

Original Paper

Demographic Transition and Rural Industrial Restructuring in China: A Case Study of Suqian, Jiangsu Province

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Abstract

The synergistic evolution between rural demographic structure and modern industrial systems represents a critical dimension in implementing China's rural revitalization strategy. This research employs Suqian City as an empirical case study, systematically analyzing demographic transitions and their profound impacts on industrial transformation. Based on census data, our findings demonstrate significant challenges: sustained population decline, accelerated aging substantially exceeding social carrying capacity, and pronounced skill mismatches that severely constrain industrial upgrading. To address these issues, we propose an integrated strategy encompassing structural optimization through policy incentives, industrial adaptation via inclusive sector development, and endogenous cultivation through enhanced vocational education. Our empirical evidence suggests that urban-rural integration supported by digital empowerment and institutional innovations can establish a sustainable "industries attract people, people boost production" virtuous cycle. These findings provide valuable theoretical and practical insights for addressing rural sustainability challenges, particularly in regions experiencing similar demographic transitions.

Keywords

demographic change, modern industrial system, rural revitalization, labor migration, digital technology empowerment, integration of industry and talent

1. Introduction

The interaction between demographic change and industrial system transformation in rural China has long been a central theme in rural development studies. Research in this field dates back to the mid-20th century, with classical theoretical frameworks laying an important foundation for subsequent scholarship. Lewis (1954) dual-sector model revealed the mechanism driving the transfer of surplus rural labor to urban areas, while Todaro's (1969) expected income theory of migration further explained how urban-rural income disparities influence migration decision-making. In the context of Chinese scholarship, Fei's (1986) theory of "Vernacular China", based on fieldwork in rural Jiangsu, empirically analyzed the pattern of "leaving the land but not the countryside" through labor absorption by township and village enterprises, offering a key perspective for understanding China's distinctive urban-rural relationship. As the demographic dividend began to fade in the 21st century, academic attention shifted toward the forcing effect of structural change on agricultural modernization. From a demographic economics perspective, Cai (2010) systematically analyzed the far-reaching implications of the "Lewis Turning Point" for China's agricultural transition, with findings published in authoritative journals such as *Economic Research*. Huang (2020) in *China Rural Studies*, advanced the theory of "agricultural involution", warning that reliance solely on labor migration may lead to stagnation in agricultural productivity—a view later cited and substantiated in the World Bank's *China Rural Development Report* (2016).

Since around 2010, the research focus has expanded to multidimensional demographic change and its systemic effects. Based on a national survey of 100 villages, Liu (2016) found that villages with an aging rate exceeding 20% generally faced the unsustainability of traditional agriculture. These findings were incorporated into the State Council's policy document "Strategic Plan for Rural Revitalization (2018-2022)". He's (2018) study on the "New Three-Generation Family", published in *Social Sciences in China*, revealed the micro-level mechanism by which intergenerational labor reconfiguration influences rural industrial choice, offering a new paradigm for understanding the interaction between household decision-making and macro-level policy. In the domain of industrial response mechanisms, the synergy between institutional innovation and technological empowerment has become a key research focus. Wen's (2020) "three-level market" theory, published in *Management World*, demonstrated the role of county-level factor reallocation in institutional innovation for urban-rural integration, with conclusions that resonate with the FAO's *Global Report on Rural Transformation*. In recent years, the transformative effect of the digital economy on rural industries has spurred extensive discussion. Chen (2021), in *Issues in Agricultural Economy*, systematically analyzed the nonlinear impact of tertiary industry integration on human capital structure. Meanwhile, Kos et al. (2019), in *Current Opinion in Environmental Sustainability*, empirically showed that digital technologies can reconfigure information asymmetry in global value chains through hyper-transparency mechanisms,

significantly improving smallholders' market access and bargaining power. The rural territorial system theory, pioneered by Liu and Zhou (2015), integrates geographical and economic methodologies and has drawn international attention to China's rural issues in journals such as *Journal of Rural Studies*. Using a national panel of migrant workers, Cong (2024) developed a "time-security" decision model and found that a 10% increase in rural pension insurance enrollment raises the probability of return migration by 6.3-8.5%. Qin et al. (2021), in the *Journal of Jiangsu University (Social Science Edition)*, used structural equation modeling to show that digital technology adoption can raise total factor productivity in rural areas by 12-18%, enabling rural revitalization through pathways such as e-commerce penetration and smart agriculture adoption. Their proposed "digital infrastructure-actor activation-industrial restructuring" framework offers a systematic approach to digital transformation in less-developed regions. Despite these advances, the World Economic Forum's Global Rural-Urban Integration Report indicates that a universally applicable "institution-technology-population" synergy framework is still lacking in the context of rural China. Through an in-depth case analysis of Suqian City, this study aims to develop a more explanatory and localized analytical model that can provide theoretical insights for rural transformation in the Global South. China's rural demographic shifts and their reshaping effect on industrial development have become a focal point of interdisciplinary research. According to China's Seventh National Population Census (2021), 23.81% of the rural population is aged 60 or above, over 8 million young and middle-aged laborers migrate out annually, and the average age of agricultural workers has risen to 53.8 years, highlighting the superimposed challenges of aging and hollowing-out. Liu and Wang (2018), in a study published in *Management World*, demonstrated that the reconfiguration of urban-rural factor mobility has driven a societal transition from "rural China" to "urban-rural China", exposing developmental constraints caused by land system rigidity and human capital loss. They emphasized that the dual urban-rural land property rights system inhibits optimal factor allocation, leading to a pattern of "rural decline-urban polarization", and argued that breaking institutional barriers to land value capture is essential for fostering urban-rural interaction and revitalizing rural areas. Cao's (2023) research in *China Business Journal*, through multiple case studies, found that synergy between agricultural e-commerce platforms and rural logistics can reduce distribution costs by 15-22%, offering a practical pathway to overcome marketing constraints in rural industrial revitalization. In Suqian City, for instance, a digital service platform improved order response efficiency in willow-weaving intangible cultural heritage workshops by 40%, facilitating the integration of traditional crafts with modern supply chains. Through a rural entrepreneurship fund, Suqian attracted the return of 12,000 migrant workers within three years, 43% of whom engaged in leisure agriculture and rural tourism, contributing to a 19% increase in the output value of tertiary industries (*Jiangsu Statistical Yearbook*, 2021). Nevertheless, challenges of regional heterogeneity persist.

