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Research on the Measurement and Spatiotemporal Evolution of Agricultural Green Total Factor Productivity

-- Based on City Panel Data in the Yangtze River Delta Region

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Abstract

In the new era of rapid economic development, my country is facing greater pressure on resources and the environment, and the contradiction of uncoordinated green development in the region is more prominent. This project is based on the panel data of 41 cities in the Yangtze River Delta region from 2001 to 2021 , and uses the SBM super-efficiency model to measure total factor productivity. On this basis, it uses the Moran index model analysis to improve agricultural green total factor productivity and boost economic growth. The path to achieve quality development. In terms of research objects, there are few literatures on agricultural green total factor productivity in the Yangtze River Delta region. In terms of research content, considering that agricultural production has the dual attributes of carbon sources and carbon sinks, the measurement results are more reliable. In terms of research methods, , using global and local Moran indices to study the spatiotemporal evolution characteristics of agricultural green total factor productivity in the Yangtze River Delta region, but there are few related studies in the past. The research results have reference significance for accurately evaluating agricultural carbon emission reduction and carbon absorption capabilities and achieving the " double carbon " goal.

Keywords

SBM Super-efficiency Model; Mallmquist-luenberger Index Model; Decomposition Efficiency of Agricultural Green Total Factor Productivity.

1. Research Background

1.1. Research Significance

An important carrier affecting global climate change and threatening the natural environment is greenhouse gas emissions. It is not conducive to food security. Changes in climate and temperature, light and intensity, and precipitation patterns will hinder crop pollination and promote ecological disasters such as pests and diseases, which is detrimental to improving the quality and efficiency of agricultural production. Use the SBM super-efficiency model to measure total factor productivity. The total amount of greenhouse gases released by agricultural land has reached 60% of the world's total net increase in man-made greenhouse gas emissions. This growth rate is even rising. Agricultural satellite effect emission reduction cannot be delayed.

The Yangtze River Delta region has strong regional coverage, strong geographical area, extensive economic status, and huge green development potential, which occupies an extremely important position in my country's overall economic development strategy. However, in the context of quality economic development in the new era, it still faces huge environmental resources and pressure, and there are also conflicts in the uneven green development within the region.

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The improvement of the production efficiency of all green objects in the Yangtze River Delta region is a factor affecting high-quality economic development and is also the focus of current academic research. The literature on the current status of total green agriculture and the overall spatiotemporal characteristics outlined in this article provides enlightening experience and many learning methods, but there is still room for improvement. First, the assessment and evaluation system established when studying the total productivity of green agricultural elements only considers the unintended carbon emissions of agricultural agriculture and ignores the characteristic characteristics of carbon agricultural products, so that the results can be predicted; second, a broader approach includes entropy Laws, double differential or primary component analysis methods, development of the entire green elemental level and effect factors.

1.2. Macroeconomic Analysis

Overall, China's GDP growth rate will be 3% in 2022 , and the GDP will exceed 121 trillion yuan; the employment situation is stable, with more than 11 million new jobs in urban areas, and the consumer price index of the population continues to rise to 2% . Compared with the previous year, grain output once again set a harvest record of 0.5% . Social domestic demand continues to increase, the economy and society are harmonious and stable, and the social development environment is good. In the short term, China's overall economic situation remains stable, and economic production has generally reached a new level. However, in the long term, China's economic growth rate in 2022 has not reached the predetermined target of 5.5% . Although the impact of the epidemic has gradually weakened, the economy still faces challenges in the recovery stage, lack of development momentum, and many unstable and uncertain factors. Domestic enterprises Lack of survivability. In this context, effective action is needed to address the many difficulties and challenges facing the economy. The literature on the current status of total green agriculture and the overall spatiotemporal characteristics outlined in this article provides enlightening experience and many learning methods, but there is still room for improvement. First, the assessment and evaluation system established when studying the total productivity of green agricultural elements only considers the unintended carbon emissions of agricultural agriculture and ignores the characteristic characteristics of carbon agricultural products, so that the results can be predicted; second, a broader approach includes entropy Laws, double differential or primary component analysis methods, development of the entire green elemental level and effect factors.

2. Model Selection, Selection Indicators and Source Data

2.1. Model Selection

2.1.1. Capital Stock

Calculated using the perpetual inventory method, based on the Consumer Price Index (CPI) , in real GDP , nominal GDP times real GDP . Where GDP=$AK^{a}L^{b}X^{1-a-b}$.

2.1.2. SBM Super-efficiency Model and Mallmquist - luenberger Exponential Model

$$\rho^{*}=\operatorname{Min}\frac{1-\frac{\sum_{\rho=1}^{\rho}\frac{S_{r}^{x}}{X_{p}^{k}}}{\rho}}{1+\frac{1}{Q+1}\left(\sum_{Q=1}^{Q}\frac{S_{q}^{k}}{y_{q}^{k}}+\sum_{R=1}^{R}\frac{S_{u}^{k}}{y_{r}^{k}}\right)}$$

$$Y_{Q}^{K}=\sum_{q}^{k}\omega_{k}\,y_{Q}^{k}-S_{Q}^{y}$$

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$$U_R^K = \sum_r^k \omega_k X_r^k + S_R^u$$

$$S_p^x \geq 0, S_Q^y \geq 0, S_r^u \geq 0, \omega_k \geq 0, \sum_z^k w_k = 1$$

In the formula: $x_p^k, y_q^k, u_r^k\ S_p^x, S_q^x, S_r^x \omega_k$.

