

The Coupling and Coordination and Orientation Selection of Green Finance and Green Agriculture Development in Anhui Province

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Abstract: In recent years, China has continuously introduced policies and measures to solve the problems of agriculture, rural areas and farmers, improve people's livelihood, and enhance farmers' happiness. Green agriculture and green finance system are both dynamic, open and relatively complex integrated systems, which promote and interact with each other. The index system based on the development of green agriculture and green finance is established, using the entropy method and coupling coordination model, the comprehensive index of the development of green agriculture and green finance in Anhui Province, and the coupling degree and coupling coordination degree between the two systems are calculated. The research suggests that we should increase the policy support for the coordinated development of green agriculture and green finance, and accelerate the feasible path of the development of Anhui province.

Keywords: Green agriculture, Green finance, Entropy evaluation method, Coupling coordination.

1. Introduction

In his report to the 19th National Congress of the Communist Party of China, General Secretary Xi formally put forward the rural revitalization strategy, stressing that solving problems concerning agriculture, rural areas and farmers is the top priority in the work of the whole Party, giving priority to agricultural and rural development, and accelerating the modernization of agriculture and rural areas. In 2018, the CPC Central Committee 1 document proposed green development of agriculture and rural areas for rural revitalization, providing a golden opportunity for the development of green finance. In the context of the comprehensive implementation of the CPC Central Committee's rural revitalization strategy, the development of green finance is timely.

The relationship between green agricultural development and financial support has always been the focus and focus of research. Among them, Qiu Dongfang et al, conducted empirical research on agricultural carbon emissions and rural financial support in China by using the coupled coordination degree model. Ma Jiujiu and others believe that supply chain finance is an important means to promote the green development of agriculture. Lei Yao et al, analyzed the mutual promotion relationship between cultivated land quality protection, green finance and green agricultural development. Li Mingxian analyzed the necessity of credit to support the green development of agriculture. Zhou Hongmin pointed out that there is a contradiction between the credit dilemma of agricultural operators and the capital needs of agricultural green development. Jia Li et al, analyzed the important role of product-based agricultural crowdfunding in promoting the green agricultural development. Zhang Wei et al, analyzed the financial guidance mechanism to promote the green development of agriculture from the three dimensions of credit support, insurance guarantee and price protection. Wang Huijun believes that the development of green finance will help to promote the green upgrading of the agricultural industrial structure. Zhang Cheng et al, analyzed the impact

of rural inclusive finance on agricultural industrialization by using spatial measurement model and panel threshold model. Zhang Helin et al, analyzed the impact of digital inclusive finance on high-quality agricultural development. Wang Jinhai et al, analyzed the influence of rural inclusive finance on agricultural modernization in southern Jiangsu province.

To sum up, many scholars have focused on the relationship between finance and agricultural green development, but there is a lack of empirical research on the relationship between agricultural green development and green finance. This paper uses the coupling coordination model of the Anhui agricultural green development and the relationship between green financial empirical analysis, not only helps to promote the green agriculture and green finance in Anhui province, and for regional green finance and green agricultural development reform and innovation, policy orientation and path selection has certain theoretical and practical significance.

2. Organization of the Text

2.1. The great significance of green finance in supporting green agriculture

In recent years, major changes have taken place in China's agricultural and rural development environment, the problems of decreasing quantity and quality of cultivated land coexist, the constraints of agricultural water, soil and other resources are increasingly serious, agricultural non-point source pollution is intensifying, and the degradation of agricultural ecosystem is more prominent. To realize the coordinated, unified and sustainable development of agricultural production and living ecology, and form a spatial pattern, industrial structure, mode of production and way of life that saves resources and protects the environment, it is urgent to build a system of financial support for green agricultural development. In 2017, the No.1 Central Document clearly stated that agricultural supply-side structural reform should be further promoted, and reducing stocking, reducing costs and strengthening weak links are the

main tasks of agricultural supply-side reform. At the present stage, the main problems in China's agricultural development are the prominent structural contradictions and the insufficient effective supply of green agricultural products. Strengthening the weak links mainly refers to increasing the effective supply of high-quality, safe and green agricultural products, which cannot be separated from the healthy and sustainable development of green agriculture in China.

