Research on the Impact of Productive Service Industry on the Efficiency of Modern Agriculture Development

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Abstract: As an intermediate input factor for agricultural production, productive service industry is an important means to realize agricultural modernization. The DEA model was used to measure the impact of Heilongjiang's productive service industry on the efficiency of modern agricultural development from 2006 to 2015. The research results show that Heilongjiang Province's productive service industry has a higher overall efficiency level for modern agricultural development, and the level of pure technical efficiency and scale efficiency is low. Therefore, the government should improve the efficiency of pure technology and the efficiency of scale. Under the premise of maximizing the output of modern agriculture, the government should reasonably adjust the input level and input of the productive service industry.

1. Introduction

In the context of economic globalization and agricultural marketization, the productive service industry penetrates into the entire chain of agricultural production. The productive service industry will play a substantial role in the process of upgrading traditional agricultural transformation to modern agriculture [1]. With regard to the role of productive service industry in promoting the development of agricultural economy, existing scholars have conducted extensive discussions, mainly with the following views:

The productive service industry has provided new ideas and development paths for agricultural modernization development [1]. The input of productive service industry is the need for the further development of agricultural production. Increasing the proportion of productive service industry inputs in agricultural production can accelerate the development of agriculture [2]. The productive service industry helps to promote technological progress and the refinement of the agricultural division of labor, which can become the key to the transformation of traditional agriculture into modern agriculture and improve the efficiency of agricultural production [3]. The development of agricultural productive service industry is an important condition for promoting the innovation of agricultural production and management system and mechanism, realizing the transformation of China's agricultural development mode and accelerating agricultural modernization [4]. The agricultural productive service industry is an industrial form in which agriculture and service industries are integrated and developed. It is an expansion of the modern service industry and an important means to realize the transformation from traditional agriculture to modern agriculture [5].

Based on the above research, this paper further explores the impact of productive service industry on the efficiency of modern agriculture. As a major agricultural province in China, Heilongjiang Province has a certain representativeness. Based on the existing research results, this paper uses data envelopment analysis (DEA) to measure the impact of Heilongjiang's productive service industry on modern agricultural development. This article provides useful suggestions for promoting the development of modern agriculture.

2. Research Methods and Data Description

2.1 Research Methods.

Data Envelopment Analysis, or DEA for short, is a method for evaluating the production or operational efficiency of decision-making units with multiple inputs and multiple outputs. It is widely used in many research fields [6]. Based on the existing literature [3][6][8], this paper uses DEA method to measure the impact of Heilongjiang's productive service industry on the development efficiency of modern agriculture.

2.2 Data Selection.

This paper selects several types of productive service industries, such as circulation industry, financial industry and agricultural material service industry, which are closely related to the development of modern agriculture in Heilongjiang as a representative. Based on the existing literature, this paper selects circulation industry indicators, including transportation, warehousing and postal industry added value (100 million yuan) (a1) [8]; this paper selects financial industry indicators, including financial industry added value (100 million yuan) (a2) [9]; This paper selects agricultural resources service industry indicators, including the total sown area of crops (thousand hectares) (a3) and the total power of agricultural machinery (10,000 watts) (a4) [3]. The above variables are used as input indicators. This paper selects the total agricultural output value (100 million yuan) (A1) [10] as the output indicator. The research data is from 2006 to 2015. The data comes from the official website of the China Statistics Bureau and the official website of the Heilongjiang Provincial Bureau of Statistics. The specific data is shown in Table 1.

Table1 Index values of productive service industry and modern agriculture in Heilongjiang Province from 2006 to 2015

Year	A1	a1	a2	a3	a4
2006	817.45	352.04	74.17	11678.34	2570.6
2007	971.94	412.1	155.48	11898.48	2785.3
2008	1142.31	434.03	177.43	12088.41	3018.36
2009	1206.79	433.55	227.54	12129.15	3401.27
2010	1369.2	486.01	304.59	12156.2	3736.29
2011	1801.84	568.81	370.78	12222.93	4097.84
2012	2315.64	598.78	485.11	12236.99	4552.93
2013	2856.34	601.48	606.22	12200.79	4849.28
2014	3015.61	683.12	707.47	12225.92	5155.52
2015	2911.86	707.03	847.66	12294.03	5442.29

Note: The information comes from the official website of the China Statistics Bureau and the official website of the Heilongjiang Provincial Bureau of Statistics.

3. The Analysis of Empirical Results

This paper uses DEAP2.1 software to calculate the average results of the efficiency of the productive service industry in Heilongjiang Province affecting the development of modern agriculture from 2006 to 2015, as shown in Table 2. The model used in this paper is the VRS model, which is calculated from the input point of view.

It can be seen from Table 2 that the comprehensive efficiency, pure technical efficiency and scale efficiency of the production service industry in Heilongjiang Province affecting the development of modern agriculture from 2006 to 2015 are 0.932, 0.985 and 0.945, respectively. This shows that Heilongjiang Province's productive service industry has a higher overall efficiency level for modern agricultural development. In 2006, 2013 and 2014, the comprehensive efficiency, pure technical efficiency and scale efficiency value of the productive service industry in Heilongjiang Province for modern agricultural development were all 1.00, which means that the three decision-making units are effective units. This shows that the impact of Heilongjiang's productive service industry on the development of modern agriculture has been relatively efficient in these three years. In the 7 years of

2007, 2008, 2009, 2010, 2011, 2012 and 2015, the decision-making unit is invalid. These 7 years are all caused by the combination of pure technical efficiency and scale efficiency, which leads to the invalidation of decision-making units. Therefore, the government should improve both. Under the premise of maximizing output, the government should reasonably adjust the input level and input.