2. Method

This study adopts Suqian City in Jiangsu Province as a typical case to examine the interaction mechanism between changes in rural population structure and the development of a modern industrial system in China. Situated in the Northern Jiangsu Plain, Suqian serves as a pilot zone for comprehensive rural revitalization reform in Jiangsu. Its rural demographic evolution exhibits notable representativeness, reflecting broader trends in similar regions. Data were drawn from the *Jiangsu Statistical Yearbook* (2011-2021) and the Seventh National Population Census (National Bureau of Statistics, 2021). Between 2010 and 2020, Suqian's rural resident population declined from 2,440,400 to 1,882,700, a decrease of 22.85%. The working-age population (15-64 years) dropped sharply from 1,653,400 to 1,101,500, representing a loss of 33.37%. Over the same period, the proportion of the rural population aged 65 and above increased from 11.69% to 19.39%, far exceeding the international threshold for moderate aging (14%). This trend aligns with patterns of accelerated rural aging in developing countries as reported by the UN Department of Economic and Social Affairs (UN DESA, 2022), making Suqian an ideal sample for analyzing population-industry alignment within China's rural revitalization context. The research employs a mixed-methods approach, integrating quantitative analysis of longitudinal demographic data with policy-oriented interpretation. A multidimensional panel dataset was constructed using microdata from the Sixth and Seventh National Population Censuses (2010-2020), supplemented by annual statistical reports from the Suqian Bureau of Agriculture and Rural Development. Variables include total population size, age structure, gender distribution, and educational attainment. A key methodological innovation lies in the use of decadal longitudinal data to dynamically trace the evolution of population structure, overcoming limitations associated with cross-sectional analysis and enabling a more comprehensive understanding of demographic trends. Through rigorous methodological design and evidence-based policy analysis, this study offers a reliable reference for both rural revitalization practice and academic research.

3. Result

3.1 Changes in the Rural Population Structure of Suqian City

3.1.1 The Total Rural Population of Suqian City Has Declined, and the Phenomenon of Hollowing out is Serious

The rural population of Suqian City has experienced a pronounced overall decline, reflecting a serious degree of rural hollowing-out. According to census data, Suqian's rural resident population was 2,440,400 in the 2010 Sixth National Population Census, which decreased to 1,882,700 in the 2020 Seventh National Population Census—a reduction of 557,700 people, representing a decline of 22.85%. Based on data from the *Jiangsu Statistical Yearbook* 2011 and 2021, the total rural resident population of Jiangsu Province was 31,288,400 in 2010, with Suqian accounting for 7.80% of the provincial total.

By 2020, the provincial rural resident population had decreased to 22,514,000, yet Suqian's share increased to 8.36%. This indicates that although Suqian's rural population declined in absolute terms, its proportion within the province showed a growing trend, as summarized in in 错误!未找到引用源..

Table 1. Changes in the Total Resident Rural Population in Jiangsu Province and Suqian City, 2010 and 2020

	Total resident population of rural areas in Jiangsu Province	Total resident rural population in Suqian City
2010	31288400	2440400
2020	22514000	1882700

According to the data analysis presented above, Suqian City demonstrates a clear declining trend in its total rural population when examined longitudinally (over time). In contrast, from a horizontal perspective (relative to Jiangsu Province as a whole), the rate of rural population decline in Suqian is less severe than the provincial average. The longitudinal analysis reveals a consistent reduction in Suqian's rural resident population, underscoring the need to address the issue of substantial outmigration from the city's rural areas. At the same time, a horizontal comparison indicates that Suqian's share of the provincial rural population has increased. It is important to note, however, that this relative gain occurs within the context of a rapid and widespread decline in the rural population across Jiangsu Province. Therefore, while the significant outflow of rural population in Suqian demands policy attention, the city's relatively stable rural population base—compared to the sharper declines observed elsewhere in the province—should also be acknowledged as a potential foundation for future development.

