Journal of Nonlinear and Convex Analysis
Volume 26, Number 6, 2025, 1887–1898

Yokohama Publishers
ISSN 1880-5221 ONLINE JOURNAL

LEVEL MEASUREMENT, REGIONAL DIFFERENCE DECOMPOSITION AND DYNAMIC EVOLUTION OF CHINA'S AGRICULTURAL NEW QUALITY PRODUCTIVE FORCES

HUILAN WU, HAIFEN YANG*, AND JINLING YAN

Abstract. This paper explores the theoretical connotations of "new quality productive forces" and constructs an evaluation index system to assess agricultural new quality productive forces. Using panel data from 30 provinces in China spanning 2011 to 2021, the entropy weight method is applied to measure the development index of agricultural new quality productive forces. To further analyze regional disparities, their sources, and evolution patterns, the study employs the Dagum Gini coefficient decomposition method and kernel density estimation. The findings reveal that while the overall level of agricultural new quality productive forces in China remains relatively low, it has shown a gradual upward trend. Significant regional disparities are observed, with the eastern region contributing the most to inter-regional differences. This study introduces a novel framework for measuring the development level, relative differences, and absolute differences of agricultural new quality productive forces from temporal, regional, and spatial dimensions. The proposed approach offers valuable insights for enhancing the development of agricultural new quality productive forces and advancing rural revitalization initiatives.

1. Introduction

The 20th National Congress of the Communist Party of China emphasized the need to accelerate the transformation of China into an agricultural power while promoting the revitalization of rural industries, talents, culture, ecology, and organizations. However, the advancement of agricultural modernization continues to lag behind industrialization. Compared to other global agricultural powers, China's total factor productivity (TFP) in agriculture remains relatively low. Despite substantial output, high production costs, low added value, and weak competitiveness persist as critical challenges. To accelerate the development of China's agricultural strength, relying solely on traditional and conventional productivity improvements is insufficient [6]. The urgent need for developing new quality agricultural productive forces has become increasingly evident.

2020 *Mathematics Subject Classification.* 1203, 0201.

Key words and phrases. New quality agricultural productivity forces, regional coordinated development, Dagum Gini coefficient, Kernel density estimation.

Funding project： Project of National Social Science Foundation of China (No. 20BJY156)； Social Science Planning Project of Shandong Province (No. 23CJJJ32)；Philosophy and Social Science Planning Project of Jinan City (No. JNSK23XCC13)； High-level Cultivation Project of Shandong Women's University (No. 2023GSPGJ05)； Philosophy and Social Science Research Project of Higher Education in Shandong Province (No. 2024ZSM328)；Social Science Foundation Project of Hebei Province (No. HB23YJ025).

*Corresponding author.

Since its initial proposal in September 2023 and subsequent inclusion in the government work report in March 2024, the concept of "new quality productive forces" has garnered significant interest in academic circles. From a theoretical perspective, new quality productive forces in agriculture are pivotal to advancing agricultural modernization. This concept represents an innovative transformation of agricultural production factors, processes, and the organization, division of labor, and collaboration along the industrial chain [4]. It marks a shift from traditional production factors to digital and intelligent agriculture, influenced by both domestic and international environments [7, 14]. This concept retains the general characteristics of productivity but also exhibits distinct features, including imbalances, the duality of development and protection, the dependence on resource endowment, and the multiplicity of innovation actors [15]. These attributes signify the progression of productivity into a new stage [1]. Regarding the evaluation system ,Song et al. [8] constructed an evaluation index system for China's new agricultural productivity based on three dimensions: scientific and technological productivity, ecological productivity, and digital productivity. Other scholars have developed an evaluation framework grounded in Marx's productivity theory, providing insights into regional coordinated development and convergence [13]. Furthermore, some scholars argue that local government attention plays a crucial role in fostering green TFP, which may influence the development and promotion of new quality productivity [16]. Enhancing urban innovation momentum and fostering new development drivers are also critical for achieving new quality productivity [5].

