ISSN: 2710-0588

Research on the Impact of Green Finance on the Development of Ecological Agriculture in China

Yue Yu[1, a], Deyu Li[2, b, *]

[1]School of Finance, Anhui University of Finance and Economics, Bengbu, Anhui, 233030, China

[2]School of Economics, Anhui University of Finance and Economics, Bengbu, Anhui, 233030, China

[a]2124251917@qq.com, [b, *]ldy0048@163.com

Abstract

Green finance plays a positive role in promoting the development of ecological agriculture in China. In order to explore the relationship between green finance and the development of ecological agriculture in China, the article analyzes the relationship between green finance and the development of ecological agriculture in 2017-2021 by constructing two systems of green finance and the development level of ecological agriculture, using the entropy weight method and coupling model, respectively, with the help of the evaluation indicators to measure the development level of green finance and the development level of ecological agriculture. The results show that: (1) the development level of green finance and ecological agriculture is on the rise, but the development level of green finance is lower than the development level of high-quality agriculture; (2) The coupling degree of green finance and ecological agriculture development shows an upward trend on the whole, which confirms that the relationship between the two is increasingly close, and there is a large space for coupling. (3) The coordination degree of green finance and ecological agriculture development is generally high, which indicates that the two are relatively coordinated internally, and further indicates that there is an internal relationship between green finance and ecological agriculture development.

Keywords

Green Finance; Ecological Agriculture; Evaluation Indicators; Entropy Weight Method; Coupling Model.

1. Introduction

As China is steadily moving forward on the path of sustainable development, the new form of the financial industry is also developing in the direction of green finance, and the traditional agricultural model is also gradually transforming to the new ecological agricultural model. In the new era, the traditional agricultural production model in the past can no longer adapt to the rapid development of society, and the production efficiency brought by the traditional agricultural production model can not meet the needs of society. This requires that the traditional agricultural development model be transformed into a new ecological agricultural model as soon as possible to avoid the production model with high energy consumption, high pollution and low efficiency in the past. To achieve this goal, we need not only policy support, but also the promotion of external social forces. The external capital provided by the financial industry plays a mainstay role in it, and the main support object of green finance is the development goal of green economy, such as ecological agriculture. Therefore, the impact of green finance on the development of ecological agriculture in China is an important indicator

ISSN: 2710-0588

for the adjustment of China's agricultural development and green finance development policies in the next stage.

Throughout the relevant documents, most of them are based on the relationship between green finance and green economy. Only a few of them have paid attention to the impact of green finance on the development of ecological agriculture. As an important part of green economy, ecological agriculture is of great value for exploring the impact of green finance on the sustainable development of agriculture. Based on this, this paper constructs two systems of green finance and ecological agriculture development level, and uses entropy weight method and coupling model to obtain the correlation degree between green finance and ecological agriculture development with the help of evaluation indicators to measure the development level of green finance and ecological agriculture.

2. Literature Review

2.1. The Connotation of Green Finance

There is no unified definition of the connotation of green finance in China's academia. Gao Jianliang (1998) understood green finance as the financial business of the financial sector on green projects, and could achieve the goal of promoting environmental protection and coordinated economic development through this new type of financial business [1]; Deng Xiang (2012) believes that the purpose of green finance is to provide support for sustainable development, and help realize the goal of common development of economic society and ecological environment with the help of green financial tools [2]; He Qian (2021) also understood green finance as a financial operation strategy to guide the rational and effective allocation of social resources through the operation of financial business, thus promoting environmental protection and sustainable economic development [3]; He Jiankui et al. (2006), in addition to considering financial institutions and natural ecology, added the role of green finance development in economic development itself [4]; Li Xiaoyan (2007) understood green finance as a specific process, which measures the environmental or economic value and applies the calculation results to the evaluation of various financial activities [5].