For a long time, in the process of agricultural and rural development, due to the "heavy development light protection, heavy utilization light circulation, heavy production light quality", agriculture is not strong enough, the countryside is not beautiful enough, farmers are not rich enough. Implement the strategy of rejuvenating the country, an urgent need to promote green production mode, strengthen green supply of agricultural products, support characteristic advantage industry bigger and stronger, leading the rural agriculture development, boost rural environment clean, improve rural life happiness index, achieve "thriving industry, ecological livable, local custom civilization, effective governance, rich life" goal. Agriculture is the "big household" of greenhouse gases. According to the report of international research institutions, agriculture releases more than 30% of the total human-made greenhouse gas emissions, and methane emissions account for about 50% of the total methane emissions produced by human activities. At the same time, in the process of agricultural production, grasslands, forests and crops use solar energy to synthesize atmospheric carbon dioxide and water into carbohydrates, and play a role in carbon sink. Green agriculture can reduce carbon dioxide emissions and increase carbon sink through land use changes and land consolidation, and help achieve carbon peak and carbon neutral goals.

2.2. Overview of the study area

Anhui province is located in the northwest of East China,

with complex and diverse landforms, which are divided into: Huaibei Plain, Jianghuai hills, Dabie Mountains, central Anhui Plain and southern Anhui mountains. The north of the Huaihe River is a warm temperate semi-humid climate, and the south of the Huaihe River is a subtropical humid monsoon climate. From north to south, the annual average temperature is more than 14-16 °C, the average temperature in January is 3~3 °C, and in July is 27-28 °C. The average annual precipitation has gradually increased from 700 mm to more than 2000 mm. There are mainly han, Hui, and other ethnic groups. Agriculture and forestry is more developed, more production, coal, iron and steel occupy an important position in the provincial industry, handicraft industry is more developed.

3. Empirical Research

3.1. Construction of green Finance and Green Agriculture index system

Green finance and green agriculture are two systems that are independent and influential. The coupling evaluation index system includes the development level of green agriculture and the implementation degree of green finance. Considering the national strategy, operability and practicality, the evaluation index system selects the system level, first level index and second level index. Green finance and green agriculture are taken as the system layer, resource utilization, environment friendliness, output efficiency and living security are taken as the first level indicators of green agricultural system, and the total financial volume and industry, green finance and efficiency are taken as the first level indicators of green financial system. The second-level indicators are shown in Table 1.

Table 1. Construction of green agriculture and green Finance index system

system	First indicators	Secondary indicators
Green agriculture system	Resource utilization	Effective irrigation area X1, Grain crop sown area X2, Tap water penetration rate X3
	Environment-friendly	Pesticide use X4, Plastic film area X5, Agricultural plastic film X6, Agricultural fertilizer X7
	Efficient output	Grain output per unit area X8, Forest tending area X9, Total output value of agriculture, Forestry, animal husbandry and fishery X10, Total output of grain crops X11
	Life security	The average salary of agricultural employed personnel X12, The total income of rural residents X13
Green finance system	Financial aggregate and industry	Financial expenditure Y1, Balance of local and foreign currency loans Y2, Amount of stock financing Y3, Insurance income Y4
	Green finance and efficiency	Insurance depth Y5, Comprehensive utilization rate of industrial solid waste Y6, Investment in geological disaster prevention Y7

3.2. Standardized processing and weight calculation of index data

In order to ensure the relative objectivity of the evaluation results, this paper determines the weight of the evaluation indicators of green agriculture and green finance through the entropy value method. The specific calculation process is as follows.

(1) Establish a multi-index data matrix

$$M = A \begin{bmatrix} X_{11} & X_{12} & B & X_{1n} \\ X_{21} & X_{22} & B & X_{2n} \\ C & C & B & C \\ X_{m1} & X_{m2} & B & X_{mn} \end{bmatrix}$$

(2) Due to the differences in the magnitude and magnitude of the index data, it is necessary to standardize the index data:

if for positive indicators, then make:

$$U_j = \left[\frac{X_{ij} - \min(X_j)}{\max(X_j) - \min(X_j)} \right] * 0.9 + 0.1$$

If for the negative indicators, then make:

$$U_j = \left[\frac{\max(X_j) - X_{ij}}{\max(X_j) - \min(X_j)} \right] * 0.9 + 0.1$$

(3) Calculate the proportion and entropy value of each index:

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}} \quad (i = 1, 2 \dots m; j = 1, 2 \dots n)$$