The GML index can be expressed as: $GML_t^{t+1} = \frac{1+D^G(P^t,Q^t,U^t)}{1+D^G(P^{t+1},Q^{t+1},U^{t+1})}$.

2.1.3. Moran Index Model

$$\text{Morans I} = \frac{n\sum_{i=1}^n \sum_{j=1}^n w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^n \sum_{j=1}^n w_{ij} \sum_{i=1}^n (x_i - \bar{x})^2}$$

Moran's Ii >0 means that the spatial unit is low - low agglomeration or high - high agglomeration; Moran's Ii <0 means that the spatial unit is low - high agglomeration or high - low agglomeration.

2.2. Select Indicators

Taking into account the availability and feasibility of data, labor, soil input and capital input were selected as indicators for the study of the total productivity of small-scale agriculture. Land input was replaced by crop sown area. With reference to existing literature, the relationship between input and output was considered, and the capital element was defined as the total power of agricultural machinery, the use of agricultural fertilizers, pesticides, agricultural films and effective irrigation areas.

Table 1. Carbon source factors

	carbon source	Carbon emission coefficient
serial number	Carbon source	Carbon emission
No.		coefficient
1	fertilizer	0.896 kg/kg
2	pesticide	4.934kg/kg
3	agricultural film	5.180kg/kg
4	diesel fuel	0.593 kg/kg
5	Crop sowing	3.1 kg/hm ^{2}
6	irrigation	0.25 kg/hm ^{2}

2.3. Data Selection

Panel data of 41 prefecture-level cities in the Yangtze River Delta region from 2001 to 2021 , "China Rural Statistical Yearbook" and "China Energy Statistical Yearbook". Based on panel data at the municipal level and above, the SBM super-efficiency model and the Mallmquist - Luenberger index model are used to measure its specific effects. The Moran index model is used to select relevant intermediary variables to study the spatiotemporal evolution characteristics of agricultural green total factor productivity in the Yangtze River Delta region. Here Based on this, specific implementation paths and policy measures are proposed. The research technology route is shown in the figure.

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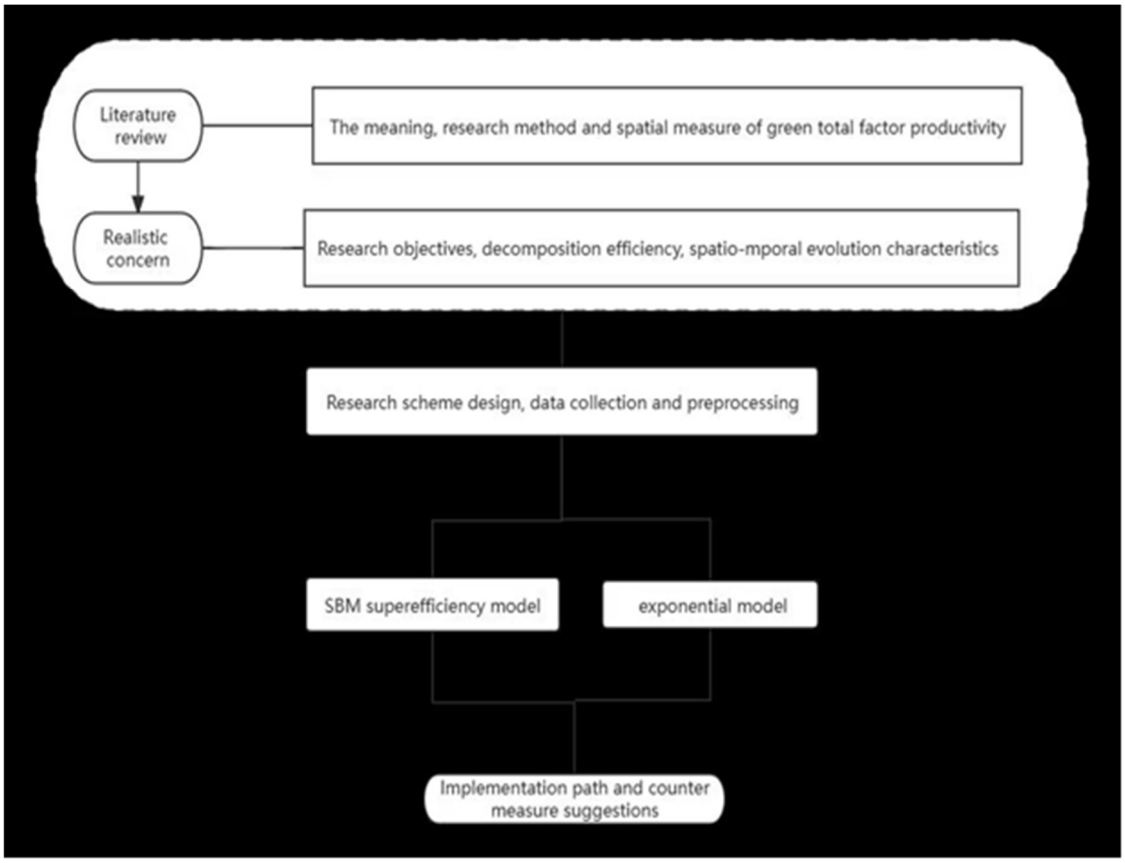