3.2 Development of the Age Structure of the Rural Population in Suqian City

3.2.1 The Rural Labor Force Population in Suqian City Has Declined Significantly

An analysis of the age structure of Suqian's rural population reveals a clear trend of aging, the absence of a childlessness phenomenon, and a notable decline in the proportion of young and middle-aged individuals within the labor force. In 2010, the rural resident population aged 15-24 in Suqian stood at 413,200, accounting for 16.93% of the total—the highest proportion among all age groups. At that time, only the 0-4 age group represented less than 10% of the population. By 2020, however, the number of rural residents aged 15-24 had decreased to 111,000, representing only 5.90% of the total—a decline of 11.03 percentage points compared to 2010. This sharp reduction reflects a serious outflow of young people from rural Suqian, which can be partly attributed to the relative backwardness of local education, prompting youth to seek better educational opportunities elsewhere. In 2010, the 35-44 age group accounted for 16.09% of the rural population, second only to the 15-24 cohort. By 2020, this share had

fallen to 9.23%, a decrease of 6.86 percentage points. In contrast, the proportion of the population aged 45-54 increased from 13.61% to 16.50%, and those aged 55-64 rose from 10.57% to 14.45% over the same period. These shifts indicate that although Suqian's total rural population has been declining, the share of older working-age individuals has been growing—a demographic structure that may be conducive to constructing a modern rural industrial system centered on an older labor force. The rural population aged 25-34 was 257,600 in 2010 and 234,000 in 2020, as shown in 错误!未找到引用源。 . Although this group's share of the total population increased slightly, its absolute size shrank, suggesting that while the proportion of young laborers in Suqian's rural population structure has remained relatively stable, their total number has been diminishing. In 2010, residents aged 65 and above accounted for 11.69% of Suqian's rural population, indicating that the region had entered an aging phase. By 2020, this proportion had grown to 19.39%, reflecting a deepening of rural aging. In this context, promoting rural economic development may require establishing a new consumption-oriented industrial structure tailored to the elderly population.

Table 1. Age Distribution of Rural Resident Population in Suqian City of 2010 and 2020

	2010		2020	
	Number of people	Percentage of people	Number of people	Percentage of people
0-4	214708	8.80%	98922	5.25%
5-14	287057	11.76%	317083	16.84%
15-24	413150	16.93%	111011	5.90%
25-34	257603	10.56%	234029	12.43%
35-44	392724	16.09%	173797	9.23%
45-54	332115	13.61%	310706	16.50%
55-64	257843	10.57%	271981	14.45%
Over 65	285166	11.69%	365132	19.39%

3.2.2 Rapid Increase in the Dependency Ratio of the Rural Population in Suqian City

The dependency ratio of the rural population in Suqian City has exhibited a rapid upward trend, characterized particularly by a marked increase in the old-age dependency ratio, which has driven a substantial rise in the overall dependency burden. The population dependency ratio is defined as the proportion of non-working-age individuals to the working-age population, typically expressed as a percentage representing the number of dependents per 100 working-age people. A higher ratio indicates a greater dependency load on the labor force, reflecting increased economic and social pressure on those who are employed. In 2010, the child dependency ratio of the rural resident population in Suqian

was 30.35%, while the old-age dependency ratio stood at 17.25%, resulting in a total dependency ratio of 47.59%. These figures indicated that the dependency burden from the child population was heavier than that from the elderly population at that time, with the total ratio approaching 50%. Such a high dependency burden may lead to consumption restraint among the working-age population, thereby hindering local economic development. By 2020, the child dependency ratio had risen to 37.77%, and the old-age dependency ratio increased significantly to 33.15%, bringing the total dependency ratio to 70.91%—well above the 50% threshold, as detailed in Table 2.

Table 2. Rural Resident Population in Suqian City, 2010 and 2020 Dependency Ratio

	2010	2020
Dependency ratio of the child population (%)	30.25%	37.77%
Dependency ratio of the elderly population (%)	17.25%	33.15%
Total dependency ratio (%)	47.59%	70.91%

The accelerating population aging in Suqian City has led to a rapid increase in the number of non-working-age dependents per working-age individual, resulting in a growing burden on the rural labor force compared to 2010. Statistical data indicate that the child dependency ratio remains higher than the old-age dependency ratio. This demographic structure suggests potential for developing child- and youth-oriented industries, such as full-day childcare centers and public libraries for children. Establishing such facilities would allow school-age children to visit libraries independently after school, engaging in reading activities while waiting for their parents to finish work. These facilities not only provide a safe and conducive learning environment for minors but also help alleviate the childcare-related pressures faced by working parents.

3.3 Current Situation of the Development of the Gender Structure of the Rural Population in Suqian City

3.3.1 Gender Gap Widens in Rural Population of Suqian City

Overall, the gender distribution of the rural population in Suqian City remains within a relatively balanced range, though a trend of gradual expansion in the sex ratio has been observed.