Based on the academic research on the level of China's agricultural new quality productivity, this paper defines the agricultural new quality productivity as: In the process of agricultural modernization, the innovation and optimization of production factors, production process and industrial chain should be promoted through the synergy of scientific and technological innovation, application of achievements, green development, optimization of production relations and talent support, so as to realize the improvement, transformation and upgrading of agricultural productivity. The marginal contributions of this paper are as follows: first, a scientifically constructed evaluation index system for agricultural new quality productivity is developed, and reveals its real development status and improvement potential through empirical measurement; second, the Dagum Gini coefficient decomposition method and kernel density estimation method are applied to assess relative and absolute trends in regional disparities, revealing both evolutionary characteristics and polarization tendencies. The analysis provides insights into the synergistic enhancement of differentiated agricultural productivity.

2. Evaluation index system and measurement method of agricultural new quality productivity

2.1. **Construction of an evaluation index system for agricultural new quality productive forces.** On January 31, 2024, General Secretary Xi Jinping, while presiding over the eleventh collective study session of the Political Bureau of the CPC Central Committee, provided a comprehensive overview of the development path for new quality productivity. He explicitly outlined five core requirements: "scientific and technological innovation, application of results, green development, production relations, and talent support." Guided by this ideology and the definition of new quality agricultural productivity presented in this paper, an evaluation system for agricultural new quality productivity can be constructed based on these five dimensions. It comprises a total of 21 specific indicators, as detailed in Table 1.

Scientific and technological innovation is a critical driver in improving agricultural productivity and quality, injecting significant momentum into its evolution [12]. The application of results represents a critical step in advancing novel and enhanced agricultural productivity. The application of scientific and technological innovations to specific industries and industrial chains contributes to building a modern agricultural industrial system. Green development represents a fundamental pillar of the new quality of agricultural productivity forces. Promoting the green transformation of agriculture is essential for enhancing the new quality of agricultural productivity [17]. The relations of production serve as fundamental prerequisites for advancing agricultural productivity and must evolve in alignment with the development of productive forces. The provision of talent support is a crucial element in advancing new agricultural productivity. Strengthening training programs and enhancing educational support in rural areas should therefore be prioritized [10].

2.2. **Data sources.** This study employed 21 specific indicators to calculate the comprehensive index of agricultural new quality productive forces across 30 provinces in China (excluding Hong Kong, Macao, Taiwan, and Tibet) from 2011 to 2021. The data used in constructing the index system were obtained from a variety of authoritative sources, including the *China Rural Statistical Yearbook, China Leisure Yearbook, China Education Statistical Yearbook, China Urban and Rural Statistical Yearbook, China Urban and Rural Construction Statistical Yearbook*, the EPS Global Statistical Data Platform, and the State Intellectual Property Office.

2.3. **Method selection and model setting.** The entropy weight method is an objective weighting approach widely applied in economic research due to its strong objectivity [2] and its ability to accurately reflect the relative importance of each indicator within a comprehensive index. In this paper, the entropy weight method is employed to calculate the comprehensive index of China's agricultural new quality productive forces as well as the indexes of each subsystem.

3. A quantitative analysis of the measurement results pertaining to the agricultural new quality productive forces level

3.1. **Overview of the characteristics of China's agricultural new quality productive forces level index.** Fig. 1 presents the calculated trends of the comprehensive index and subsystem indexes of China's agricultural new quality productive forces level from 2011 to 2021. The results exhibit the following distinct characteristics:

3.1.1. *Characteristics of the comprehensive index of agricultural new quality productive forces level.* Firstly, the comprehensive index of agricultural new quality productivity in China remains at a relatively low level overall. The highest value observed during the study period was 0.1831 in 2021. Secondly, the composite index of agricultural new quality productivity has exhibited a consistent upward trend

Table 1. Evaluation index system of China's agricultural new quality productive forces.

