

Development of Urban Agriculture and Carrying Capacity of Resources and Environment in Yangtze River Delta Research on Coordination Relationship

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Abstract

This paper constructs an evaluation index system of urban agricultural development and resources and environment carrying capacity, evaluates the urban agricultural development level and resources and environment carrying capacity of Nanjing and Shanghai from 2007 to 2018, and measures the coupling and coordination relationship between them. The results show that: the overall level of the two systems in Nanjing is fluctuating upward, and the coordination state changes from the antagonistic stage to the current coupling stage; The development of urban agriculture in Shanghai continues to improve, but the resource and environmental constraints are highlighted. The coordination state of the two systems is a coupling stage, but there is still a certain gap with the high coupling.

Keywords

Urban agriculture; Carrying capacity of resources and environment; Coupling coordination.

1. Introduction

Since the reform and opening up, the development mode of combining elements and resources has effectively promoted the rapid growth of China's economy. However, the new impetus for economic development in China is a little inadequate, and the new and new ones are difficult to undertake efficiently, which leads to the low efficiency of current green development. With the development and deepening of the application of Internet and information and communication technology, data as a new factor of production has been put into production, and digital as the product of a new round of technological revolution has shown a strong driving force in the fields of green production, green consumption and green government affairs, which has obvious impact on green development. It is an inevitable choice to promote the deep integration of new data kinetic energy and green development, and create new green business forms to conform to the current economic situation and international environment. At the same time, problems such as ecological environment damage and tight resource constraints are increasingly prominent, Promoting the improvement of green development efficiency has become the key to the economic transformation in China. In this context, the characteristics of sustainable development in the development and reform of modern agriculture in China are more and more distinct. Urban agriculture, as a product of urbanization and modern agriculture, plays an important role in urban economic activities. The dual advantages of geographical location and natural resources make urban agriculture more powerful in providing agricultural products and leisure agriculture services for urban areas. In the process of fighting the impact of the epidemic, urban agriculture provides a certain guarantee for the food supply of surrounding cities. On the one hand, it has an impact on the supply, economic development and environmental changes of green agricultural products in the surrounding areas, and on the

other hand, it has a dependence on the resource and environment of the region. The development of urban agriculture and the resources and environment in the region have interactive and interactive relationship. Therefore, under the background of tight resource and environment constraints, how to establish the coupling and coordination relationship between urban agricultural development and the carrying capacity of resources and environment has become an important issue at present.

The existing research has carried out some discussion on the urban agriculture and the bearing capacity of resources and environment. Dieleman analyzes the development characteristics of Mexico urban agriculture in ecological and economic aspects by constructing the policy framework of urban agriculture. Micoli and others discussed the planning of urban agriculture from the perspective of food supply. Campbell, based on the analysis of policy documents and semi structured interviews, discusses the reasons why urban agriculture is incorporated into the New York food policy and sustainable development plan. Deng Chuxiong et al. [4] made a comprehensive study on the sustainable development of urban agriculture in Shanghai by using AHP. Wang Dai et al. [5] analyzed the influencing factors of urban agriculture in Beijing by constructing DSR evaluation model, and showed that the tight resource and environment constraints are a major constraint to the development of urban agriculture in Beijing.

At present, the academic community has rich research on the subsystems of urban agricultural development and resource and environmental capacity. The relevant research results have important reference significance for promoting the high-quality development of urban agriculture and the protection of resources and environment. But the research on the relationship between them is mostly the impact of urban agricultural development on ecological environment or the role of resource and environment endowment on urban agricultural development, and less analysis of the two-way interaction between them. In view of this, two evaluation index systems are constructed respectively, and the development level of urban agriculture and resource and environmental bearing capacity of Nanjing and Shanghai in Yangtze River Delta region from 2007 to 2018 is measured, and the interaction between them is discussed by using coupling coordination degree model. Based on the conclusions, the paper puts forward some suggestions, which can provide useful reference for promoting the high-quality economic development and improving the urban ecological environment.

2. Coordinated Promotion Mechanism of Urban Agricultural Development and Resources and Environment Carrying Capacity

Urban agriculture is a modern agriculture with multiple functions of production, economy, society and ecology, which is closely related to the carrying capacity of resources and environment.