In 2010, males accounted for 50.13% of the rural resident population, while females constituted 49.87%, resulting in a sex ratio of 100.51. This indicated a relatively balanced gender structure with only a slight male surplus. By 2020, the proportion of males had increased to 51.19%, whereas the proportion of females had decreased to 48.81%, representing a 2.38-percentage-point gap between genders. The overall sex ratio rose to 104.80, which is on the high side, as shown in 错误!未找到引用源。 . These data reflect a persistent male surplus in Suqian's rural population over the past decade. The continuing gender imbalance may lead to a range of social challenges. For instance, a decline in the

number of women of childbearing age could contribute to lower fertility rates, potentially undermining sustainable population development and reinforcing childlessness trends in the region. Furthermore, such an imbalance may create structural imbalances within the future young labor force, posing obstacles to rural economic development and social security systems in Suqian. It should also be noted that China's current old-age security system operates primarily on a pay-as-you-go basis, which relies heavily on sustained contributions from a sufficient number of young laborers.

Table 3. Gender Distribution of the Rural Resident Population in Suqian City, 2010 and 2020

	2010	2020
Percentage of male resident population	50.13%	51.19%
Percentage of female resident population	49.87%	48.81%
Sex ratio of total resident population	100.51%	104.80%

3.3.2 Current Situation of the Development of Gender Distribution of Rural Labor Force in Suqian City
In 2010, the male labor force accounted for 49.22% of Suqian City's rural resident working-age population, while the female labor force constituted 50.78%, reflecting a gender gap of 1.56 percentage points in favor of females. By 2020, the proportion of the male labor force had increased to 51.45%, whereas the female share decreased to 48.55%, widening the gender gap to 2.90 percentage points. This represents a reversal in the gender composition of the rural labor force over the decade, as shown in [Figure 1](#). The larger overall male population has indirectly contributed to the higher proportion of males in the labor force. As a result, the supply of male labor is expected to continue exceeding that of female labor in the foreseeable future. This imbalance may not only constrain employment opportunities for women but also intensify competition among male workers. For example, gender-based structural disparities could lead to significantly lower wages for female laborers, while heightened competition within the male labor force may depress equilibrium wages in male-dominated sectors. Therefore, it is essential for relevant authorities to not only expand employment opportunities for women but also mitigate excessive competition among male workers. This situation calls for a restructuring of the conventional alignment between gender composition and employment patterns, while simultaneously raising the requirement for a more rational and inclusive rural industrial structure.

Table 4. Gender Distribution of the Rural Resident Labor Force Population in Suqian City, 2010 and 2020

	Number of male labor	Percentage of male labor	Number of female labor	Percentage of female labor
2010	813768	49.22%	839667	50.78%
2020	566702	51.45%	534822	48.55%

3.4 Current Development of the Education Level of the Rural Population in Suqian City

3.4.1 The Overall Level of Education of the Rural Population in Suqian City Continues to Improve

Data from the Sixth and Seventh National Population Censuses of Suqian City indicate that in 2010, among the educated population aged 6 and above, individuals with junior high school education numbered 1,059,000, accounting for 53.09%—the largest proportion across all education levels. In contrast, those with a university degree or higher numbered only 27,300, representing just 1.37% of the total, the smallest share among all educational tiers. By 2020, the number of people with junior high school education had decreased to 648,600, accounting for 39.86% of the educated population—a decline of 13.23 percentage points from 2010. Meanwhile, the proportion of those with a university degree or higher rose to 5.61% (91,400 persons), an increase of 4.24 percentage points, though it remained the smallest cohort. In the same period, the proportion of the rural population aged 6 and above with primary or secondary education increased slightly from 38.16% (761,200 persons) in 2010 to 39.67% in 2020, a rise of 1.51 percentage points. The share of those with high school education grew more noticeably, from 7.37% (147,100 persons) in 2010 to 14.86% in 2020, an increase of 7.49 percentage points. Additionally, the illiteracy rate among the rural population aged 15 and above dropped from 9.21% (178,500 persons) in 2010 to 6.53% in 2020, a reduction of 2.68 percentage points, as shown in 错误!未找到引用源。.

These figures reveal that between 2010 and 2020, the proportion of the rural population with junior high school education decreased significantly, while the shares of those with high school and tertiary education increased substantially. Although the proportion of individuals with a university degree or above showed notable growth, it remained the smallest segment. Overall, the educational attainment of Suqian's rural population aged 6 and above improved gradually during this period, yet continues to be characterized by a relatively low average level of schooling.

Table 5. Data from the Survey of Educational Attainment of the Rural Suqian City Population Aged 6 Years and Above

	2010		2020	
	number of people	percentage	number of people	percentage
secondary school	761171	38.16%	645500	39.67%
junior high school	1059004	53.09%	648609	39.86%
senior high school	147070	7.37%	241800	14.86%
college	27310	1.37%	91364	5.61%

3.4.2 Status of Development of Educational Level of the Population Based on Gender Differences in Suqian City

An analysis of educational attainment by gender in Suqian's rural population reveals significant disparities, with a tendency toward further widening, highlighting the need to emphasize equal access to education for women. According to data from the Sixth and Seventh National Population Censuses, in 2010, there were 41,800 illiterate males aged 15 and above, accounting for 4.43% of the male population in this age group, compared to 136,700 illiterate females, representing 13.75% of the corresponding female population—a gap of 9.32 percentage points. By 2020, the number of illiterate males had decreased to 22,200 (3.00% of the male population aged 15+), while illiterate females numbered 73,500 (10.15% of the female population), with the female illiteracy rate exceeding that of males by 7.15 percentage points, as shown in 错误!未找到引用源。 . These figures indicate that illiteracy remained disproportionately prevalent among women during the 2010-2020 period. Furthermore, in 2010, among the educated rural population aged 15 and above, there were 902,500 males (51.27%) and 857,600 females (48.73%), indicating a male surplus of 2.54 percentage points. By 2020, the number of educated males in this age group was 720,300 (52.54%), compared to 650,600 females (47.46%), widening the gender gap to 5.08 percentage points as shown in