Subsystem	Dimensions	Specific metrics	Attributes
Technological innovation	Agricultural mechanization	Total power of agricultural machinery (kW)	Forward
	Digitalization of agriculture	Rural broadband access users (ten thousand households)	Forward
		Mobile Internet users (ten thousand)	Positive
	Agricultural science and technology	Agricultural green patent	Forward
Application of results	Labor productivity	Total output value of agriculture, forestry, animal husbandry and fishery/number of employees in the primary industry	Positive
	Land productivity	Total agricultural output/crop sown area	Positive
	Grain production capacity	Comprehensive grain production capacity (ten thousand tons)	Positive
	Level of industrial integration	Main business income of agricultural product processing enterprises above designated size / 100 million yuan	Positive
	Level of facility farming	Greenhouse area/crop sown area (%)	Forward
	Level of facility farming	Greenhouse area/crop sown area (%)	Forward
		Greenhouse area/crop sown area (%)	Forward
Green development	Carbon emissions per unit of output value	Agricultural carbon emissions/total agricultural output value	Negative
	Fertilizer application rate per unit area	Fertilizer application rate/cultivated area	Negative
	Pesticide use per unit area	Pesticide use/area of cultivated land	Negative
		Greenhouse area/crop sown area (%)	Forward
	Use of agricultural plastic film per unit area	Agricultural plastic film usage/total sown area of crops	Negative
Relations of production	Industrial coordination	Agricultural industrial structure adjustment index: 1-(agricultural output value/total output value of agriculture, forestry, animal husbandry and fishery	Positive
	Urban-rural coordination	Bivariate comparison coefficient: labor productivity of primary industry/labor productivity of secondary and tertiary industries	Positive
	Agricultural trade	Total imports and exports of agricultural products/agricultural value added	Positive
	Farmers' income growth	Growth rate of per capita net income of farmers (%)	Positive
Talent support	Human capital	Years of education in rural areas	Positive
	Educational foundation	Number of full-time teachers from rural kindergarten to high school (person)	Positive
		Number of teachers with bachelor degree or above from kindergarten to high school in rural areas (person)	Positive
	Public service	Village doctors and hygienists (people)	Forward

throughout the study period. The index increased from 0.1254 at the start of the study to 0.1831 in 2021, representing a cumulative growth of 46%. In general, the steady increase in the composite index reflects the progressive modernization and digitalization of China's agriculture, driven by the synergistic effects of multiple policies.

3.1.2. *Structural characteristics of the comprehensive index of agricultural new quality productive forces level.* This study examines the structural characteristics and evolutionary trends of the index by analyzing its five subsystems. The findings are as follows: Firstly, the science and technology innovation index exhibited a modest yet

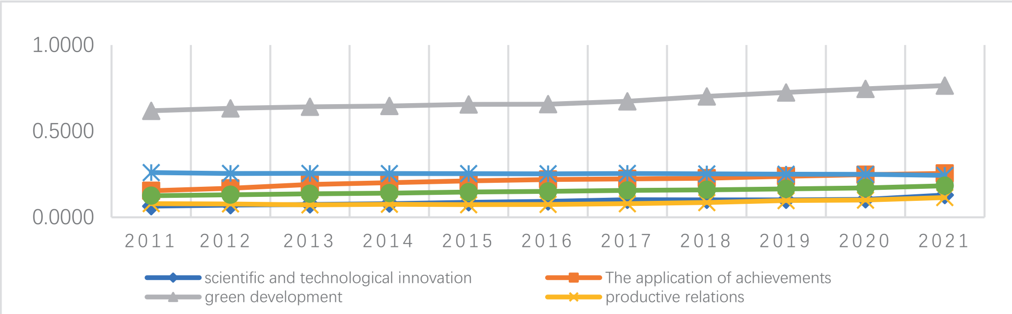


FIGURE 1. Change in the trend of the comprehensive index of agricultural new quality productive forces and its sub-system indexes from 2011 to 2021.

fluctuating increase throughout the study period.This highlights the pivotal role of scientific and technological innovation in driving advancements in agricultural new quality productivity. Secondly, the achievement application index showed a steady upward trend, with an average annual growth rate of 5.2%. This reflects the gradual expansion and integration of agricultural science and technology achievements into practical applications. Thirdly, the green development index demonstrated an average annual growth rate of 2% during the study period, with significant acceleration since 2018. This suggests that sustainable resource utilization and environmental protection measures have been increasingly reinforced. Fourth, the production relations index displayed relatively low volatility but maintained a consistent upward trend. This indicates that the optimization of production relations has contributed to a more rational allocation of resources, fostering conditions conducive to the enhancement of agricultural new quality productivity. The talent support index showed a stable upward trend, underscoring the importance of cultivating a highly skilled agricultural workforce as a foundational element in advancing agricultural productivity. In general, all five subsystem indices experienced a turning point following the implementation of the Rural Revita lisation Strategy in 2018, demonstrating a notable upward trajectory.