Table 2 DEA efficiency values

Year	crste	vrste	scale	scale return
2006	1.000	1.000	1.000	constant
2007	0.886	0.985	0.899	increment
2008	0.941	0.973	0.967	increment
2009	0.850	0.971	0.876	increment
2010	0.800	0.972	0.823	increment
2011	0.917	0.976	0.940	increment
2012	0.965	0.985	0.979	increment
2013	1.000	1.000	1.000	constant
2014	1.000	1.000	1.000	constant
2015	0.960	0.992	0.968	increment
mean	0.932	0.985	0.945	

From Table 2, the years in which the productive service industry needs improvement include 2007, 2008, 2009, 2010, 2011, 2012, and 2015. The reference values for the improvement of the productive service industry in Heilongjiang Province are shown in Table 3.

Table 3 Heilongjiang Province productive service industry investment improvement reference value

Year	Item	A1	a1	a2	a3	a4
2007	Initial value	971.94	412.10	155.48	11898.48	2785.30
	Target value	971.94	370.94	114.48	11717.93	2743.26
	Adjustment	0.00	-41.16	-41.00	-180.55	-42.04
	Improve%	0.00	-9.99	-26.37	-1.52	-1.51
2008	Initial value	1142.31	434.03	177.43	12088.41	3018.36
	Target value	1142.31	393.24	160.34	11761.22	2936.66
	Adjustment	0.00	-40.79	-17.09	-327.19	-81.70
	Improve%	0.00	-9.40	-9.63	-2.71	-2.71
2009	Initial value	1206.79	433.55	227.54	12129.15	3401.27
	Target value	1206.79	410.68	186.34	11775.33	3028.44
	Adjustment	0.00	-22.87	-41.20	-353.82	-372.83
	Improve%	0.00	-5.27	-18.11	-2.92	-10.96
2010	Initial value	1369.20	486.01	304.59	12156.20	3736.29
	Target value	1369.20	435.14	233.13	11815.79	3219.43
	Adjustment	0.00	-50.87	-71.46	-340.41	-516.86
	Improve%	0.00	-10.47	-23.46	-2.80	-13.83
2011	Initial value	1801.84	568.81	370.78	12222.93	4097.84
	Target value	1801.84	500.31	357.78	11923.56	3728.19
	Adjustment	0.00	-68.50	-13.00	-299.37	-369.65
	Improve%	0.00	-12.04	-3.51	-2.45	-9.02
2012	Initial value	2315.64	598.78	485.11	12236.99	4552.93
	Target value	2315.64	548.79	478.05	12058.84	4272.76
	Adjustment	0.00	-49.99	-7.06	-178.15	-280.17
	Improve%	0.00	-8.35	-1.46	-1.46	-6.15
2015	Initial value	2911.86	707.03	847.66	12294.03	5442.29
	Target value	2911.86	667.49	677.58	12200.08	5033.52
	Adjustment	0.00	-39.54	-170.08	-93.95	-408.78
	Improve%	0.00	-5.59	-20.06	-0.76	-7.51

From Table 3, in 2007, the adjustment amounts of inputs a1, a2, a3, and a4 were -9.99%, -26.37%, -1.52%, and -1.51%, respectively. In 2008, the adjustment amounts of inputs a1, a2, a3, and a4 were -9.40%, -9.63%, -2.71%, and -2.71%, respectively. In 2009, the adjustment amounts of inputs a1, a2, a3, and a4 were -5.27%, -18.11%, -2.92%, and -10.96%, respectively. In 2010, the adjustments for inputs a1, a2, a3, and a4 were -10.47%, -23.46%, -2.80%, and -13.83%, respectively. In 2011, the

adjustment amounts of inputs a1, a2, a3, and a4 were -12.04%, -3.51%, -2.45%, and -9.02%, respectively. In 2012, the adjustment amounts of inputs a1, a2, a3, and a4 were -8.35%, -1.46%, -1.46%, and -6.15%, respectively. In 2015, the adjustment amounts of inputs a1, a2, a3, and a4 were -5.59%, -20.06%, -0.76%, and -7.51%, respectively.

4. Conclusions

Taking Heilongjiang Province as an example, this paper uses data envelopment analysis to explore the impact of productive service industry on the efficiency of modern agriculture. The research shows that the comprehensive efficiency level of the productive service industry in Heilongjiang Province to modern agriculture is higher overall, and the pure technical efficiency and scale efficiency level are lower. In view of the above analysis, this paper proposes the following suggestions: First, the government should increase the intensification of input from the productive service industry and realize the benign interaction between the productive service industry and modern agriculture. On the one hand, the government should break the barriers to entry into the productive service industry. In the process of modern agricultural production, the government should integrate more productive services as an intermediate input factor and increase the added value of agricultural products. On the other hand, the government should improve the efficiency of the productive service industry to serve the development of modern agriculture. The government should improve the efficiency of agricultural modernization and guide modern agriculture to the path of green development. Second, the government should improve rural infrastructure construction and establish a modern rural comprehensive circulation service system. The government needs to build an efficient agricultural distribution network to reduce the cost of agricultural circulation.

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