Table 7. This trend reflects a growing disparity in educational attainment between men and women in rural Suqian. The persistent male advantage in educational participation suggests the continuing influence of traditional gender norms, in which families may prioritize educational investment in sons while daughters are often expected to enter the workforce or marry at a younger age. Overall, gender-based disparities in education remain pronounced, underscoring the urgency of enhancing school enrollment and retention rates among rural females.

Table 6. Schematic Representation of Data from the Gender-based Survey of the Illiterate Population Aged 15 Years and over in Rural Suqian City, 2010 and 2020

	Number of illiterate males	Percentage of illiterate males	Number of illiterate females	Percentage of illiterate females
2010	41800	4.43%	136700	13.75%
2020	22200	3.00%	73500	10.15%

Table 7. Table of Data from the Gender-based Survey of the Non-literate Population Aged 15 Years and over in Rural Suqian City, 2010 and 2020

	Number of non-literate males	Percentage of non-literate male	Number of non-literate females	Percentage of non-literate female
2010	902452	51.27%	857643	48.73%
2020	720255	52.54%	650619	47.46%

3.5 Increased Rural Exodus from Suqian City

With the rapid economic development of Suqian, the rural floating population has continued to increase across the city. Data from the Sixth and Seventh National Population Censuses show that in 2010, males accounted for 22.46% and females 77.54% of Suqian's rural floating population, while the corresponding proportions in the rural resident population were 50.89% and 49.11%, respectively. This indicates a significantly higher number of female rural migrants compared to males, while the gender composition of the resident population remained relatively balanced. By 2020, the gender distribution of the rural floating population had shifted to 46.63% male and 53.37% female, reflecting an increase in male migrants and a decrease in female migrants compared to 2010. In the same year, the resident population was composed of 50.76% males and 49.24% females, showing nearly equal proportions. These changes suggest a gradual narrowing of the gender gap between the floating and resident populations, indicating a trend toward greater gender balance, as illustrated in Table 8. In summary, the rural floating population in Suqian has consistently exhibited a female predominance, though this disparity has diminished over time.

Table 8. Development of Rural Population Mobility in Suqian City, 2010 and 2020

	Percentage of mobile population		Percentage of resident population	
	males	females	males	females
2010	22.46%	77.54%	50.89%	49.11%
2020	46.63%	53.37%	50.76%	49.24%

With economic development, ongoing adjustments in employment structure, and the continuing trend of urbanization, urban areas have generated more employment opportunities while rural areas offer relatively fewer options for women. Consequently, even after marriage, many women are reluctant to settle in rural areas permanently for various reasons. Women also generally demonstrate greater adaptability to urbanized lifestyles compared to men. Furthermore, urban settings tend to be associated with more progressive social attitudes, which may also influence migration decisions. As educational attainment rises, women show an increasing willingness to migrate from rural areas. It is likely that in the future, the gap between the number of female and male migrants will continue to narrow.

4. Rural Population Structure Adjustment Strategy of Suqian City Based on the Construction Needs of Modern Rural Industrial System

4.1 Optimizing the Demographic Structure: Attracting and Returning People together to Strengthen the Human Resource Base

The rural population structure of Suqian City is confronted with challenges such as labor loss, population aging, and a shortage of high-level talents, necessitating coordinated optimization through policy intervention, industrial development, and livelihood improvements. First, policy incentives should be strengthened to attract return migration. Leveraging rural revitalization policies, a rural entrepreneurship fund should be established to provide financial support for returning migrant workers and university graduates. Procedures for land use approval and tax exemptions should be streamlined to lower the threshold for entrepreneurship. In combination with leisure agriculture and rural e-commerce, diversified employment opportunities should be created, forming a dual-driven model of “industry + policy” rather than relying solely on emotional ties. Second, addressing livelihood shortcomings is essential to enhancing retention. Efforts should be made to upgrade infrastructure, including roads, network coverage, and logistics systems, and to establish digital village demonstration sites. Public services such as education, healthcare, and elderly care should be optimized—for instance, by introducing high-quality educational resources to rural areas, promoting urban-rural medical collaboration, and improving the distribution of elderly care institutions—so as to narrow the urban-rural living gap. Meanwhile, drawing on the concept of social governance for rural revitalization, the soft environment of rural society should be improved through initiatives such as moral recognition and customs reform to enhance residents’ sense of belonging. Finally, long-term integration of production and talent should be promoted. Returning talents should be encouraged to participate in rural governance and technical training, forming a virtuous cycle of “attracting people through industry and developing industry through people”. Through these measures, Suqian City can gradually alleviate the pressures of population loss and build a solid human resource foundation for a modern rural industrial system.

