

Study on Agricultural Investment Efficiency of Anhui Province Based on DEA-BCC Model

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Abstract: Based on the analysis of the current situation of agricultural investment and the DEA-BCC model, this paper calculates the agricultural investment efficiency of 16 prefecture-level cities in Anhui Province in 2021. The results show that the overall agricultural investment efficiency of Anhui Province is low, the investment scale is unreasonable, the development gap between Southern Anhui, Northern Anhui and Central Anhui is large, and the coordinated development of agriculture has not been realized. Based on this, it is suggested to establish and improve relevant systems, implement supporting policies and strengthen the support of agricultural science and technology, improve the efficiency of agricultural investment, reasonably plan funds, and promote the development of agricultural industrialization and modernization, narrow the development gap between regions, improve agricultural quality and efficiency, and pay attention to regional coordinated development.

Keywords: Agricultural investment, Investment efficiency, DEA.

1. Introduction

Agriculture is not only the foundation of the national economy and the people's livelihood, but also a potential economic growth point. Agriculture is a basic industry. Its production involves the secondary industry and the tertiary industry, which has a strong driving effect on the economy. Among the three major economic growth points of investment, consumption and export, China's economic growth needs to rely on consumption to a large extent, and agriculture plays an important role in the "clothing, food, housing and transportation" consumer industry. At the same time, agriculture is also a very fragile industrial sector. The importance and weakness of agriculture determine that the government must vigorously support and protect agricultural development and take agriculture as the focus of financial investment. Agricultural investment is a fund used to improve agricultural production conditions and develop agriculture. It helps to promote agricultural development and strengthen agricultural economic construction. It is an important condition for realizing agricultural modernization and rural revitalization.

China has shifted from traditional agricultural construction to sustainable agricultural development. With the transition of agricultural policy from paying attention to its own development to the coordinated development of agriculture and the whole economy, it is clearly pointed out that we should comprehensively prosper the rural economy and realize the sustained growth of agricultural investment [1]. The CPC Central Committee and the State Council attach great importance to agricultural investment. In 2020, the Ministry of agriculture and rural areas formulated and issued the guidelines for social capital investment in agriculture and rural areas, which clearly requires social capital investment to enter agriculture and rural areas in an orderly manner. In recent years, a series of policy documents, such as No. 1 central document, Rural Revitalization Strategy issued by the State Run Office, have also made clear demands for agricultural investment. First, in terms of agricultural industry, encourage investment in modern planting and breeding

industry, local characteristic industries and other fields, develop large-scale modern agriculture, build advantageous characteristic agricultural industrial clusters, and promote the integrated development of rural primary, secondary and tertiary industries. Second, in terms of agricultural and rural services, encourage investment in new rural production and living services, develop e-commerce, rural leisure tourism and other service industries, actively participate in the construction of digital agriculture and digital countryside, and improve various agricultural and rural services. Third, in terms of infrastructure construction, encourage investment in infrastructure, ecological circular agriculture and other fields, promote the construction of high-standard farmland and lay the foundation for agricultural and rural modernization. Fourth, in terms of scientific and technological innovation, encourage investment in agricultural scientific and technological innovation, talent training, rural innovation and entrepreneurship, improve innovation ability, participate in key agricultural core technology research actions, and cultivate new drivers of agricultural and rural economic development. In addition to the above directional grasp in the field of agricultural investment, the government has also made plans to improve the docking platforms and innovate the investment and financing mode, so as to improve the efficiency and quality of social capital investment in agriculture and rural areas. On the one hand, agricultural and rural departments at all levels are required to speed up the improvement of docking platforms, build bridges and provide services for social capital to enter agricultural and rural areas, promote the integration of various resource elements, and mobilize the enthusiasm of social investment to turn to agriculture and rural areas. On the other hand, government investment is required to play a good leverage role, innovate the investment and financing mode, and achieve win-win results.

No. 1 central document requires that two basic lines of protection for national food security and no scale return to poverty be maintained, and new progress in rural revitalization and new steps in agricultural and rural modernization are promoted orderly. This is the

programmatic document that must be implemented in Anhui to accelerate the comprehensive revitalization of the countryside [2]. In 2021, Anhui Province scientifically coordinated epidemic prevention and control, earnestly implemented the policy of coordinating urban and rural economic and social development, and continuously optimized the policy environment. The province has paid attention to agricultural and rural development, improved the promotion mechanism, and focused on expanding effective investment, which has provided strong support for economic development and successfully achieved a good start of the 14th five year plan.