2.2. Connotation of Ecological Agriculture

In China, the concept of "ecological agriculture" was first formally put forward by Professor Ye Qianji in 1982. Academician Ma Shijun was the first to give the concept of the connotation of ecological agriculture. Ma Shijun et al. (1987) pointed out in the book "Agricultural Ecological Engineering in China" that ecological agriculture is the application of ecological engineering in agriculture. It uses the biological symbiosis and material recycling regeneration principle of the ecosystem, combines the system engineering method and modern scientific and technological achievements, and reasonably combines the proportion of agriculture, forestry, animal husbandry, fishing and processing according to local natural resources, An agricultural production system that maximizes economic, ecological and social benefits [6]. Academician Ma Shijun's explanation of ecological agriculture is more detailed, which is defined from the specific agricultural activities involved in ecological agriculture. After that, Ye Qianji (1987) defined ecological agriculture as an agricultural development model using ecology, economics, ecological economics and various modern scientific and technological achievements and management methods [7]; Bian Yousheng (2000) believed that "China's ecological agriculture is a comprehensive agricultural production system of multi-level, multi-structure and multi-function intensive management established and developed on the basis of summing up and absorbing the successful experience of various agricultural production practices, according to the principles of ecology and ecological economy, and applying modern scientific and technological methods" [8]; Li Zhou (2004) proposed that ecological agriculture is the unity of

ISSN: 2710-0588

ecological and economic benefits that rely on scientific and technological means and organic fertilizer production to alleviate ecological pressure after the oil agricultural crisis [9]; Luo Shiming (2017) believes that eco-agriculture is a service means to strengthen the eco-agricultural system through a series of ecological research methods with the goal of sustainable development of agricultural production [10].

3. Construction of Evaluation Indicators

3.1. Indicator System for Measuring the Development Level of Green Finance

At present, there are two methods of measuring green finance in academia. They are using a single indicator to measure green finance and building an indicator system to measure green finance.

Regarding the use of a single indicator to measure green finance, Sun Yanlin et al. (2019) took the green enterprises in various provinces and cities as a breakthrough, and used the funds obtained by such enterprises from government departments, financial institutions and various financing means as the data source to measure the development level of green finance in various provinces and cities [11]; Huang Jianhuan et al. (2014) took the credit loans provided by banks for environmental governance activities as a measure of whether they triggered the green financial effect, and took the proportion of the total amount of funds obtained by enterprises through bank credit and other channels to control environmental pollution as a measure of the green financial effect in various regions [12].

The measurement method adopted in this paper is to measure green finance by constructing an indicator system. Zeng Xuewen et al. (2014), in order to reflect the connotation of green finance, selected five second-level indicators such as financial carbon intensity and ten third-level indicators such as the proportion of CDM, and used these indicators to build an indicator system to measure the development level of green finance [13]; Gao Jinjie et al. (2021) also selected five indicators of green credit, green bonds, green investment, green insurance and financial carbon intensity to measure the development level of green finance [14].

Since this study uses five secondary indicators to build an indicator system to measure green finance, the specific accounting content of the five secondary indicators is described in detail below. Li Hong et al; Feng Langang et al. (2022) expressed green bonds through the proportion of the market value of the six energy-consuming industries in the A-share market value [16]; Liu Zi et al. (2022) used the proportion of industrial pollution control investment in GDP to represent green investment, and the proportion of agricultural insurance expenditure in insurance expenditure to represent green insurance [17]; After the calculation method of industry carbon intensity index proposed by Shen Hongtao et al. (2019), the financial carbon intensity of each province is calculated by the ratio of CO2 emissions to RMB loan balance [18].

3.2. Evaluation Index System for Measuring the Development Level of Ecological Agriculture

There is no unified measurement method for the evaluation and measurement of the development level of ecological agriculture in academic circles. Based on the research results of Xu Yijun et al Five secondary indicators: forest coverage, pesticide use intensity and land multiple cropping coefficient; The indicators of economic structure should be specifically measured by four secondary indicators: per capita grain output of farmers, per capita disposable income of farmers, per capita agricultural output value of labor and the proportion of total agricultural output value to GDP; The social production indicators need to measure three secondary indicators: agricultural fixed asset investment, agricultural employment rate and rural household Engel coefficient.