3.2. **Regional characteristics of China's new quality agricultural productivity level index.**

3.2.1. *Regional characteristics of the comprehensive index of new quality agricultural productivity level.* As shown in Fig. 2 (i), the overall levels of agricultural new quality productivity in all four regions exhibited steady growth throughout the study period. This indicates that the new quality productive forces of agriculture in China's regions have been consistently improving. From a regional perspective, the eastern region consistently ranked the highest, significantly outpacing other regions, followed by the central, northeastern, and western regions. The average annual growth rates for the four regions were 4.17%, 3.45%, 2.07%, and 4.39%, respectively. These results reveal a spatial pattern of agricultural new quality productivity levels in China that is "high in the east and low in the west," with marked regional disparities. The disparity can largely be attributed to differences in resource endowments, economic foundations, and other developmental factors. Notably, after the implementation of the rural revitalization strategy in 2018, a strong "catch-up effect" has emerged, with regional disparities in agricultural new quality productivity levels gradually narrowing.

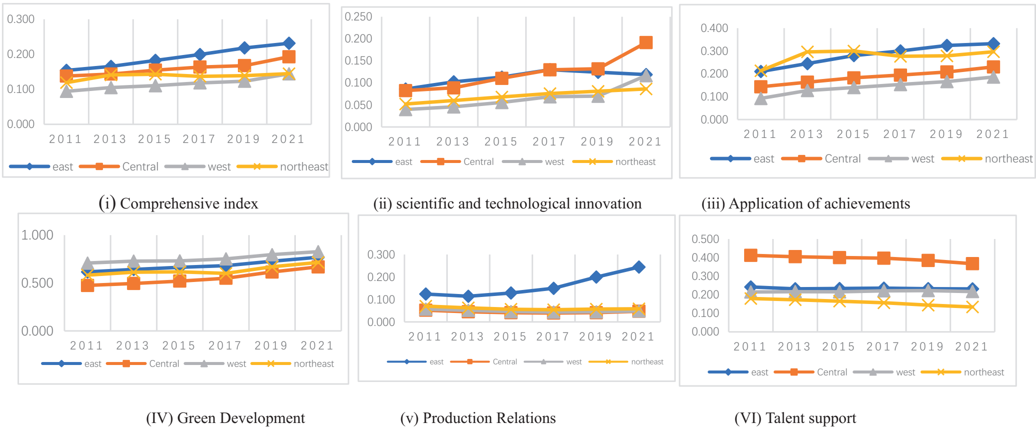


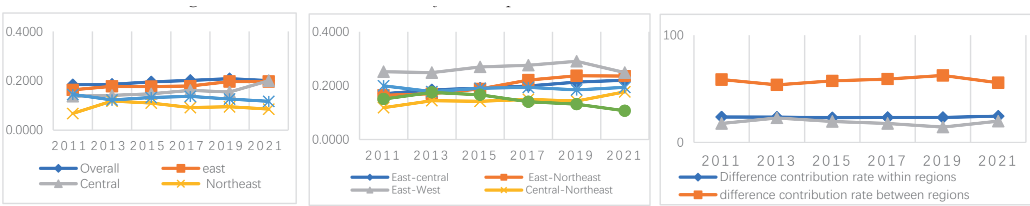
FIGURE 2. Change trend of comprehensive index and sub-system index of agricultural new quality productive forces level in four regions from 2011 to 2021.