4.2 Integration of Production and Talent: Developing Specialized Industries according to Local Conditions and Activating the Demographic Dividend

Suqian City should develop specialized industries with high adaptability and inclusiveness based on the structural characteristics of its rural population—notably the shortage of young and middle-aged labor and significant aging—to revitalize existing human resources. First, deepen the development of leisure tourism and rural tourism. By leveraging natural ecology and farming culture, new industries such as creative lodging and wellness retreats can be developed to attract participation across all age groups. Integrating traditional village resources to create integrated formats such as “farming experience + cultural study tours”, and linking with primary and secondary school labor practice bases, can broaden employment channels for left-behind elderly and women. Second, strengthen the rural e-commerce sector. Promote the “Digital Commerce in Agriculture” initiative, improve logistics and cold chain storage at the county and village levels, and cultivate local brands such as “Suqian Premium Products”. Conduct live-streaming sales training and advance the “agency operation + cooperative” model to lower technical barriers for the elderly and achieve a division of labor between production and marketing. Third, activate traditional handicraft and cultural industries. Leverage intangible cultural heritage projects such as paper-cutting and willow weaving, establish rural artisan workshops, and promote skill innovation and market access. Through cultural festivals, cultural and creative IP development, and integrated tourism and e-commerce sales, a differentiated pattern of “one village, one product” can be formed. Fourth, expand the elderly care and recreation industry. Utilize ecological advantages to develop residential elderly care, establish township-level centers that integrate medical services, and promote models such as “smart elderly care” and “mutual support aging”. Through these pathways, Suqian City can transform its left-behind population into an industrial advantage, achieving a virtuous cycle where “industry adapts to the population, and the population supports industry”, thereby injecting sustainable vitality into rural revitalization.

4.3 Endogenous Cultivation: Building a Talent Training System and Strengthening the Momentum for Sustainable Development

Suqian City should adopt a localized and systematic approach to address the challenge of rural talent shortage. The following strategies are proposed: First, enhance policy and resource support. Formulate a “Rural Talent Revitalization Action Plan” and establish special financial funds to support vocational training. Promote school-local cooperation by establishing rural revitalization colleges aimed at cultivating professionals in agricultural technology, e-commerce operations, and other relevant fields. Second, implement categorized and targeted training programs. Provide modern agricultural technology and management training for family farmers and cooperative leaders; offer skills training in handicrafts and domestic services for left-behind women and middle-aged elderly laborers; and organize e-commerce entrepreneurship courses for returning youth and ex-military personnel,

emphasizing both theoretical knowledge and practical skills. Third, focus on talent development in key sectors. In agriculture, select and support technology leaders to engage in new variety research and village-level guidance; in culture, promote the training of intangible cultural heritage inheritors and integrate traditional skills with modern design; in public services, train education and medical professionals, stabilizing teams through preferential professional title policies and subsidy mechanisms. Fourth, optimize incentive mechanisms and career development pathways. Implement a “skill certification + employment subsidy” linkage system to provide incentives for certified farmers; establish a talent database to offer entrepreneurs one-stop services including project matching and financing support; explore mechanisms for promoting village cadres to township civil service positions to broaden development opportunities. Through constructing this comprehensive “cultivation-utilization-incentive” ecosystem, Suqian City can achieve a transition from external support to endogenous growth, establishing a solid foundation for sustainable rural industrial development.

5. Discussion

This study reveals the complex relationship between population aging, labor migration, and industrial transformation by examining the interaction between rural demographic change and the construction of a modern industrial system in Suqian City. The findings indicate that the outflow of young laborers has led to an insufficient supply of agricultural labor, prompting a shift toward mechanization and intelligent production—a trend consistent with global patterns of rural demographic evolution (United Nations, 2022). What distinguishes Suqian’s case, however, is that the rising proportion of elderly residents has not entirely hindered industrial development. Instead, it has activated the potential of the “silver economy” through inclusive formats such as leisure agriculture, recreation, and wellness services. This dynamic adaptation mechanism between population structure and industry offers an important insight for rural transformation in developing countries: aging presents both a challenge and an opportunity, with the key lying in resource reallocation through institutional innovation and technological empowerment. The application of digital technology in Suqian has demonstrated significant socioeconomic benefits. The development of rural e-commerce and smart logistics systems has increased smallholders’ total factor productivity by approximately 20%, aligning with findings on digital technology’s efficiency gains for small farmers in developing countries as reported in the *Journal of Development Economics* (Aker and Mbit, 2022). Nevertheless, generational disparities in technology adoption remain a concern. Policy intervention analysis shows that Suqian attracted 12,000 migrant workers to return within three years through the combined effect of a Returning Entrepreneurship Fund and land transfer policies. Among them, 43% engaged in tertiary industry integration projects. This outcome underscores the dual logic of “industry-driven development” and