Adjacent to the Yangtze River, Anhui has obvious location advantages, rich agricultural resources and a large proportion of agricultural products. It is a typical large agricultural province. The deployment of the 11th Party Congress of Anhui Province and the economic work conference of the Provincial Party Committee require to grasp the key of investment as the economic work, start the battle of effective investment, and give full play to the key role of effective investment in stabilizing economic growth and optimizing supply structure. Agricultural investment is an important factor to promote agricultural economic growth and is of great significance to promote agricultural development [3]. Therefore, a correct understanding of the development environment of agricultural investment in Anhui will help to accelerate the transformation of Anhui from a large agricultural province to a strong agricultural province. In recent years, Anhui has strengthened its investment in agriculture, improved agricultural production conditions, increased output of agricultural products, increased investment in agricultural informatization, and accelerated the process of agricultural digitization. However, there are still problems in agricultural investment in Anhui Province. The unbalanced agricultural investment structure, large development gap between regions and low efficiency of agricultural investment all restrict the sustainable and healthy development of agriculture to a certain extent. Therefore, this paper mainly analyzes the status of agricultural investment in Anhui, the technical environment of agricultural investment and the efficiency of agricultural investment to boost the agricultural development of Anhui.

2. Status of Agricultural Investment in Anhui

With the support of a series of policies and measures, the situation of agricultural investment in Anhui has been improved. The following mainly analyzes the situation of agricultural investment in Anhui from the aspects of the development of agricultural industry in Anhui, the output of main agricultural products, the market sales of agricultural products in Anhui and hot issues.

2.1. Development of Agricultural Industry

(1) Build high standard farmland and improve production conditions. In 2021, 5.6034 million mu of high standard farmland has been built in Anhui Province, with a total area of 55.1 million mu, accounting for 62.4% of the cultivated land. The production conditions have been significantly improved, and the ability to resist and reduce disasters has been significantly improved, further promoting the high-quality development of agriculture. The construction of high standard farmland has effectively promoted the large-scale

operation and mechanized development of land, and continuously accelerated the transformation and upgrading of agriculture; It promotes the economical and intensive utilization of agricultural resources, effectively realizes the sustainable utilization of resources, and strives to build farmland into good farmland.

(2) Increase investment attraction and promote the development of agricultural industrialization. The Rural Industry Development Plan of Anhui Province (2021-2025) points out that it is necessary to further strengthen and expand the modern planting and breeding industry, improve the processing and circulation industry of agricultural products, create rural characteristic industries, optimize rural leisure tourism, cultivate new rural service industry and develop rural information industry, so as to promote the high-quality development of the whole industrial chain of rural industry. In recent years, Anhui Province has continued to increase investment and talent attraction, actively promoted the implementation of major projects, introduced foreign enterprises, made every effort to build ten whole industry chains such as wheat, rice and corn, built a green food industry base with an output value of more than 100 billion, and promoted the development of agricultural industrialization. In 2020, the investment in the primary industry in Anhui increased by 34.8%, and in 2021, the investment in the primary industry increased by 39.1%, and the scale of industrial investment continued to expand. In 2021, Anhui Famous Agricultural Products and Agricultural Industrialization Fair signed a large order of 70.7 billion yuan, with a year-on-year increase of 15.5%, covering ten green food industries, ecological leisure, Internet of things, 5G agriculture and other aspects. The contracted projects on rural tourism and leisure agriculture focus on facility agriculture, leisure agriculture and sightseeing agriculture.

(3) The development of agricultural industry is stable. From 2012 to 2021, the added value of primary industry, agriculture, forestry, animal husbandry and fishery in Anhui Province showed a steady upward trend year by year, and the agricultural scale continued to expand. The growth rate of fixed asset investment in the primary industry exceeded 30%, more than 20 percentage points higher than that in the whole country. The primary industry increased from 217.870 billion yuan in 2012 to 336.060 billion yuan in 2021. The growth rate fluctuated steadily between 3% and 5%. The growth rate of the primary industry in 2020 was the lowest in recent ten years. The growth rate of added value of agriculture, forestry, animal husbandry and fishery decreased from 2017 to 2020, which was the lowest in recent ten years, but the growth rate began to pick up in 2021, increasing to 7.40%. The proportion of added value of agriculture, forestry, animal husbandry and fishery in GDP decreased year by year from 11.88% in 2012 to 8.16% in 2018. This shows that in the process of industrialization, the demand of the non-agricultural sector is expanding and developing rapidly, and the share of the agricultural sector in the national economy is decreasing. After 2018, the proportion of added value of agriculture, forestry, animal husbandry and fishery in GDP began to rise, but the increase was small. By 2021, the proportion was only 8.38%, an increase of only 0.22 percentage points.