3.2.2. *Regional characteristics of sub-system index of agricultural new quality productive forces level.* This paper further analyzes the sources of differences in the composite index by examining the trends of the subsystems (Fig. 2 (ii) - Fig. 2 (iii)). The results reveal the following: From a trend perspective, the subsystem indexes in all four regions exhibit consistent upward trajectories. Regarding growth rates, the central region recorded the highest average growth rates for the scientific and technological innovation and green development indexes, at 9.28% and 3.49%, respectively. Meanwhile, the western region achieved the highest average growth rates for the Application of results and talent support indexes, at 7.37% and 4.39%, respectively. Overall, the development level of the green development subsystem is the most advanced among the four regions, particularly in the western region. This indicates that the industrialization process in the western region remains slow, and the conditions for fully realizing the strategy of "promoting agriculture with industry and driving rural development with urban growth" have yet to be fully established.

4. THE DECOMPOSITION OF REGIONAL DIFFERENCES IN THE LEVEL OF NEW QUALITY AGRICULTURAL PRODUCTIVITY

4.1. **Method selection and model setting.** The Dagum Gini coefficient is a widely used index for measuring inequality. A smaller Gini coefficient indicates a more equal distribution, while a larger coefficient reflects greater inequality. The Dagum Gini coefficient not only evaluates the influence of subgroups on overall disparities but also addresses the issue of overlapping among sample data [3]. The calculation procedure in this study is based on the methodology proposed by Xu and Wang [11].

4.2. **Regional variations and sources of the new quality productive forces level index of agriculture.**



(i) overall and intra-regional differences (ii) inter-regional differences (iii) contribution rates of regional differences

FIGURE 3. Regional differences and contribution rates of agricultural new quality productive forces.

4.2.1. *Regional variations and sources of the composite index.* (1) Overall differences and sources

From the perspective of the overall difference trend, as illustrated in Fig. 3 (i), the overall Gini coefficient of China's agricultural new quality productive forces initially increased and then declined. Between 2011 and 2014, the Gini coefficient remained relatively stable at 0.18. Beginning in 2015, it exhibited an upward trend, with the overall difference expanding and the Gini coefficient rising from 0.196 to 0.209. However, a decline was observed starting in 2020, with the Gini coefficient decreasing by 4.1%. This can be attributed to several factors. Before 2018, rapid development in new quality agricultural productivity contributed to the expansion of regional disparities. However, since the implementation of the rural revitalization strategy in 2018, regions have progressively increased their resource inputs to improve the levels of new quality agricultural productivity. Although policy implementation is subject to a time lag, the overall discrepancy began to diminish by 2020. Regarding the contribution rate of regional differences, as shown in Fig. 3 (iii), inter-regional disparities account for the largest share, with an annual average contribution rate of 58.59%. Intra-regional differences contribute an average of 23.42% annually, while hyper-variable density contributes 17.99% on average. These findings indicate that inter-regional disparities are the primary drivers of regional variations in agricultural new quality productive forces.

(2) Intra-regional differences

Regarding intra-regional disparities, the mean Gini coefficients for the eastern, central, northeastern, and western regions during the sample period were 0.1785, 0.1533, 0.0933, and 0.1307, respectively. These values highlight significant imbalances in the development of new agricultural productivity within each region. Notably, the eastern and central regions exhibit pronounced and widening disparities, with annual average increases in Gini coefficients of 0.3% and 4.2%, respectively. In contrast, the intra-regional differences in the western and northeastern regions are gradually narrowing, with annual average decreases of 0.5% and 3.7%, respectively.

These intra-regional disparities are the result of a complex interplay of economic, social, and geographic factors. These findings underscore that the discrepancies in agricultural new quality productivity across regions are shaped by a multifaceted interplay of factors, including regional development strategies, resource endowments, technological advancements, and economic foundations.

(3) Regional differences

Fig. 3 (ii) provides a visual representation of the inter-regional disparities and evolutionary trends in the levels of new agricultural productivity across China. Overall, the discrepancies between the eastern region and other regions are particularly pronounced, exhibiting an average annual difference value of 0.2652. This is followed by the differences between the eastern and central regions and the eastern and northeastern regions. The fundamental reason for these significant disparities lies in the eastern region's strong economic foundation and favorable resource endowment. In contrast, the central, northeastern, and western regions face challenges due to their relatively weaker economic foundations, lower levels of technological development, limited talent reserves, and insufficient financial investment. These factors hinder their ability to match the level of new agricultural productivity achieved in the eastern region. Disparities between the northeastern region and other regions, however, are relatively modest, with average annual difference values of 0.1424 (Northeast-Central) and 0.1435 (Northeast-West). This is attributed to the geographic proximity of the agricultural bases in the three northeastern provinces and their relatively consistent progress in agricultural mechanization and green production methods.