On the one hand, regional resources and environment is an important support for the development of agriculture in surrounding cities, which provides the source of production factors for its development. The development of urban agriculture depends on the natural endowments of the surrounding cities in the region. At the same time, it uses the location advantages, capital and labor factors to develop. The change of environmental capacity and resource carrying capacity of urban agriculture determines the structure and level of urban agriculture development.

On the other hand, the scientific and orderly development of urban agriculture provides an effective guarantee for the carrying capacity of resources and environment. First, the development of urban agriculture can improve the carrying capacity of urban resources. The development of urban agriculture is not only an important factor to ensure household food security, but also an effective way to change the traditional mode of production and improve the efficiency of resource utilization. Second, urban agriculture plays an important role in urban

environmental capacity through its ecological function. Urban agriculture not only integrates regional resources to provide agricultural and sideline products for cities, but also plays an important role in environmental improvement.

The development spillover effect of urban agriculture promotes the growth of regional green economy, which is embodied in the following aspects: first, network effect. With the popularity of the Internet, the number of network interfaces is increasing year by year. With the help of the Internet, urban agriculture shows the nature of increasing marginal revenue and decreasing marginal cost, which makes it possible for urban agriculture to maximize profits through the network. Through a virtuous cycle of reasonable taxation, increasing employment opportunities and improving product quality, urban agriculture can increase regional GDP and promote green economic growth. Second, the long-term effect. The progress of science and technology promotes the emergence of urban agriculture, and the development of urban agriculture will also promote the innovation of science and technology, which will further increase the regional green economy. Therefore, the effect of urban agricultural development on green economic growth is long-term and stable. Third, demonstration and competition effect. Digital products are often the achievements of enterprises with the help of digital technology. These enterprises have innovative thinking and advanced means, so they become the benchmark of the industry and play a leading role in demonstration. In order to ensure the competitiveness of their products and take full account of the environmental advantages, it will cause competition within the entity sector, and greatly stimulate the enthusiasm of enterprise innovation. Urban agriculture can not only directly promote the development level of regional green economy, but also indirectly affect China's economy by influencing the level of education, foreign investment and financial system. The emergence of urban agriculture has attracted a large number of foreign investment, created conditions for the import and export of foreign-invested enterprises, become the engine of economic development, and improved China's economic level. Starting from the connotation of urban agriculture, human capital is an important part of it. Urban agriculture promotes the development of education and provides a steady stream of high-quality talents for China's economic construction. The upgrading of human resources can also greatly enhance regional GDP and promote green economic growth.

3. Research Methods and Data Sources

3.1. Index System Construction and Comprehensive Development Level

Referring to the existing research results [6], based on the development situation and practical operability of the two cities, nine secondary indicators are selected as the evaluation index system of urban agricultural development level of the two cities; Seven secondary indicators are selected as the evaluation index system of resource and environment carrying capacity of the two cities (Table 1). The relevant measurement data mainly come from China Urban Statistical Yearbook, Nanjing statistical yearbook and Shanghai Statistical Yearbook.

According to the current research level, there are two methods of data weighting, the first is subjective weighting method, the second is objective weighting method. Both of them have their own advantages and disadvantages. The subjective weighting method is simpler and easier to adjust, but it lacks certain objectivity. The objective weighting method is more objective. Subjective weighting method means that people mainly estimate the weight of each index according to their psychological subjective feelings. Objective weighting method refers to weighting the indicators according to the amount of information provided by each indicator. Subjective weighting method is mainly based on the subjective judgment of researchers. To some extent, it is subjective and does not fully rely on the original data.

Referring to the analysis method of Xing Ying et al., the entropy method is used to calculate the index weights of Nanjing and Shanghai urban agricultural development and resource and

environment carrying capacity. Before the analysis of the data, considering the different data units, there are large differences in the order of magnitude, the data will be standardized, because the indicators used in this paper are very large indicators, consider the use of standardized processing, and then after the standardized processing of the data. The weight of digital economy index calculated by entropy method is shown in Table 1, and then the comprehensive development level is measured, which are expressed as $f(x)$ and $F(y)$ respectively.