ISSN: 2710-0588

3.3. Specific Contents and Data Sources of the Evaluation Index System

3.3.1. Specific Contents of the Evaluation Index System

The construction of the evaluation index system lays the foundation for the study of the coupling relationship between the two systems, and is also an important tool for analyzing the impact relationship between the two systems. Table 1 shows the specific contents of the evaluation index system of the two systems.

Table 1. Indicators of green finance and ecological agriculture development level

System	First-level indicators	Specific measures
Green finance	Green credit	Proportion of the number of business outlets in each province in the country × National green credit loan balance
	Green bonds	The market value of A-share and A-share in the six energy-intensive industries in each province
	Green investment	Investment completed in industrial pollution control in each province/GDP
	Green insurance	Agricultural insurance expenditure/total insurance expenditure
	Financial carbon intensity	CO2 emissions/RMB loan balance
Ecological agriculture	Ecosystem	Effective irrigation rate: effective irrigation area/total cultivated area
		Fertilization amount per unit cultivated land: fertilizer application amount/total cultivated land area
		Forest coverage: forest area/total land area
		Pesticide use intensity: pesticide use/total planting area of crops
		Land multiple cropping coefficient: total sown area of crops/total cultivated area
	Economic structure	Per capita grain output of farmers: total grain output/number of farmers
		Per capita disposable income of farmers: total disposable income of farmers/total number of people
		Average agricultural output value per worker: agricultural output value/number of agricultural employees
		Proportion of total agricultural output value to GDP: agricultural output value/GDP
	Social production	Investment in agricultural fixed assets: investment in agricultural fixed assets
		Agricultural employment rate: number of agricultural employees/total number of employees
		Engel's coefficient of rural households: expenses directly spent by rural people on food/total expenditure of rural people

3.3.2. Data Source

Referring to the data collection method of Zhang Yan (2020), the data source area is 34 provinces and cities across the country, and the data of 34 provinces and cities from 2017 to 2021 is selected as the study area. Data sources include China Banking Social Responsibility Report, China Insurance Yearbook, China Environmental Statistics Yearbook, China Rural Statistics Yearbook, China Statistical Yearbook and China Ecological Agriculture Journal.

ISSN: 2710-0588

4. Research Methods

4.1. Measurement of Green Finance and Ecological Agriculture Development Level based on Entropy Weight Method

(1) Data preprocessing. There are five first-level indicators in the green financial system, of which green bonds and green investment are negative indicators, and the other indicators are positive indicators; There are 3 primary indicators and 12 secondary indicators in the eco-agricultural system, of which the amount of fertilizer applied per unit of cultivated land, the intensity of pesticide use and the Engel coefficient of rural households are negative indicators, and the other indicators are positive indicators. At the same time, in order to eliminate the impact of different indicator dimensions, it is necessary to set the value range of each value to [0,1], and first preprocess the data. If the indicator is positive, it is:

$$y_{ij} = \frac{x_{ij} - x_{ijmin}}{x_{ijmax} - x_{ijmin}} + 0.01 \tag{1}$$

If the indicator is negative, it is:

$$y_{ij} = \frac{x_{ijmax} - x_{ij}}{x_{ijmax} - x_{ijmin}} + 0.01 \tag{2}$$

Where: $x_{ij}$is the average value of the indicator data of a unit in 34 provinces and cities in a certain year, and the calculation formula is $x_{ij} = \frac{x_1 + x_2 + \cdots + x_{34}}{34}$, x_{ijmax} is the maximum value, x_{ijmin} is the minimum value.