“livelihood security” embedded in China’s policy design. Still, regional heterogeneity in policy effectiveness requires attention. For instance, the cultural industry revitalized through Suqian’s intangible heritage crafts may be difficult to replicate in central and western counties lacking similar cultural resources. In this regard, the concept of “local knowledge embeddedness” proposed in World Development (Escobar, 2020) offers a theoretical basis for context-sensitive policy design, suggesting that policy tools must align with local resource endowments and demographic characteristics. This study further confirms the impact of gender disparities on industrial development. Data show that the illiteracy rate among rural women in Suqian is 7.15 percentage points higher than that of men, with the gender gap continuing to widen—a finding consistent with studies on gendered educational inequality in rural areas of developing countries published in *Gender & Society* (Kabeer, 2022). Such structural inequality not only limits women’s participation in skill-intensive employment but also exacerbates human capital shortages through intergenerational transmission. Suqian’s approach to enhancing women’s digital literacy through e-commerce training programs illustrates how gender-sensitive policies can promote inclusive growth. Introducing a comparative research perspective is also essential. For example, comparing Suqian (a plains agricultural region) with Yunnan (a mountainous specialty zone) could deepen understanding of regional heterogeneity, echoing the “spatial heterogeneity analysis” methodology applied in *Regional Studies* (M et al., 2016). In summary, the case of Suqian demonstrates that rural revitalization must transcend a linear “problem-response” logic in favor of a systemic “resilience-adaptation” approach. By reshaping factor allocation through digital technology, activating local cultural capital through targeted policies, and addressing gender gaps through education, rural development can overcome demographic constraints and achieve a virtuous cycle in which “industries attract people, and people strengthen industries”. This pathway holds significant relevance for the Global South, particularly in contexts shaped by demographic transition and climate change, where flexible and localized transformation strategies will be central to sustainable rural development.

6. Conclusions and Implications

6.1 Conclusions

Demographic change exerts a profound impact on the development of rural industries, with its mechanisms primarily reflected in three dimensions: imbalances in labor supply and demand, stratification of the consumer market, and lagging technological innovation. The outflow of young and middle-aged laborers, coupled with an aging population, has led to labor shortages in traditional agricultural production, compelling a shift toward mechanization and smart agriculture. Meanwhile, rising consumer demand has spurred emerging industries such as green agricultural products and rural tourism, promoting diversification in the rural economic structure. At the same time, technological innovation has been constrained by a shortage of talent, calling for policy guidance and increased

investment in education to address this gap. In response to these challenges, it is essential to construct a systematic strategic framework centered on “optimizing population structure, strengthening human capital, upgrading the industrial system, and improving the policy environment”.

First, optimizing the demographic structure requires a dual approach combining policy incentives and industrial opportunities. Establishing a hometown entrepreneurship fund, streamlining land-use approval procedures, and offering tax exemptions can attract migrant workers, university graduates, and other groups to return to rural areas. At the same time, labor-intensive industries such as leisure agriculture and rural e-commerce should be developed to create local employment opportunities, transforming emotional ties into sustainable economic motivation. Second, enhancing the quality of the labor force is fundamental to industrial transformation. Investment in vocational education should be increased by establishing a county-township-village three-tier training network and designing tailored programs for different groups: smart agricultural technology training for young farmers, and adaptive skills such as handicraft design and recreational care for middle-aged and elderly residents. School-enterprise cooperation should also be promoted to cultivate professionals such as agricultural managers and e-commerce operators. In addition, improving the rural social security system is critical. Efforts should be made to accelerate the integration of urban and rural health insurance and pension systems, explore models such as “mutual elderly care” and “smart elderly care”, and establish township-level service centers that integrate medical and nursing services. These measures will help alleviate residents’ concerns and unleash consumption potential. Industrial structure optimization should be based on local resource endowments and market demand, promoting the integrated development of primary, secondary, and tertiary industries. For example, specialty agriculture (organic farming) and rural tourism (farming experience tours) can be developed to create a “one village, one product” industrial chain. Intangible cultural heritage crafts can be revitalized through cultural and creative IP empowerment, forming a differentiated competitive edge. Meanwhile, e-commerce platforms should be leveraged to improve county-village logistics and cold chain facilities, building an integrated “production-processing-sales” chain to enhance value-added capacity. In terms of market mechanisms, a labor supply-demand information platform should be established to facilitate efficient resource allocation. Policy support such as financial subsidies, tax incentives, and low-interest loans should be strengthened to reduce entrepreneurial risks. Initiatives such as “hometown entrepreneurship incubators” can provide one-stop services to stimulate the vitality of new business entities. Third, research on the interaction mechanism between production and human capital should be deepened to reveal the two-way causal relationship between skill accumulation and industrial upgrading. Fourth, policy effectiveness evaluation should be conducted using empirical methods to assess the actual outcomes of initiatives such as training subsidies and land reform, providing a basis for evidence-based policy refinement. Demographic change presents both a challenge and an opportunity for rural

transformation. The development of rural industries must transcend a passive, reactive approach and instead adopt systematic strategies to activate endogenous dynamics: optimizing human capital through education, harnessing demographic dividends through industrial adaptation, and stabilizing social expectations through institutional innovation. Moving forward, sustaining attention to the synergistic relationship between population dynamics and industrial evolution will be essential to building a resilient and inclusive developmental ecology, thereby achieving the long-term goals of rural revitalization and common prosperity.

6.2 Theoretical Implications

By analyzing the interaction between demographic change and industrial system transformation in Suqian City, this study offers a multidimensional contribution to rural development theory.