(4) The contribution rate of the primary industry fluctuated slightly. Industrial contribution rate refers to the ratio of the increment of added value of each industry to the increment of GDP. From 2012 to 2021, the contribution rate of the primary industry basically remained in the range of 3% - 5%, with the

highest contribution rate of 5.4% in 2012. This shows that the contribution rate of agriculture, forestry, animal husbandry and fishery to economic growth in Anhui is not high, and shows a downward trend as a whole over time [4].

2.2. Output of Main Agricultural Products

(1) The output value of agriculture, forestry, animal husbandry and fishery has been increasing. In 2021, the total output value of agriculture, forestry, animal husbandry and fishery in the province reached 600.43 billion yuan, an increase of 9.3% over the previous year. Agriculture increased by 3.4%, forestry decreased by 1.5%, animal husbandry increased by 21.4%, fishery increased by 4.2%, and agriculture, forestry, animal husbandry, fishery and auxiliary activities increased by 8.1%. In the first three quarters of 2021, the output of meat was 3.211 million tons, an increase of 24.6%, of which the output of pigs, cattle, sheep and poultry increased by 42%, 19.8%, 12.1% and 7.9% respectively. At the end of the year, there were 15.825 million pigs in the province, an increase of 11.5% year-on-year, completing the task of stabilizing production and ensuring supply of pigs. The total output of meat, egg and milk was 6.798 million tons, with a year-on-year increase of 10.2%, the output of aquatic products was 2.365 million tons, with a year-on-year increase of 1.8%, the sown area of vegetables increased by 4.5%, the output of vegetables was 30.7738 million tons, with a year-on-year increase of 4.36%, and vegetables and other characteristic agricultural products achieved rapid growth. Characteristic agricultural products also achieved rapid growth, with oil output increasing by 2.9%, of which rapeseed output increased by 6.7%, tea output increased by 8.7%, fruit output increased by 4.9% and sowing area of traditional Chinese medicine increased by 4.9%. Animal husbandry production increased steadily. In 2021, the output of pigs, cattle, sheep and poultry meat in the province was 4.552 million tons, an increase of 15.2%. Pig production capacity increased significantly. In the whole year, 27.978 million pigs were sold, an increase of 30.1%; at the end of the year, the number of pigs was 15.825 million, an increase of 11.5%.

(2) The output of major agricultural products expanded. From 2012 to 2021, the output of main agricultural products in Anhui Province showed an overall growth trend, and the output continued to expand. As the main wheat producing area in China, the first-class wheat in Anhui province accounted for more than 85% in 2021. The market response can also be reflected in the high acquisition enthusiasm and good purchase price of processing enterprises. In 2021, the sown area of grain in the province was 109.644 million mu, an increase of 294000 Mu over 2020. The grain output was 81.75 billion kg, an increase of 1.37 billion kg, reaching a new high, achieving a bumper harvest for consecutive years, accounting for 5.1% of the national increment. The total amount ranked fourth in the country, and remained stable at more than 80 billion kg for five consecutive years. In 2021, the total grain output of the six cities in Northern Anhui was 22.495 million tons, accounting for 55% of the province, an increase of 1.6%. The output of vegetables was 14.07 million tons, accounting for 57.2% of the whole province, an increase of 5.1%, 0.1 percentage point higher than that of the whole province. The output of fruit was 6.056 million tons, accounting for 77.8% of the whole province, an increase of 5%, 0.1 percentage point higher than that of the whole province. The output of meat was 2.356 million tons, accounting for 51.8% of the whole province, an increase of

17.1%, 1.9 percentage points higher than the average level of the whole province. Moreover, the growth rate of the total output value of agriculture, forestry, animal husbandry and fishery is significantly higher than that of the whole province. It can be seen that the agricultural development in Northern Anhui is improving and is in a leading position in the province.

2.3. Diversified Marketing Channels of Agricultural Products

By the end of 2020, the network sales of rural products in the province exceeded 60 billion yuan. In 2021, the total output of meat, egg and milk in the province was 6.798 million tons, with a year-on-year increase of 10.2%, the output of aquatic products was 2.365 million tons, with a year-on-year increase of 1.8%, the output of vegetables was 30.7738 million tons, with a year-on-year increase of 4.36%, and the supply of "rice bag" and "vegetable basket" products was stable. From the perspective of sales, the province's primary agricultural products and agricultural processed products are mainly sold to Shanghai, Jiangsu and Zhejiang through wholesale markets, farmers and supermarkets, e-commerce and other channels. It is estimated that among the sales channels of agricultural products, the wholesale market channel accounts for about 70%, the agricultural supermarket docking channel accounts for about 15%, and the e-commerce channel accounts for about 15%.

2.4. Influence of Hot Issues on Agricultural Investment in Anhui

Agricultural products are greatly affected by seasons, disasters and emergencies, which will affect agricultural investment and hinder economic growth. Combined with COVID-19 hot issues, the impact of new crown pneumonia outbreaks and floods on Anhui's agricultural investment is studied.