The formula for the entropy calculation is:

$$E_j = -K \sum_{i=1}^m P_{ij} \ln(P_{ij})$$

Among them, the adjustment coefficient is:

$$K = 1 / \ln(m)$$

(4) Determine the difference coefficient and weight of the j

th index: the difference coefficient $g_j = \frac{1 - E_j}{m - E_e}$ among

$$E_e = \sum_{j=1}^n E_j \quad , \quad \text{The index weight is}$$

$$w_j = g_j / \sum_{j=1}^n g_j \quad (j = 1, 2 \dots n)$$

According to the above process, the index weight of green agriculture and green finance in Anhui Province is calculated, as shown in Table 2:

Table 2. Index weights of green economy and green finance in Anhui Province

system	First indicators	Secondary indicators
Green agriculture system	Resource utilization	Effective irrigation area(0.0482), Grain crop sown area(0.1266), Tap water penetration rate(0.0407)
	Environment-friendly	Pesticide use(0.0514), Plastic film area(0.0317), Agricultural plastic film(0.0434), Agricultural fertilizer(0.0672)
	Efficient output	Grain output per unit area(0.0278), Forest tending area(0.0431), Total output value of agriculture, Forestry, animal husbandry and fishery(0.0496), Total output of grain crops(0.0607)
Green finance system	Life security	The average salary of agricultural employed personnel(0.0325), The total income of rural residents(0.0407)
	Financial aggregate and industry	Financial expenditure(0.0502), Balance of local and foreign currency loans(0.0509), Amount of stock financing(0.0629), Insurance income(0.0513)
	Green finance and efficiency	Insurance depth(0.0391), Comprehensive utilization rate of industrial solid waste (0.0350), Investment in geological disaster prevention(0.0470)

3.3. Measurement of the comprehensive Index of Green Agriculture and Green Finance

According to the weight of each index of green agriculture and green finance in Table 2 and the value of each index after standardization, the comprehensive indexes E (X) and E (y) of the development of green agriculture system and green finance system can be measured, including:

$$E(x) = \sum_{i=1}^n w_i X_i, F(y) = \sum_{i=1}^n w_i Y_i$$

The development level of each comprehensive system is proportional to the E (x) and E (y) after quantitative measurement. The larger the quantitative value, the higher the development level of each system, and the lower the versa. The specific value is shown in Table 3.

Table 3. Green Agriculture and Green Finance Composite Index of Anhui Province

Year	2013	2014	2015	2016	2017	2018	2019	2020
E(X)	0.1318	0.1852	0.2614	0.3051	0.3638	0.5333	0.5205	0.5829
E(Y)	0.0903	0.0947	0.1109	0.2174	0.2409	0.2366	0.2087	0.2651

From the developmental index correlation evolution in Table 3, Since 2012 to 2020, the comprehensive index of green agriculture and green finance in Anhui Province has shown a trend of first low and then high, And has consistently maintained a steady growth rate, According to the table, the development level of green finance lags behind the development needs of green agriculture, Although it has been gradually increasing since 2013, But it has never reached a high level, It shows that the development and support of green finance in Anhui province in recent years, The development trend of green finance is looking good, This is also related to the implementation of the green financial system

development plan in Anhui Province in 2016, But Anhui province still needs to vigorously support the development of green finance and green agriculture, Promote its rapid progress. Similarly, it can be seen from Table 3 that the green finance development index continues to be lower than the green economy development index, but the two have maintained steady progress, showing that a benign interactive development mechanism is gradually formed between the two integrated systems.

3.4. Coupled coordination degree model and its measurement

Coupling theory model is draw lessons from the physical method to analyze two or more system interdependence, interaction of a measure, by measuring the coupling coordination between green agriculture and green financial development, can find the interaction between the two systems and influence, determine the two system evolution of disorder and orderly law and the stage, and through the coupling effect to promote the system to a higher degree of coordinated development. The intersystem coupling degree calculation model is as follows:

$$C = \frac{\sqrt{E(x) \times E(y)}}{\sqrt{[E(x) + E(y)]^2}}$$

In the above equation, E (x) and E (y) are the composite indexes of green agriculture and green finance in Table 3, respectively. C indicates the coupling degree, and its value is between 0 and 1. The larger the value is, the higher the coupling degree between the two integrated systems, which means that the development between the systems is more coordinated and orderly. And when $0 < C < 0.3$; $0.3 < C < 0.5$; $0.5 < C < 0.8$, with high degree of coupling; $0.8 < C < 1$ is the highest degree of coupling. Due to the coupling degree can

only show that the interaction between two subsystems and can not reflect the coordinated development of green and green agriculture system and green financial system has certain differences in their development, there may be both levels are low level will still appear the phenomenon of high coupling degree, therefore need to build a coupling coordination model to better measure the green economy and green coupling coordination between the two financial system, the formula is as follows:

$$D = \sqrt{C \times T}, \quad T = \alpha E(x) + \beta F(y)$$

In the above formula, D is the coupling and coordination degree between green agriculture and green finance systems, and C is the coupling degree measured above,