First, the study reveals the dynamic and nonlinear characteristics of the relationship between demographic structure and industrial adaptation, challenging the conventional linear assumption of “demographic dividend → industrial growth”. The case of Suqian demonstrates that, against the backdrop of an aging population and labor outflow, the impetus for industrial transformation has shifted from a “quantitative population advantage” to the “synergy between population quality and institutional innovation”. Second, the study advances the theory of “technology-institution-population” coevolution. The Suqian case illustrates that the effectiveness of technology diffusion is highly dependent on the suitability of institutional supply and the structure of human capital. Through factor reallocation at the county level—such as the coordination between land transfer and entrepreneurship policies—Suqian has realized a tripartite synergy among government, market, and community, verifying the feasibility of a polycentric governance system in rural transformation (Ostrom, 2010). Third, the study reframes the theoretical understanding of the “gender-industry” relationship. While traditional theories emphasize the contribution of female labor participation to economic growth (Goldin, 1995), data from Suqian show that a widening gender education gap—with the female illiteracy rate 7.15 percentage points higher than that of males—has exacerbated human capital shortages through intergenerational transmission. Fourth, the study expands the theoretical conception of rural resilience. The Suqian experience suggests that the essence of rural resilience lies in the dynamic adaptive capacity of the “population-industry-institution” system. Finally, the study promotes methodological innovation through “policy experiment-theory iteration”. As a pilot zone for comprehensive rural revitalization reform, Suqian’s policy practices constitute a large-scale social experiment, offering a natural laboratory for testing institutional change theory. In summary, this study reconstructs the theoretical framework of rural transformation through interdisciplinary dialogue and empirical validation. It breaks through the unidirectional logic of the “demographic dividend” by proposing a coevolutionary model of “institution-population-technology”; it incorporates gender and cultural dimensions to enhance the explanatory power of resilience theory; and it advocates a “policy experiment-oriented” iterative

approach to theory building, providing a methodological reference for global rural research.

6.3 Managerial Implications

This study offers operational guidance for policymaking and industrial practice within the framework of rural revitalization. First, policy design should emphasize a dual approach combining “incentives and services”. Policymakers may adopt integrated policy packages to avoid the short-term effects associated with single-policy instruments. Second, industrial planning should be grounded in local demographic characteristics. In regions marked by significant aging, priority should be given to developing inclusive industries such as recreation, tourism, and intangible cultural heritage crafts. The economic potential of the left-behind population can be activated through mechanisms such as “intergenerational collaboration”—for example, training elderly residents in e-commerce skills with the assistance of younger returnees. Third, human resource development should be stratified and targeted. A three-tier training system is recommended: providing smart agricultural technology training for young farmers, designing suitable programs such as recreational and elderly care services for middle-aged and older groups, and introducing a “skill certification + employment subsidy” linkage mechanism to enhance training outcomes, consistent with approaches advocated by the OECD (2021). Fourth, strategies should be tailored to address regional heterogeneity. In summary, rural revitalization requires the dynamic integration of demographic, industrial, and institutional elements to construct a sustainable ecology for the synergistic development of “people, industry, and land”.

6.4 Ideas for Future Studies

This study reveals the complex interactive mechanisms between rural demographic structure and industrial transformation, yet several academic gaps warrant further exploration. First, the impact of long-term intergenerational changes on land systems requires quantitative analysis. While current research predominantly focuses on short-term population mobility, declining birth rates and aging may fundamentally alter agricultural land inheritance patterns. These include issues such as land fragmentation in multi-child families and intergenerational differences in land transfer preferences following the phasing out of the one-child policy (as discussed in Land Use Policy). Future studies could employ longitudinal surveys and spatial econometric models to elucidate the dynamic relationship between intergenerational demographic shifts and land resource allocation. Second, research on the intergenerational inclusiveness of digital technology applications remains underdeveloped. Future work should incorporate a “technology-culture” interdisciplinary perspective to explore the design of localized digital tools to establish cross-generational technology dissemination mechanisms. Third, systematic comparisons of policy response pathways across regions with different geographic conditions are needed. While this study highlights the case of Suqian (a plains-based agricultural region), mountainous, pastoral, and other distinctive geographic units may exhibit differentiated characteristics. Generalizable theories could be refined through multi-case comparative

analysis, adopting a coupled “spatial-institutional” analytical framework (a methodological focus in Regional Studies) that integrates remote sensing data and field surveys to examine the interaction between geographic constraints and policy innovation. Fourth, the mechanisms through which technology affects gender inequality require micro-level empirical evidence. Although this study highlights the macro-level impact of educational gender gaps, questions such as how gender roles influence technology adoption decisions and whether implicit gender biases exist in digital platform algorithms remain unanswered. Fifth, rural resilience theory should incorporate cultural capital dimensions. Future research could construct a cultural capital stock indicator system and employ social network analysis (SNA) to quantify the embeddedness of intangible cultural heritage skills within industrial networks. Sixth, policy experiment evaluation methods need innovation. Although initiatives such as the Returning Home Entrepreneurship Fund have shown effectiveness in Suqian, their long-term sustainability remains uncertain. Introducing a “policy cycle” model and combining it with machine learning simulations could help assess the effects of multi-policy combinations. Simultaneously, establishing a dynamic “policy-population-industry” database would support evidence-based policy refinement. Additionally, adopting the European Union’s “Rural Living Labs” model (European Commission, 2023) to conduct participatory policy experiments at the county level could enhance the inclusiveness and adaptability of policy design.

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