Figure 1. Research path

3. Analysis of Empirical Results

3.1. Phased Analysis of Bim Calculation of Agricultural Green Productivity

1997-1999 stage : The overall green productivity of agriculture at different levels is still low and has small fluctuations . According to our investigation of the existing data, we can find that clustering can obtain three types of groups. The proportions of these three types of groups are 35.0%, 29.7%, and 35.3% respectively. Overall, the distribution of the three types of groups is relatively even, which is also This greatly reflects the good clustering effect of our data analysis results. From 2000 to 2014 , the entire green agricultural productivity level rose to a new level and developed rapidly. In 2008 , there was a significant decline in the upstream areas. 2015-2019 stage . _ The green total factor productivity of agriculture in the Yangtze River Economic Belt has shown rapid growth.

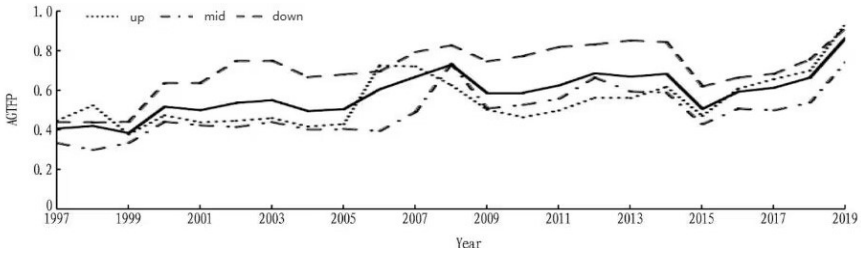

Figure 2. Phased analysis of agricultural green productivity

3.2. Economic Factors Affecting Agricultural Green Productivity

In these statistics, the required KMO result is 0.865 , indicating that the sample data can be included in the analysis of the principal component factors. Furthermore, Bartlett's excellent test score is less than 0.05 , which suggests that the sample's statistics are more important.

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Using KMO to check whether the sample data we can choose can verify whether the original sample data can be used for the reanalysis method of key components, which can only be applied when the KMO value exceeds or is close to 0.6 . K-means clustering is a clustering algorithm based on sample set partitioning. Divide the samples into k subsets to form k categories . Divide n samples into k categories. The distance between each sample and the center of the class to which it belongs is the smallest, and there is a large difference between different categories. It is significant at the 1% level, indicating that economic policy uncertainty will negatively regulate the impact of the digital economy on agricultural green total factor productivity, and economic policy uncertainty will hinder the promotion effect of the digital economy on agricultural green total factor productivity . Hypothesis Get verified.

Table 2. Bartlett's test of

Bartlett's test of	KMO sampling suitability quantity	0.865
	Approximate chi-square	3443.935
	degrees of freedom	120
	Significance	0.001

4. Innovation Points and Project Features

This article uses global maps and local mapping to study spatiotemporal evolution, studying the complete green agricultural elements in a long triangle, where past studies have been much less frequent and much more innovative. In the study, the evaluation index system established by the literature aimed at measuring the agricultural level of the entire green agriculture only considered the carbon accidentally emitted by the farm and ignored the dual characteristics of the carbon produced at the same time, thereby over-evaluating the calculation. This study is groundbreaking. This article provides a comprehensive analysis of agricultural productivity in the Yangtze River Delta region and cities.

On the one hand, the government should strengthen support for rural agricultural productivity, encourage more young people who are familiar with agricultural productivity to join the ranks of rural agricultural productivity development, organize outstanding agricultural producers, conduct centralized training, carry out experience exchange and other activities, and provide Local agricultural productivity professionals provide services such as technical support and entrepreneurial guidance, promote the construction of rural agricultural productivity talent teams, and achieve professional production of rural agricultural productivity. On the other hand, the government should strengthen its organizational and guidance functions, prescribe the right medicine for the chaos that occurs, guide short video consumers to consciously boycott vulgar and low-quality content, explore the role of agricultural productivity in inheriting and developing excellent rural culture, and use rural short videos to Video integrates and expands rural cultural service channels, thereby enhancing the cultural connotation of agricultural productivity short video content, promoting the development of rural regional culture, and promoting high-quality economic development while promoting the spread of rural culture.

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