(2) Entropy weight method. In this study, the entropy weight method is used to determine the weight of each indicator in the green finance and ecological agriculture systems. According to the above data preprocessing, matrix Y is obtained. Calculate the weight of the ith sample under the jth index:

$$q_{ij} = \frac{y_{ij}}{\sum_{i=1}^{n} y_{ij}} \tag{3}$$

Calculate the information entropy of the jth index:

$$w_j = -\frac{\sum_{i=1}^{n} q_{ij} \ln q_{ij}}{\ln n}, (j = 1,2, \dots, n) \tag{4}$$

Where: n represents the number of indicators

Then normalize the information entropy value to get the weight of each index:

$$Z_j = \frac{w_j}{\sum_{i=1}^{n} w_j}, (j = 1,2, \dots, n) \tag{5}$$

Finally, sum the product of each index value and the corresponding weight by using the linear weighted summation method to obtain the scores of the two systems:

$$M_{ij} = \sum_{i=1}^{n} Z_j \cdot q_{ij} \tag{6}$$

4.2. Correlation Analysis of Green Finance and Ecological Agriculture Development based on Coupling Model

(1) Coupling correlation degree. The coupling correlation degree can reflect the correlation between green finance and the development level of ecological agriculture. In this study, the final score of the two systems obtained by the linear weighted summation method is used to build a coupling correlation model and analyze the coupling correlation degree between the two systems

$$\alpha = \frac{\sqrt{ab}}{a+b} \tag{7}$$

Where: a and b represent the scores of green finance and ecological agriculture development level respectively. When coupling correlation degree α The greater the correlation between the

ISSN: 2710-0588

two systems. Referring to the research results of Liu Shuru et al. (2019) [23], the correlation level of coupling is divided into six stages, as shown in Table 2:

Table 2. Classification and characteristics of coupling correlation degree

Coupling co-dispatch interval	Coupling level	Features
$\alpha = 0$	No relationship	The elements in the system are almost independent
$0 < \alpha \leq 0.3$	Low level coupling	Low level of coupling between systems begins to occur
$0.3 < \alpha \leq 0.5$	Antagonistic stage	Interaction between systems begins to occur, and communication between elements is realized.
$0.5 < \alpha \leq 0.8$	Running-in stage	There is a benign coupling state between systems.
$0.8 < \alpha \leq 1$	High level coupling	There is complete coupling between systems.
$\alpha = 1$	Benign resonance coupling	The coupling degree reaches the highest value, and all elements are in benign resonance coupling.

(2) Coupling co-scheduling. The purpose of calculating the coupling coordination degree is to prevent the occurrence of extreme situations such as excessive development of one system in the green finance and ecological agriculture systems, resulting in severe extrusion of the other system, so as to obtain the coordinated development between the two systems. The comprehensive coordination index T of green finance and ecological agriculture development is:

$$T = \gamma a + \delta b$$

Including: γ, δ Respectively indicate the importance of green finance and ecological agriculture development.

Finally, the coupling co-scheduling between the two systems is obtained β:

$$\beta = \sqrt{\alpha \cdot T}$$

Including: α is the coupling correlation degree, β is coupling co-scheduling, β∈[0,1], and the higher the value of β, the higher the coordination between the two systems.

Referring to the coupling coordination model built by Wang Cheng et al. (2018) [24], it is divided into five parts, as shown in Table 3:

Table 3. Classification and characteristics of coupling coordination degree

Coupling co-dispatch interval	Coupling level	Features
$0 < \beta \leq 0.2$	Serious disorder	The development speed of ecological agriculture is too fast, and the development speed of green finance cannot adapt, and the two are not coordinated.
$0.2 < \beta \leq 0.4$	Moderate disorder	The development of ecological agriculture is still dominant, but the development level of green finance is gradually improving.
$0.4 < \beta \leq 0.5$	Basic coordination	The development speed of ecological agriculture has slowed down, and the development speed of green finance has gradually increased, and the gap between the two has gradually decreased.
$0.5 < \beta \leq 0.8$	Moderate coordination	The development of green finance has begun to promote the development of ecological agriculture, and the development level of green finance is still improving steadily.
$0.8 < \beta \leq 1$	Highly coordinated	The development of green finance and ecological agriculture can promote each other and meet the requirements of different stakeholders.