5. The distribution and dynamic evolution of new quality productive forces in China's agriculture

5.1. Method selection and model set. The kernel density estimation method is utilized to describe the spatial distribution of a random variable's state through a continuous density curve. This approach is characterized by its minimal dependence on specific assumptions, strong robustness, and the ability to intuitively capture the spatiotemporal evolution trends of regional agricultural productivity at varying levels of absolute difference.

5.2. The representation and dynamic evolution of new agricultural productivity levels. As illustrated in Fig. 4 , the kernel density curves depict the distribution of new quality productive forces in agriculture across the nation and its four regions. Considering the implementation of the Rural Revitalization Strategy in 2018 and the subsequent lag in policy effects, this study takes 2018 as a reference point,a comparison period encompassing two to three years before and after 2018 is selected. From the perspective of distribution location, the kernel density curve for national agricultural productivity shifts to the right during the new study period. This shift signifies an overall improvement in the total level of agricultural productivity. Regarding distribution shape, the peaks of the kernel density curves become more pronounced, and the curve widths narrow. This indicates that disparities in agricultural productivity among provinces are diminishing. In terms of distribution extensibility, the curves exhibit a distinct right-tail characteristic, highlighting provinces with high levels of agricultural productivity. Overall, the analysis demonstrates a steady improvement in the level of new quality productive forces in agriculture across the nation, with a gradual reduction in inter-provincial disparities. However, a discernible tendency toward differentiation among provinces remains evident.

5.3. **Distribution and dynamic evolution of agricultural new quality productive forces levels in the four regions.** As illustrated in Fig. 4 (ii) to (v), the kernel density curves of agricultural productivity in the eastern region show a progressive shift to the right, a narrowing of the distribution, and the emergence of a bimodal pattern. This suggests a continuous improvement in agricultural productivity in the East, with provincial disparities gradually diminishing and the degree of polarization remaining relatively low. In the central region, the kernel density curve of agricultural productivity shifts to the right, exhibiting a fluctuating trend with narrowing wave width. This indicates that the overall level of agricultural productivity in central China is steadily increasing, accompanied by a reduction in absolute differences. In the western region, the kernel density curve shows a sharp rightward shift, with the main peak slightly declining. This implies that while agricultural productivity in the western region is increasing, the regional disparities are widening, signaling a mild trend toward differentiation. In the northeastern region, the main peak of the kernel density curve shifts slightly to the right, with the peak height increasing and the width narrowing. This indicates a slow but steady rise in agricultural productivity in the Northeast, accompanied by a reduction in provincial differences. However, the presence of a left-tail phenomenon suggests that certain provinces still fall below the mean, indicating an imbalanced distribution of agricultural productivity.