T is the comprehensive coordination index between two systems, α and β are the weight coefficient, $\alpha = \beta = 0.5$ is selected in this paper. When $0 < D < 0.3$, it is moderate or above disorder; when $0.3 < D < 0.5$, it is mild and near disorder; when $0.5 < D < 0.8$, it is in the preliminary and intermediate coordination stage; when $0.8 < D < 1$, it is high and high quality coordination. The relevant data in Table 3 are brought into the calculation formula of coupling degree C and coupling coordination degree D, and the data of coupling degree and coupling coordination degree of green agriculture and green finance in Anhui Province are obtained, as shown in Table 4.

Table 4. Coupling degree and coordination degree between green agriculture and green finance in Anhui Province

Year	2013	2014	2015	2016	2017	2018	2019	2020
C	0.4912	0.4731	0.4573	0.4929	0.4896	0.4614	0.4520	0.4636
Coupling level	Basic coupling							
D	0.2336	0.2573	0.2918	0.3588	0.3847	0.4214	0.4059	0.4433
Coupling coordination level	Moderate or above dysregulation				Mild, near the disorder stage			

In order to make the development and coupling and coordinated evolution trend of green agriculture and green finance in Anhui province more intuitive, the coupling degree

and coordination degree of green agriculture and green finance development in 2013-2020 are now drawn into a line map, as shown in Figure 1.

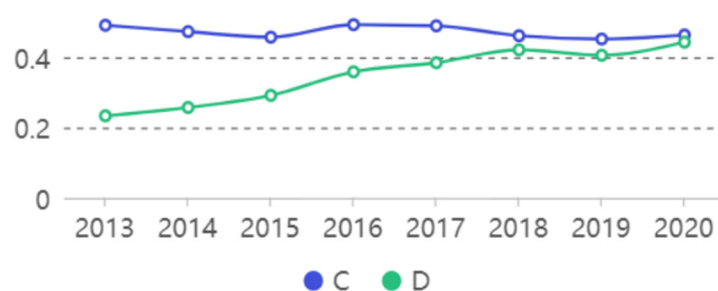


Figure 1. Couple degree of green agriculture and green finance development in Anhui Province from 2013 to 2020

Through Table 4 and Figure 1, it can be found that the coupling development of green agriculture and green finance in Anhui Province from 2013 to 2020 is relatively stable, but it has been in a basic coupling state. Although the coupling degree is increasing and the interaction strength between the two subsystems is increasing, the overall situation has not increased, and the overall coupling degree still needs to be improved. In 2013 to 2015, the coupling coordination degree increased from 0.2336 to 0.2918. However, the development of green agriculture and green finance in Anhui Province was still in moderate or above imbalance, while the coupling coordination degree gradually increased from 0.3588 to

0.44433 in 2020. Although it experienced a small decline in 2019, it was still in the mild and near stage of imbalance. Although Anhui province has not reached a high degree of coupling coordination between green agriculture and green finance, since the development of green finance in Anhui Province, the degree of coupling coordination has been rising continuously, showing a steady trend of coordinated development.

4. Conclusion

As a result, Anhui province in recent years, green

agriculture and green financial development index are overall upward trend, and gradually formed the coupling between two systems the coordinated development situation, especially in 2016 in Anhui province since a series of environmental protection and green financial policy, green agricultural comprehensive index and green financial index are larger growth, Anhui support of green finance, green agriculture policy and system design has begun to release "bonus", makes the green financial innovation and green agriculture development transformation of coordinated development role. But in Anhui province in 2013-2020 green agriculture and green financial development system between the coupling degree and coupling ^{coordination} is still at a low level, and once stagnant, between two systems has not yet establish significant effective correlation mechanism, thus affects the green agriculture and finance to a higher stage of interaction coordinated development, Anhui province should further play the existing advantages, swallow the related short board, realize green agriculture and green finance to good quality coupling coordination stage development.

Acknowledgment

This work is supported by Anhui University of Finance and Economics college students innovation and entrepreneurship

training program, Project number: X202210378062.

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