Table 1. Evaluation index system of urban agricultural development and resources and environment carrying capacity

System layer	Element content	Target layer		Specific indicators	Index layer		effect
		Nanjing	Shanghai		Nanjing	Shanghai	
Urban agricultural development system	Production function x1	0.4241	0.4337	Total agricultural output value x 11 (ten thousand yuan)	0.1219	0.0759	Positive
				Per capita disposable income of farmers X12 (yuan)	0.1369	0.1313	
				Total power of agricultural machinery per unit area x13(104kW.h/10 ³ hm ²)	0.1653	0.2265	
	Social function x2	0.2383	0.2404	Output value of agricultural service industry x21	0.1131	0.1233	Positive
				Income gap between urban and rural residents x22	0.1251	0.1172	
				Per capita public green space area x31(m ²)			
	Ecological function x3	0.3376	0.5952	Fertilizer application intensity x32(t/103hm ²)	0.1194	0.1313	Positive
				Proportion of environmental protection investment in GDP x33	0.0439	0.0789	Negative
				Road area per capita y11(m ²)	0.1743	0.1156	Negative
Resources and environment carrying capacity system	Environmental capacity y1	0.6451	0.4048	Green coverage rate of built-up area y12(%)	0.1139	0.1722	Positive
				Total supply of LPG y13(T)	0.2647	0.0882	
				Sewage daily treatment capacity y14(104t)	0.1598	0.0809	
	Resource carrying capacity y2	0.3549	0.5952	Population density y21(person/km ²)	0.1067	0.0635	Positive
				Per capita domestic power consumption in urban and rural areas y22(kw.h)	0.0532	0.3515	
				GDP per capita y23(yuan)	0.1354	0.1028	

3.2. Coupling Degree and Coupling Coordination Degree Model

In order to clarify the nature and extent of the interaction between urban agricultural development and resources and environment carrying capacity, the coupling degree model of the two systems is constructed.

$$C = 2 \times \left\{ \frac{f(x) \times f(y)}{\prod [f(x) + f(y)]} \right\}^{\frac{1}{2}} \quad (1)$$

Where C is the coupling degree of the two systems; $F(x)$ and $f(y)$ respectively represent the comprehensive development level of urban agricultural development and resources and environment carrying capacity. Furthermore, in order to identify whether there is pseudo coordination between urban agricultural development and resources and environment

carrying capacity, and to clarify the specific coordination degree of the interaction between the two systems in different years, a coupling coordination degree model is introduced.

$$D = (C \times T)^{1/2}, \quad T = \alpha f(x) + \beta f(y) \quad (2)$$

Where, D is the coupling coordination degree of urban agricultural development and resources and environment carrying capacity; T is the comprehensive development index of the two systems, α , β The Contribution Coefficients of urban agricultural development and resources and environment carrying capacity are given α , β All values are assigned to 0.5. Referring to the widely used "quartering method" [7], the coupling coordination degree is divided into four different intervals according to the value of 0-1, as shown in Table 2.

Table 2. Classification of coupling coordination degree

Coordination degree interval	Coupling coordination state	Coordination degree interval	Coupling coordination state
$D \in [0, 0.3]$	Low level coordination	$D \in [0.3, 0.5]$	Antagonistic stage
$D \in [0.5, 0.8]$	Coupling stage	$D \in [0.8, 1]$	Highly coupled

4. Analysis on Coupling Degree and Coupling Coordination Degree of Urban Agricultural Development and Resources and Environment Carrying Capacity in Two Cities

The overall development level of urban agriculture in Nanjing and Shanghai is in a fluctuating upward trend. The coupling degree C between urban agriculture development and resources and environment carrying capacity in Nanjing rises steadily, while the coupling degree C between the two systems in Shanghai fluctuates slightly, roughly maintained at 0.87-0.99 (Table 3). This shows that the interactive relationship between urban agricultural development and resources and environment carrying capacity of the two cities exists and continues to optimize in this study period; From the overall trend of the coupling degree of the two systems, the interaction between the two systems will continue, but restricted by the development of each subsystem, the coupling degree of the two systems will improve slowly. From the coupling coordination degree D of the two cities and two systems, we can know that the coupling coordination degree of the two systems in Nanjing shows a steady growth trend. From the whole investigation period, the coupling coordination degree D of the two systems in Shanghai is higher than that in Nanjing.

