom-up” innovation in the grass roots areas may be an indispensable policy implementation framework for comprehensive land consolidation in the future (Figure 7).

In the development strategy of comprehensive land consolidation, we may rely on local government-led and promoted integration of comprehensive land consolidation into the goals of socioeconomic development and ecological civilization construction assessment. We may rely on scientific and technological progress to explore the harmony and unity of the man-land-ecological interrelations and build a beautiful countryside. We should be demand-oriented based on local conditions and develop individualized villages. In the institutional construction of comprehensive land consolidation, an innovative implementation framework coupled with a one-vote veto system for issues relating to ecological protection and public satisfaction may be a promising option. Laws should be enacted to protect farmers’ interests and to outlaw acts that violate farmers’ rights during the process of rural restructuring. Closed-end management of land consolidation capital, exclusive use of capital, and creating an independent supervisory body are also an imperative. In the incentive mechanism of comprehensive land consolidation, public participation and supervision should be strengthened. Comprehensive land consolidation for rural transformation is the common choice of all rural residents, so public decision-making must be enforced to prevent the local government from arranging everything. Give play to the role of rural elites in comprehensive land remediation, open up information and share benefits, moderately encourage land mergers while improving the social security system, overcome the deficiencies of the household contract responsibility system, develop family farms, and increase farmers’ income to mitigate the gap of urban–rural areas in China.

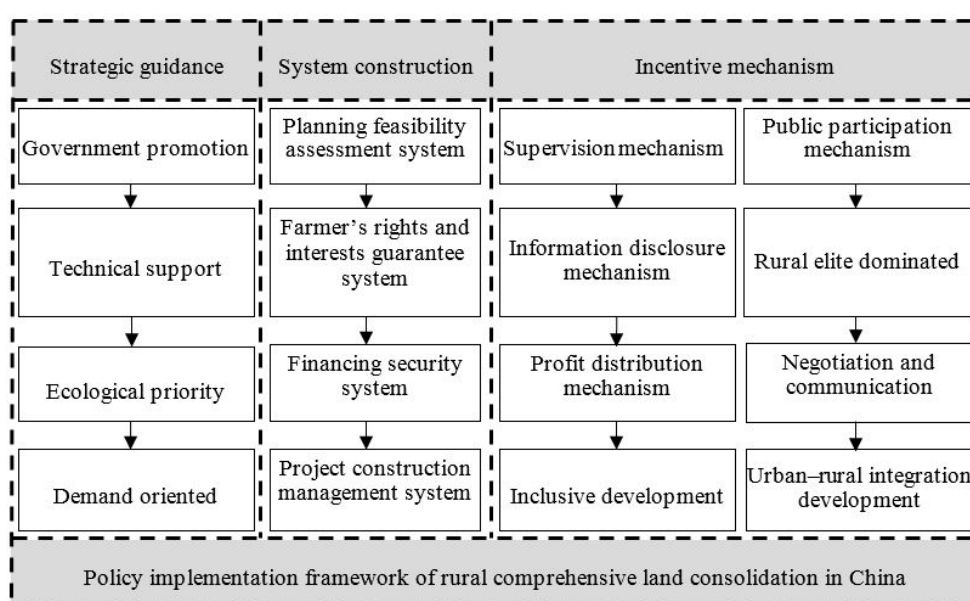


Figure 7. Execution framework for future comprehensive land consolidation in rural China.

5. Conclusions

Rural recession has become a major challenge for integration development of urban-rural areas and inclusive growth in China. China launched a new policy of promoting rural transformation while developing cities in 2008. This study aims at unraveling the role and practical effects of comprehensive land consolidation on rural transformation. From March to August 2016, a field survey was conducted in Jiangsu Province. The result of this study showed that comprehensive land consolidation had a significant role in promoting rural transformation. Farmers' income within 88.1% of the projects achieved a faster increase than in other areas based on the premise of excluding the average growth rate. The increasing farmer's income was mainly attributed to non-agricultural income as non-agricultural employment was still a precondition for rural transformation and the degree of local industrialization and educational levels received by farmers were limited for rural transformation. However, this policy still has some risks, such as local land quota demand and government capacity in financial operations. "Top-down" policy guidance combined with "bottom-up" innovation in the grass roots areas is indispensable to future comprehensive land consolidation in rural China. The above conclusions are helpful in understanding rural transformation, enriching the academic literature in related fields, and are of practical significance for rural revitalization in developing countries.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2071-1050/10/6/2029/s1>, Table S1: Income change index. Table S2: Basic characteristic of whole village restructuring projects in Jiangsu province, China, Table S3: Resettlement cost and land quota transfer income of whole village restructuring projects in Jiangsu Province.

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