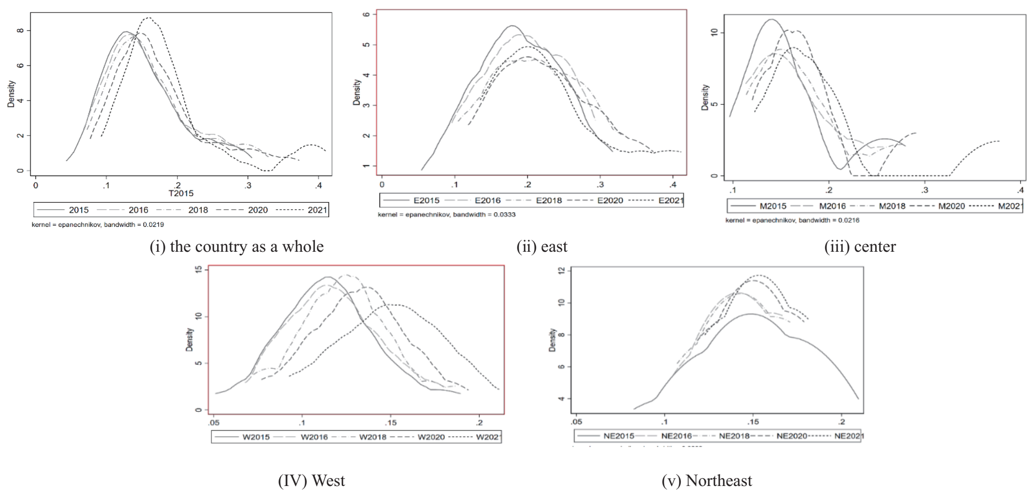


Figure 4. Kernel density curves of agricultural new quality productive forces in the whole country and four regions.

6. Conclusions, recommendations and shortcomings

6.1. **Conclusions.** This paper constructs the index system of China's agricultural new quality productivity and empirically analyzes its regional differences, distribution dynamics and evolution trend. The conclusions are as follows: Firstly, during the study period, the level of agricultural new quality productive forces in China was relatively low but exhibited an overall upward trajectory. This growth, however, was accompanied by clear spatial imbalances. The eastern region demonstrated the highest productivity levels, followed by the central, northeastern, and western regions. This gap presents a key challenge for improving agricultural productivity and achieving balanced development. Secondly, when examining the relative differences, the gap in the level of agricultural new quality productive forces in China shows a declining trend. The primary driver of this discrepancy is the inter-regional disparity, followed by intra-regional variations. Thirdly, when considering absolute differences, the overall absolute gap in agricultural new quality productive forces across China has consistently narrowed.

6.2. **Recommendations.** Based on the conclusions drawn from this study, it is clear that the imbalanced and insufficient development of China's new quality agricultural productivity poses a significant challenge to the goal of transforming China into an agricultural powerhouse. Accelerating the development and improvement of new quality agricultural productivity, while narrowing regional disparities, has become an urgent task in the context of comprehensive rural revitalization. In response to these challenges, this paper offers a series of targeted measures and recommendations.

The first step is to strengthen the dual approach of "scientific and technological innovation" and "institutional reform" to fully activate rural resources. Scientific and technological innovation, along with institutional reform, are pivotal to optimizing resource allocation and driving the development of new agricultural productivity. By utilizing and integrating key rural resources—including labor, expertise, technology, management, data, and capital—China can advance its agricultural productivity.

Secondly, it is crucial to accelerate the synergistic regional development of new agricultural productivity. Significant discrepancies exist in the level of new agricultural productivity across China's diverse regions, and uneven development is a key factor contributing to this imbalance. The first step is to establish a cross-regional cooperation mechanism. Facilitate the transfer of advanced experiences and technologies from the eastern region to the central, western, and northeastern regions, and help promote the exchange of experiences and technology diffusion, while also supporting lagging regions in addressing deficiencies in science, technology, and management. Moreover, to facilitate the flow of resources, it is essential to prioritize the development of modern logistics systems and information networks, which will help reduce the costs associated with resource movement.

Thirdly, there is a need to reduce regional disparities in green agricultural productivity. First, existing green agricultural policies should be strengthened, with increased financial support directed towards the central, western, and less developed regions. Second, a differentiated green development strategy should be formulated and tailored to the resource characteristics of each region. Promoting locally appropriate ecological agricultural models can help optimize resource utilization and improve regional productivity. Furthermore, targeted training programs should be developed to enhance farmers' knowledge and skills in green development.

6.3. **Shortcomings.** This paper develops an index system to measure China's agricultural new quality productivity from the perspective of development goals. It analyzes regional differences, distribution dynamics, and the evolving trends in agricultural new quality productivity. However, there are several limitations, and future research can be further deepened and expanded. From a developmental stage perspective, China's agricultural new quality productivity is in a phase of rapid growth, yet its overall level remains relatively low. The inclusion of more comprehensive data could enhance the current findings and provide a more nuanced understanding in future studies. From a research methodology standpoint, this paper employs a predominantly quantitative approach to analysis. While quantitative methods offer valuable insights, future studies could benefit from incorporating qualitative approaches to explore the complex, contextual factors influencing agricultural productivity more comprehensively.