ISSN: 2710-0588

5. Empirical Research Results

5.1. There is a Certain Link between Green Finance and the Development of Ecological Agriculture

The weight of each indicator is determined by the entropy weight method, and the average comprehensive score of green finance and ecological agriculture development in 34 provinces of the country is calculated, which represents the comprehensive score of the country.

According to the score curve of the development level of green finance in China, the development level of green finance in the whole country is on the rise. Although there was a relatively obvious decline in 2019, it was gradually recovering. In 2021, the development level of green finance will rise rapidly and catch up with the previous years. Therefore, on the whole, the development trend of green finance in China in recent years is still upward.

From the national average curve of ecological agriculture development, the development of ecological agriculture is increasing year by year, especially in 2018-2019. The growth rate from 2019 to 2020 is relatively slow down due to the impact of the COVID-19 epidemic, but it is still in the growth stage. On the whole, the development trend of China's ecological agriculture in recent years is also upward.

Specifically, the development level of green finance and ecological agriculture in China in 2017-2018 was very fast, and the development speed of both was slowed down in 2019-2020. Therefore, it can be inferred that there is a certain impact relationship between the development of green finance and ecological agriculture in China.

5.2. The Coupling Degree of Green Finance and Ecological Agriculture Development is on the Rise as a Whole

It can be seen from Figure 2 that the coupling degree of the two systems (that is, the coupling correlation degree), except for a slight decline in 2019-2020, is in a steady increase in the rest of the years, and has a more significant increase in 2020-2021 compared with the other years. The coupling degree of the two systems in the five years 2017-2021 $\alpha \in [0.392,0.651]$, is in the stage of antagonism and running-in. Since 2018, the coupling degree is greater than 0.5, and the two systems have entered the running-in stage, showing a benign coupling state. In recent years, the coupling degree of green finance and ecological agriculture development in China has been steadily increasing on the whole, and the rising speed is also increasing. At the same time, with the increase of coupling degree, the relationship between green finance and the development of ecological agriculture is becoming closer and closer.

5.3. The Coordination between Green Finance and Ecological Agriculture is Generally High

From the perspective of development trend, the coordination degree of the two systems is generally stable in 2017-2021, and the development trend of coordination degree and coupling degree of the two systems is almost the same. In 2017-2019, coordination degree and coupling degree increased steadily, in 2019-2020, coordination degree and coupling degree decreased synchronously, and in 2020-2021, coordination degree and coupling degree rose synchronously. From the level of development, the degree of coordination $\beta \in [0.813,0.923]$, in a highly coordinated stage, the development of green finance and ecological agriculture can promote each other and meet the requirements of different stakeholders. Therefore, in recent years, the coordination between green finance and ecological agriculture in China is generally high.

ISSN: 2710-0588

6. Conclusion

This paper analyzes the relationship between national green finance and ecological agriculture development in 2017-2021 by constructing two systems of green finance and ecological agriculture development level, using the entropy weight method and the coupling model, and draws the following conclusions. (1) The development level of green finance and ecological agriculture is on the rise, but the development level of green finance is lower than that of high-quality agriculture; (2) The coupling degree of green finance and ecological agriculture development shows an upward trend on the whole, which confirms that the relationship between the two is increasingly close, and there is a large space for coupling. (3) The coordination degree of green finance and ecological agriculture development is generally high, which indicates that the two are relatively coordinated internally, and further indicates that there is an internal relationship between green finance and ecological agriculture development.

References

[1] Gao Jianliang "Green finance": a new financial operation strategy [J]. Yunnan Finance, 1998 (1): 21-22.

[2] Deng Xiang. Review of green finance research [J]. Journal of Central South University of Economics and Law, 2012 (06): 67-71.

[3] He Qian. The origin, development and global practice of green finance [J]. Journal of Southwest University (Social Science Edition), 2021 (1): 83-94.