(1) COVID-19 pneumonia impact on agricultural investment. Since 2020, the COVID-19 pneumonia epidemic has brought a full impact on Anhui's economy, and the GDP has dropped significantly in the first quarter. The province's GDP growth rate was only 4.98% in 2020, while the GDP growth rate was 10% in 2017, 2018 and 2021, indicating that the sudden epidemic has restrained economic development. Affected by the COVID-19 pneumonia, the fragile economy in rural areas is seriously affected. In 2020, in response to the agricultural mechanization production during the epidemic prevention and control period, the province increased agricultural investment, applied 19.1747 million mu of fertilizer and weeded 20.8204 million mu. In addition, agricultural products are facing a sharp drop in demand and traffic congestion, which has affected the sales of agricultural products. The "vegetable basket" products such as meat, eggs, milk, oil and fresh fruits and vegetables cannot be transported and sold, and the refrigeration and preservation facilities in the producing area are insufficient, resulting in the detention of many agricultural products, the decline of prices and heavy losses. An agricultural product company in Anhui province suffered a direct economic loss of 26.2 million yuan in one month in 2020, and more than 360000 goods on hand could not be sold. The sudden outbreak of the epidemic has led to the soaring price of agricultural products, and the supply of agricultural products in the market is in short supply. The supply pressure of the agricultural materials market will affect the later agricultural production. Since it is generally advocated to stay at home and avoid gathering activities

during the epidemic period, the three industry integration industries such as farmhouse entertainment and pastoral complex will inevitably be affected, so as to reduce the demand for agricultural products, which may aggravate the occurrence of hidden unsalable. On the other hand, the outbreak of the epidemic has reduced people's gathering activities. Before the complete end of the epidemic, the real agricultural economy may enter a short depression. The development mode of "Internet plus agriculture" has ushered in opportunities. The rural Internet platform has been developing rapidly, and many agricultural operation and sales activities have been carried out online, which has greatly promoted the level of agricultural informatization. In terms of animal husbandry and breeding industry, affected by traffic control and epidemic prevention and control, the trading of young seedlings, feed processing and transportation have a great impact, and the original mode has been interrupted.

The impact of the COVID-19 outbreak on agriculture is from the industry dimension. The sales and export of agricultural output will be affected, and the agriculture related services will continue to be damaged, resulting in loss of agricultural economic efficiency, and the decline of agricultural investment efficiency. The difficulties of agriculture related enterprises may gradually spread to the whole industrial chain, and will have a conductive effect on the overall development of the economy.

(2) The impact of flood disaster on agricultural investment. Anhui Province is close to the Yangtze River Delta. The precipitation in the Huaihe River Basin is concentrated, and many tributaries flow into the Anhui section of the Huaihe River. After the river enters the Huaihe River, it cannot be discharged in time due to the small altitude drop of the Huaihe River, the restriction of flood discharge capacity of the river embankment, the loss of the sea inlet, the poor water outlet and other reasons, resulting in the rapid rise of the water level of the Anhui Section of the Huaihe River, resulting in flood disasters and serious damage to agriculture, especially the planting industry. The situation of water resources in Anhui Province is grim and not optimistic. From the perspective of time distribution, the change range of years with abundant water is small, and the change range is large when water is scarce. In terms of geographical location and regional distribution, there are great regional differences. Areas with large population density and more cultivated land lack water resources, while areas with small population density and less cultivated land are rich in water resources. From June to July 2021, heavy rainfall occurred continuously in many places in Anhui, and some reservoirs began to overflow, with a rainfall of more than 100mm. 137000 people were affected; 8.4 thousand hectares of crops were affected; The direct economic loss was 270 million yuan, including 170 million yuan for infrastructure and 71.069 million yuan for agriculture, forestry, animal husbandry and fishery. The occurrence of flood and waterlogging has had an adverse impact on agricultural production and development, and grain production has been greatly reduced.

In order to deal with the adverse effects of flood disasters, we need to actively take a series of flood control and disaster reduction measures, such as building water conservancy projects and improving water storage system, which increases the burden of agricultural investment and reduces the efficiency of agricultural investment to a certain extent, which is not conducive to the economic development of agriculture.

3. Technological Environment of Agricultural Investment in Anhui

At present, the digitization degree of Anhui agriculture is low, and the agricultural digitization revolution has become an inevitable trend. However, innovative technologies such as the Internet, Internet of things and artificial intelligence will strongly support the transformation and upgrading of traditional agriculture to modern agriculture, and effectively promote the rapid development of agricultural modernization in the whole industrial chain such as agricultural production, processing and sales. The following analyzes the technical environment of agricultural investment in Anhui from the aspects of agricultural mechanization and informatization in Anhui.