References

[1] R. Cao, *An ESG evaluation system based on new quality productivity and blockchain application*, Academic Journal of Science and Technology **11** (2024), 192–196.

[2] M. Chen, B. Zhang, T. Zhang and Q. Chu, *Unbalanced and Inadequate Situation, Mechanisms and Countermeasures of Rural Livelihood Development in China*, Issues in Agricultural Economy No.03 (2023), 34–50.

[3] C. Dagum, *Decomposition and interpretation of Gini and the generalized entropy inequality measures*, Statistica **57** (1997), 295–308.

[4] Y. Gao and J. Ma, *New quality productivity in agriculture: a political economy perspective*, Issues in Agricultural Economy No.03 (2024), 81–94.

[5] G. Liu and L. Xu, *Spatial heterogeneity analysis of urban innovation efficiency in Shandong province*, Academic Journal of Humanities & Social Sciences **7** (2024), 16–23.

[6] B. Luo, *On new quality productivity of agriculture*, Reform. No. 03 (2024), 19–30.

[7] B. Luo and P. Geng, *New agricultural productivity: Theoretical vein, basic kernel and enhancement path*, Issues in Agricultural Economy No. 03 (2024), 13–26.

[8] Z. J. Song, M. N. Leng, B. Zhou and X.P. Gao, *New quality productivity in Chinese agriculture: evaluation system construction, dynamic evolution and policy implications*, Journal of Agro-Forestry Economics and Management **23** (2024), 425–434.

[9] Z. Tao and H. Dongyue, *The spatiotemporal evolutionary characteristics of farmers' income growth impetus from the perspective of income structure: A case study of rocky desertification poverty alleviation areas*, Human Geography **39** (2024), 48–58.

[10] J. Wang, Z. Yao and Q. Wu, *Let New Quality Productive Forces Empower Agricultural Modernization to Lead the Way*, Xinhua Daily No.03 (2024).

[11] X. Xu and Y. Wang, *Measurement of China's rural revitalisation level, decomposition of regional differences and dynamic evolution*, The Journal of Quantitative & Technical Economics **39** (2022), 64–83.

[12] J. Yang, *People's Daily Overseas Edition*, New quality productivity accelerates No.03 (2024)

[13] J. Yang and Q. Wang, *Regional differences and convergence in the development level of new quality productivity in digital agriculture*, Journal of University of Finance and Economics. No.03 (2024), DOI:10.19331/j.cnki.jxufe.20240516.001.

[14] L. You and X. Tian, *New quality productivity in agriculture: logic of reality, connotation analysis and generation mechanism*, On Economic Problems No.03 (2024), 27–35.

[15] H. Zhang and Z. Wang, *New agricultural productivity: Theoretical connotation, practical basis and enhancement path*, Journal of Nanjing Agricultural University Social Sciences Edition **24** (2024), 28–38.

[16] Z. Zhang, Z. Hua, Z. He, X. Wei and H. Sun, *The impact of local government attention on green total factor productivity: An empirical study based on System GMM dynamic panel model*, Journal of Cleaner Production **458** (2024): 142275.

[17] L. Zuo, H. Zhang and L. Sun, *Research on the dynamic smart digitalization paths of green agricultural development under the goal of "Carbon Peaking and Carbon Neutrality"*, Journal of Northwest Minzu University (Philosophy and Social Sciences) No.03 (2024), 141–152.

Manuscript received July 18, 2024
revised December 13, 2024

W. Huilan
School of Economics and Management, Hebei Agricultural University, Baoding 071000;
School of Economics, Shandong Women's University, Jinan 250000, China
E-mail address: 466180885@qq.com

Y. Haifen
School of Economics and Management, Hebei Agricultural University, Baoding 071000, China
E-mail address: yhf369@126.com

Y. Jinling
School of Economics and Management, Hebei Agricultural University, Baoding 071000, China
E-mail address: yanjinlingchina@sina.com