[4] He Jiankui, Jiang Tong, Wang Wenli "Green finance" and sustainable economic development [J]. Ecological Economy, 2006 (07): 78-81.

[5] Li Xiaoyan, Wang Linping, Zheng Hairong. Comparison of green finance and its related concepts [J]. Science and Technology and Industry, 2007 (7): 82-85.

[6] Ma Shijun, Li Songhua. Agricultural Ecological Engineering in China [M]. Beijing: Science and Technology Press, 1987:1-9.

[7] Ye Qianji. Strategic issues of ecological agriculture development [J]. Journal of Southwest Agricultural University, 1987,9 (1): 1-8.

[8] Bian Yousheng. Comparison of ecological agriculture at home and abroad - theory and practice [M]. China Environment Press, 2000.

[9] Li Zhou. Economic principles of ecological agriculture [J] Journal of Yunnan University (Social Science Edition), 2004 (2): 44-54.

[10] Luo Shiming. The situation of agro-ecological transformation and the path of China's eco-agricultural construction. Journal of China's Ecological Agriculture, 2017,25 (1): 1-7.

[11] Sun Yanlin, Chen Qingqing. The impact of green finance development on technological progress and economic growth -- an empirical study based on PVAR model [J]. Finance and Economics, 2019, (05): 28-33.

[12] Huang Jianhuan, Lv Hailong, Wang Liangjian. The mechanism of financial development affecting regional green development - based on ecological efficiency and spatial measurement [J]. Geographic Research, 2014,33 (03): 532-545.

[13] Zeng Xuewen, Liu Yongqiang, Man Mingjun, Shen Qilang. Measurement and analysis of the development of green finance in China [J]. Journal of China Yan'an Cadre College, 2014,7 (06): 112-121+105.

[14] Gao Jinjie, Zhang Weiwei. Research on the impact of green finance on the ecological of China's industrial structure: an empirical test based on the system GMM model [J]. Economic Review, 2021 (2): 105-115.

[15] Li Hong, Zhao Qianqian. Green finance, technological progress and environmental quality: an empirical study based on intermediary effect [J]. Regional Finance Research, 2021 (10): 5-11.

ISSN: 2710-0588

[16] Feng Langang, Yang Wenli, Zhao Qing. Statistical test of the effect of green finance on industrial pollution [J]. Statistics and Decision, 2022 (6): 144-149.

[17] Liu Zi, Fan Qiufang, Wang Yanli. Research on China's provincial green finance, clean energy and ecological sustainable co-financing and sharing development and spatial connection network [J]. New Finance, 2022 (3): 48-56.

[18] Shen Hongtao, Huang Nan. Can carbon emission trading mechanism improve enterprise value [J]. Finance, Trade and Economics, 2019 (1): 144-161.

[19] Xu Yijun, Ren Murong. Construction and evaluation of evaluation index system of modern agriculture in Hunan [J]. Journal of Hunan Agricultural University, 2008, (4): 38-44.

[20] He Xiaorong, Huang Dongming. Empirical study on the integration and coordination of tourism and agricultural industries in Hunan [J]. Journal of Central South Forestry University (Social Science Journal), 2018, v12; No.68(03): 67-72+79.

[21] Wang Baoyi. Evaluation, analysis and countermeasure selection of China's agricultural ecological development [D] Shandong Agricultural University, 2018.

[22] Zhang Yan Research on the coupling development of eco-agriculture and tourism in Hunan Province [D]. Hunan Agricultural University, 2020.

[23] Liu Shuru, Wei Xiaoxiao, Measurement of the coordinated development of new urbanization and industrial structure in the new era [J] Hunan Social Sciences, 2019 (01): 88-94.

[24] Wang Cheng, Tang Ning. The spatiotemporal characteristics and pattern evolution of the spatial function coupling and coordination of the three rural residents in Chongqing [J]. Geographic Research, 2018(6): 1100-1114.