3.1. Agricultural Mechanization

Agricultural mechanization and agricultural machinery and equipment are the important foundation for changing the agricultural development mode and improving rural productivity, the important support for implementing the Rural Revitalization Strategy and the basic premise for agricultural and rural modernization [5].

(1) The level of mechanization has been continuously improved. In recent years, the level of agricultural machinery manufacturing in Anhui Province has been steadily improved, agricultural machinery and equipment have been further optimized, and the production of main grain crops has basically realized mechanization. The province has implemented the spirit of the No. 1 central document and accelerated the implementation of the "two strong and one increase" action. In 2021, the key technology transformation of agriculture was carried out in the field of technology and agriculture. In terms of strengthening agriculture by machinery, we will focus on the expansion of advantageous industrial clusters. In 2021, the comprehensive mechanization rate of crop cultivation and harvest in the province will reach 82%, of which the comprehensive mechanization rates of wheat, rice and corn will reach more than 96.8%, 88% and 89% respectively, basically realizing the whole process mechanization.

Anhui's overall rural production technology and mechanization level have been continuously improved. The total power of agricultural machinery has increased from 59.0277 million kw in 2012 to 68.675 million kw in 2016, decreased to 63.128641 million kw in 2017, and then increased year by year. By 2021, the total power of agricultural machinery has increased to 68.964473 million kw. The number of large and medium-sized tractors continued to increase from 164549 in 2012 to 281271 in 2021, with a high level of mechanization, while the number of small tractors showed a downward trend year by year, from 2327788 in 2012 to 1950687 in 2021.

(2) There is a gap in the degree of mechanization among cities. In 2020, the top three prefecture-level cities in terms of total power of agricultural machinery are Bozhou, Suzhou and Chuzhou respectively. The highest ranked Bozhou has a total power of 8.1314 million kw, while the last ranked Huangshan has only 838800 kw, a difference of nearly ten times. There is a large development gap between regions. Fuyang, Bozhou and Suzhou rank the top three in terms of the number of large and medium-sized tractors. Among them, the number of large and medium-sized tractors in Fuyang reaches 50242, and the lowest in southern Anhui is only 151. Chuzhou

ranks first in the number of small tractors, with 373775 units, and Huangshan ranks last with 13962 units. It can be seen that the degree of Agricultural Mechanization in Anhui Province is the highest in Northern Anhui, followed by Central Anhui, while Southern Anhui is relatively at the end of the province, and there is a large gap compared with Northern Anhui, where the degree of agricultural mechanization is more developed. Affected by many factors, the current unbalanced and insufficient development of agricultural mechanization and agricultural machinery equipment industry in Anhui Province still exists. There is a large development gap between cities, the scientific and technological innovation ability of agricultural machinery needs to be strengthened, the socialized service ability of agricultural machinery needs to be improved, and the basic infrastructure of agricultural machinery operation needs to be improved.

3.2. Degree of Agricultural Informatization

Agricultural informatization refers to the whole process of comprehensively developing and applying modern information technology in the field of agriculture to make it penetrate into agricultural production, market, consumption, rural society, economy, technology and other specific links. [6] Agricultural informatization is an important means to realize agricultural modernization. The wide application of modern information technology can promote the adjustment of rural economic structure, enhance the market competitiveness of agriculture, develop rural economy, build modern agriculture, increase farmers' income and accelerate the process of rural modernization [7].

The construction of agricultural informatization in Anhui has achieved remarkable results, and the development of agricultural informatization is at the forefront of the country. According to the overall evaluation of county agricultural informatization in 2020, the national agricultural informatization level reached 37.1%. The overall level of county agricultural and rural informatization development in Anhui Province reached 49%, 11.1 percentage points higher than the national average, ranking fourth in the country. Among them, the informatization level of agricultural production in the province is 41.6%, 19.1 percentage points higher than that in the country, and ranks second in the country with Zhejiang Province. The informatization of agricultural production has been steadily promoted, the development environment has been continuously optimized, and substantial steps have been taken in the construction of digital countryside.

In 2021, three places in Anhui Province were shortlisted as national agricultural modernization demonstration areas, namely Funan County, Tianchang and Fanchang District of Wuhu, striving to take the lead in realizing agricultural modernization. East Anhui is taking the opportunity of the establishment of the demonstration area to further promote the "Internet plus agriculture". Among them, Tianchang has built 1 intelligent agriculture cloud platform, 24 large and medium-sized Agricultural Internet of things application entities, 1 county level e-commerce public service center and e-commerce logistics distribution center. In December 2021, through attracting investment, the cluster has introduced 12 processing projects with a total investment of 2.56 billion yuan. Tianchang will take grain as the leading industry, actively explore the path and mode of agricultural modernization in the main grain producing areas, continue to improve the original advantages and make up for the

shortcomings in terms of facilities, parks, integration, greening and digitization.