Table 3. Comprehensive level and coupling coordination of urban agricultural development and resources and environment carrying capacity of the two cities from 2007 to 2018

year	f(x)		f(y)		C		D		Coupling coordination level	
	Nanjing	Shanghai	Nanjing	Shanghai	Nanjing	Shanghai	Nanjing	Shanghai	Nanjing	Shanghai
2007	0.0347	0.1853	0.3994	0.5438	0.5424	0.8708	0.3431	0.5634	Antagonism stage	coupling stage
2008	0.0618	0.2233	0.4730	0.5371	0.6396	0.9109	0.4136	0.5885		
2009	0.1533	0.3080	0.2773	0.4725	0.9577	0.9775	0.4541	0.6176		
2010	0.2106	0.3431	0.3401	0.4289	0.9719	0.9938	0.5173	0.6193		
2011	0.3416	0.3909	0.3529	0.4125	0.9999	0.9996	0.5892	0.6337		
2012	0.3998	0.4355	0.3309	0.4125	0.9955	0.9996	0.6031	0.6510		
2013	0.5498	0.5052	0.4130	0.4364	0.9899	0.9973	0.6903	0.6852		
2014	0.6153	0.6552	0.4189	0.2479	0.9818	0.8925	0.7125	0.6348		
2015	0.7070	0.4480	0.4644	0.2982	0.9783	0.9796	0.7569	0.6046		
2016	0.8477	0.6028	0.5554	0.3589	0.9781	0.9673	0.8283	0.6820		
2017	0.8865	0.7028	0.6057	0.3913	0.9821	0.9586	0.8560	0.7242		
2018	0.9590	0.7861	0.6925	0.4167	0.9869	0.9517	0.9027	0.7565		

5. Policy Suggestions

Combined with the above research conclusions and the development characteristics of the two cities, the following suggestions are put forward:

Based on the local resources, we should scientifically plan the development pattern of urban agriculture. The spatial spillover effect of big data and other information technology driving green development is worthy of attention. It is not the best way to optimize the green development effect of regional information technology only by local "closed door" development. It is more effective for each region to learn from each other. To face up to and make full use of the differences in technology, talent and resource endowment in the eastern, central and western regions of China, first of all, we should give full play to the leading role of regions with high development level of information technology, promote regional technology exchange and innovation cooperation, and encourage information technology talents to gather locally, so as to provide a solid talent reserve for the innovation and application of local digital information technology; The regions with slow digital development speed should actively undertake the emigration industries from the neighboring advanced regions, accumulate talents, technology and other resources for their own development, keep up with the economic trend of digital green development, actively adapt to the trend of industrial digital upgrading, respond to the high-quality development essence of green saving, and create conditions for the growth and quality improvement of local urban agricultural development. At the same time, all regions should rely on the local resource endowment, highlight the advantage of regional concentration, give consideration to the coordinated development of the three industries, and give play to the link role of urban agriculture in optimizing the coordinated development of urban economy and ecosystem.

Build green production system to ensure the sustainable development of urban agriculture. We should actively respond to the national strategy of developing agriculture through science and technology, green and quality, and accelerate the innovation and achievement transformation of digital green technology. Promote the achievement and operation of the industry university research cooperation mechanism with universities and research institutes as the core and enterprises as the carrier, grasp the forefront of global information technology, realize the breakthrough of key technology innovation, adapt to the economic situation, play a market-oriented role, promote the application of digital green technology in the actual production, and realize the transformation of achievements; In the urban agricultural industry chain, enterprises should make rational use of the advantages of big data analysis, cloud computing and other information technology to tap the market demand and its changing trend, subvert the passive form of traditional industry chain that supply precedes demand, capture consumer preferences in time and apply them to the resource allocation in the production process, so as to save the cost caused by information asymmetry in the production and marketing process, The green development effect of urban agriculture can be promoted from the aspect of factor ration of production market.

We will increase policy support and encourage the standardization of urban agriculture. Firstly, we should speed up the improvement of urban agricultural development rules and regulations, promote the standardization and standardized operation of green economy system, and timely and effectively guide the transformation of traditional agriculture around the city to digital agriculture; Secondly, we should increase the government financial support for digital green industry, advocate the enterprise behavior of using green technology to reduce production costs and market transaction costs, give appropriate rewards to the practice of green production of urban agricultural industry chain, and give certain promotion and publicity to digital consumption behavior, so as to escort the demand side market of digital urban agriculture; In addition, we should improve the intellectual property protection policies in

related fields, protect the legitimate rights and interests of enterprises that research and apply related advanced technologies, and stimulate the enthusiasm of enterprises for independent innovation; Finally, we should actively promote the construction and popularization of smart infrastructure, optimize the digital environment of urban agriculture, and provide hardware basis for the green development effect of urban agriculture driven by information technology.

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