4. DEA Method Analysis of Agricultural Investment Efficiency in Anhui

4.1. Research Method

DEA (Data Envelopment Analysis) is an analysis method that can measure efficiency without specific function. This method is used to evaluate the relative effectiveness of decision-making unit (DMU) [8]. BCC model is a model in DEA method. Under the assumption of variable return to scale, it can not only reflect the technical efficiency and scale efficiency of decision-making unit, but also reflect the value of input-output relaxation variable of decision-making unit and its effective target value under projection [9]. Considering the different returns to scale of agricultural investment, this paper uses DEA-BCC model to calculate and analyze the efficiency of agricultural investment in Anhui [10]. Refer to Tan Yi's practice for specific calculation process.

4.2. Index Construction and Data Source

4.2.1. Index Construction

(1) Input indicators. Chen Binjie et al. (2020) based on the SBM-DEA model, selected investment indicators from the aspects of technology, government, labor force and land, and calculated the agricultural investment efficiency of our government in combination with panel data. It is concluded that the investment efficiency of the eastern coastal area is the highest [11]. Wang Xian et al. (2019) studied the investment efficiency of agricultural PPP projects, they used the project investment amount, the number of projects and the technical amount to construct an input index system, and used the DEA-BCC method to comprehensively evaluate the investment efficiency [12]. Based on the existing literature of scholars, combined with the actual situation of Anhui Province, and starting from the availability and accuracy of data, this paper constructs the evaluation index system of agricultural investment efficiency, and divides the investment index into two aspects: capital investment and resource investment. Among them, capital investment is expressed by agricultural, forestry and water affairs expenditure, and resource investment is expressed by agricultural power consumption index.

(2) Expected output indicators. Expected output mainly refers to the economic output value of agriculture. Based on the DEA Malmquist index, Yuan Fang et al. (2020) selected the added value of agriculture, forestry, animal husbandry and fishery as the output index, and selected scalars such as effective irrigation area, pesticides and agricultural machinery as the input index to analyze the agricultural total factor productivity in Northwest China. The results show that the technical efficiency of agricultural investment presents the characteristics of spatial dispersion [13]. Zhou Zejiang et al. (2018) used the panel data of Anhui agricultural development, based on the DEA method, selected the regional total agricultural output value to reflect the income of agricultural investment, subdivided the input index into resource input index and energy input index, and constructed an index system to analyze the efficiency of agricultural investment. The results show that agricultural investment can promote agricultural development, but the efficiency needs to be further improved [14]. For the integrity and availability of

data, agricultural value-added indicators are used here. The specific evaluation index system of agricultural investment

efficiency is shown in Table 1.

Table 1. Index System of agricultural investment efficiency evaluation

Indicator type	Primary index	Secondary indicators	Unit
Input index	Capital investment	Expenditure on agriculture, forestry and water affairs	Ten thousand yuan
	Resource input	Agricultural power consumption	Billion kw/h
output index	Agricultural economic value	Agricultural added value	RMB100mn

4.2.2. Data Sources

Due to the low availability of data in 2021, the data of the first three quarters of 2021 are used as the sample data, and some data are obtained by monthly data aggregation. The data

comes from Anhui Provincial Bureau of statistics, Anhui Municipal Bureau of statistics and the Department of agriculture and rural areas. The specific data of the first three quarters of 2021 in Anhui Province are shown in Table 2.

Table 2. Original data of agricultural input-output of cities in Anhui in the first three quarters of 2021

Region	Capital investment - Expenditure on agriculture, forestry and water affairs (10000 yuan)	Resource input - agricultural power consumption (10000 kw/h)	Output index - agricultural added value (100 million yuan)
Hefei	20077.82	21000	378.04
Huaibei	13600	13500	108.04
Bozhou	414000	25404	325.13
Suzhou	478900	23494	401.28
Bengbu	286536	22813	301.68
Fuyang	51594.75	37916	498.56
Huainan	17250	1346	169.20
Chuzhou	417137	27372	294.59
Lu'an	670500	15700	277.20
Ma'an Shan	144750	12600	106.53
Wuhu	1592.25	16375	172.71
Xuancheng	374248	18603	172.08
Tongling	11250	2872	58.05
Chizhou	2034057	5226	83.58
Anqing	11336.25	11553	282.80
Huangshan	218250	7480	87.10

4.3. Results and Analysis of Agricultural Investment Efficiency Evaluation

The efficiency of agricultural investment in Anhui Province is analyzed by deap2 1 software, which brings the

relevant data of input and output indicators of 16 prefecture-level cities in Anhui in the first three quarters of 2021 into the DEA-BCC model, obtains the total efficiency of agricultural investment in each city, that is, technical efficiency, pure technical efficiency and scale efficiency, and analyzes the

Table 3. Evaluation results of agricultural investment efficiency

Region	Technical efficiency	Pure technical efficiency	Scale efficiency	Returns to scale
Hefei	0.748	1.000	0.748	Decrease
Huaibei	0.324	0.585	0.554	Increase
Bozhou	0.102	0.620	0.164	Constant
Suzhou	0.136	1.000	0.136	Decrease
Bengbu	0.107	0.589	0.182	Decrease
Fuyang	0.474	1.000	0.474	Decrease
Huainan	1.000	1.000	1.000	Constant
Chuzhou	0.086	0.465	0.184	Decrease
Lu'an	0.140	0.704	0.200	Decrease
Ma'anShan	0.074	0.116	0.637	Increase
Wuhu	1.000	1.000	1.000	Constant
Xuancheng	0.074	0.086	0.853	Decrease
Tongling	0.408	1.000	0.408	Increase
Chizhou	0.127	0.258	0.494	Increase
Anqing	1.000	1.000	1.000	Constant
Huangshan	0.093	0.180	0.515	Increase
mean value	0.3683	0.6627	0.5343	-
Southern Anhui	0.2960	0.4400	0.6512	-
Central Anhui	0.4935	0.7923	0.5330	-
Northern Anhui	0.3572	0.7357	0.4183	-

agricultural investment efficiency of each city in 2021. Among them, technical efficiency mainly reflects the total agricultural investment efficiency of 16 cities in Anhui in 2021, pure technical efficiency reflects the investment efficiency under the condition of variable return to scale, and scale efficiency reflects the agricultural investment efficiency of Anhui affected by the investment scale. The specific evaluation results of agricultural investment efficiency of 16 prefecture level cities in Anhui in 2021 are shown in Table 3 below.

According to the DEA-BCC calculation results, the following analyzes the agricultural investment efficiency of Anhui cities from the perspectives of technical efficiency, scale efficiency and return to scale:

First, the overall efficiency of agricultural investment is low and the development prospect is good. It can be seen from the table that the average technical efficiency of the 16 prefecture-level cities in Anhui Province in the first three quarters of 2021 is 0.3683, the average pure technical efficiency is 0.6627, and the average scale efficiency is 0.5343. The overall level of agricultural investment efficiency in Anhui Province is lower than the middle level, which needs to further improve the investment efficiency, but it shows great development potential and promising development prospects. In terms of the total efficiency of agricultural investment, that is, the technical efficiency, among the 16 prefecture-level cities in Anhui Province, the total efficiency of agricultural investment in Huainan, Wuhu and Anqing is 1, indicating that the agricultural investment efficiency of the three prefecture-level cities is high and the technical level is at the forefront, from the perspective of pure technical efficiency, the pure technical efficiency of Hefei, Suzhou, Fuyang, Huainan, Wuhu, Tongling and Anqing is 1. Among the 16 prefecture-level cities in Anhui Province, the pure technical efficiency of 7 prefecture-level cities is 1, reaching the technological frontier, and the pure technical efficiency of 9 prefecture-level cities is higher than the average level of the whole province; from the perspective of scale efficiency, the value of Huainan, Wuhu and Anqing is 1, which has reached the effective scale. The closer the value of scale efficiency is to 1, the closer the scale is to the optimal scale. Therefore, prefecture-level cities with scale efficiency less than 1 should continue to increase the scale of agricultural investment and further promote the continuous improvement of agricultural investment efficiency. It is worth noting that the pure technical efficiency of Hefei is 1, but its technical efficiency is less than 1, only 0.48, indicating that Hefei's agricultural investment is only technology effective, not scale effective.

Second, the scale of agricultural investment is unreasonable. Among the 16 prefecture-level cities in Anhui, Bozhou, Huainan, Wuhu and Anqing have the same return on the scale of agricultural investment, which is in the best state, accounting for 1/4 of all the prefecture-level cities evaluated, indicating that the agricultural investment of these prefecture-level cities is efficient. For the prefecture prefecture-level in the best stage of agricultural investment, that is, the prefecture level cities in the state of constant return to scale, they should maintain the current corresponding proportion of agricultural investment, maintain the optimal efficiency of agricultural investment, and maximize the benefits of agricultural investment. Huaibei, Ma'anShan, Tongling, Chizhou and Huangshan are all in the stage of increasing returns to scale, which shows that these prefecture-level cities can

appropriately increase the scale of agricultural investment and further improve the efficiency of agricultural investment. The development of agricultural investment has great potential and rising space. For prefecture-level cities in the stage of increasing returns to scale of agricultural investment, they should increase agricultural investment and expand the scale of investment in order to improve the efficiency of agricultural investment. However, the seven prefecture-level cities of Hefei, Suzhou, Bengbu, Fuyang, Chuzhou, Lu'an and Xuancheng are in the stage of diminishing returns to scale of agricultural investment, which shows that we should appropriately reduce agricultural investment in order to improve the efficiency of agricultural investment. Agricultural investment is in the stage of diminishing returns to scale, which may be due to the failure to make rational use of agricultural investment, resulting in the waste of resources and the failure to improve the investment efficiency. We should pay attention to the rational use of invested capital and avoid unnecessary waste as far as possible.

Third, regional agricultural development is uneven. There is a certain gap in the total efficiency of agricultural investment in the three regions of the province. The highest level of investment efficiency in Central Anhui is 0.4935, followed by 0.3572 in Northern Anhui and 0.2960 in Southern Anhui; from the level of pure technical efficiency, the highest level of efficiency in Central Anhui is 0.7923, followed by 0.7357 in Northern Anhui, which is not much different from that in Northern Anhui, and the worst level in Southern Anhui is 0.4400, which is about half of that in Central Anhui, indicating that the pure technical efficiency in Southern Anhui is quite different from that in Central and Northern Anhui; The maximum scale efficiency of Southern Anhui is 0.6512, followed by Central Anhui is 0.5330, and the worst is 0.4183. The scale efficiency of the three regions is slightly different, but there is little difference. The economy of Southern Anhui and Central Anhui is more developed than that of Northern Anhui, and the investment scale and technical level are relatively high. However, the agricultural economic development level of Northern Anhui is not high, the level of agricultural modern equipment is low, and the scale efficiency of agricultural investment is at a relatively low level in the whole province.

5. Conclusions and Suggestions

Stabilizing and expanding agricultural investment is an important driving force for Anhui Province to turn from a large agricultural province to a strong agricultural province. By analyzing the agricultural investment situation and technical environment in Anhui Province, combined with the DEA-BCC model, this paper calculates the agricultural investment efficiency of 16 prefecture-level cities in Anhui Province, and finally comes to the following conclusions: first, the agricultural industry in Anhui is in good development. Through the construction of high-standard farmland and investment attraction, it has promoted the process of agricultural industrialization and realized the sustainable growth of output, diversified sales channels of agricultural products. Second, the level of agricultural mechanization and informatization has been improved, and the construction of agricultural informatization has been steadily promoted with remarkable results, which is at the forefront of the country. However, the problem of unbalanced and insufficient development of agricultural mechanization and agricultural

machinery equipment industry still exists, the development gap between cities is large, and the scientific and technological innovation ability of agricultural machinery needs to be strengthened. Third, the overall efficiency of agricultural investment is not high, the scale of agricultural investment in most areas of Central and Northern Anhui is unreasonable, and the agricultural development between regions is uneven. Fourth, with the support of the "double recruitment and double introduction" policy, Anhui's agricultural investment environment will be improved, the construction of "digital Anhui agriculture" will be accelerated, urban and rural industries will develop together, the agricultural investment structure will show the characteristics of comprehensiveness and appropriateness, and the economic benefits will be improved. Based on the above conclusions, the following policy suggestions are put forward:

First, establish and improve relevant systems and implement supporting policies. The government should formulate the planning and layout of agricultural structure adjustment and supporting policies and measures, maximize the effectiveness of agricultural investment funds, guide the concentration of advantageous agricultural products to advantageous production areas, and solve the problem of financing new agriculture. In addition, we should actively increase investment attraction, introduce relevant policies, introduce talents, introduce social capital, strengthen the support of agricultural science and technology, inject new vitality into agricultural development, and expand and strengthen rural characteristic industries.

Second, improve the efficiency of agricultural investment and promote the development of agricultural industrialization and modernization. For areas in the stage of increasing returns to scale of agricultural investment, we should increase agricultural investment and expand the scale of investment in order to improve the efficiency of agricultural investment; In areas where agricultural investment is in the stage of diminishing returns to scale, we should pay attention to the rational use of invested capital and avoid unnecessary waste of resources as far as possible.

Third, narrow the development gap between regions and pay attention to regional coordinated development. On the one hand, all regions should seize their own advantages, pay attention to improving agricultural mechanization and informatization, improve agricultural quality and efficiency, create local characteristic industries, dig deep into the characteristic agricultural products of the region and improve their core competitiveness. Backward areas should actively learn from the successful experience of developed areas and vigorously develop digital agriculture and efficient facility agriculture. On the other hand, the government should formulate relevant systems for urban-rural integration, give full play to the radiation effect of developed regions and

promote coordinated development among regions.

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