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Evaluation and Analysis of Agricultural Economic Development Level in Northeast China

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Abstract

Agriculture is the primary industry in China, and it is the basic industry that provides support for national economic construction and development. Taking three provinces in Northeast China as the research object, this paper selects 14 indicators that can directly reflect the development of agricultural economy. Firstly, the entropy method is used to weight the overall situation of agricultural economic development in the three provinces in Northeast China. Then, the agricultural economic development level in Northeast China is evaluated from four different dimensions: overall agricultural economy, agricultural economy, agricultural ecology and agricultural society. On this basis, the scores of each province are obtained, the agricultural economic development situation in Northeast China is analyzed, and the countermeasures and suggestions for agricultural economic development are put forward.

Keywords

Agriculture; Entropy TOPSIS Method; The Northeast Area.

1. Introduction

China is a big agricultural country, and agriculture is the basic industry of the national economy. In 2020, relevant documents of the central government emphasized that priority should be given to developing agriculture and rural areas, comprehensively promoting rural revitalization, and insisting on solving the "three rural issues" as the top priority of the whole party. Therefore, the development of agricultural economy has become the core content of China's rural development and construction. Agriculture is an important industry related to people's livelihood, an important output sector of social material, and the primary industry of China's economic development, which is related to the sustainable development of the whole national economy. Among many agricultural economic problems, the regional difference of agricultural economy is a major problem that has existed for a long time in the development of agricultural economy. In the world, in the whole country and in a certain region, there are different forms and different degrees of gaps. Therefore, on the basis of comprehensive analysis of the general situation of agricultural economic development, it is of great significance to intensify the sustainable development of agricultural economy. Because there are many and complicated factors affecting the development level of agricultural economy, the evaluation of agricultural economic development level is an index system model constructed by using multiple index data. The selection of the number and size of indexes will affect the final research results, and it is difficult to select the indexes because of their different properties and functions. Considering the feasibility of the study, the availability of data and other aspects, and combining with the agricultural characteristics of the study area, select the appropriate number of indicators and build a reasonable index system. With TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), this paper comprehensively evaluates the agricultural economic development in Northeast China by taking three provinces in Northeast China as research units, finds out the

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existing problems, and puts forward feasible suggestions for agricultural economic development in Northeast China, with a view to providing reference for agricultural development in Northeast China.

2. Research Methods

2.1. Entropy Weight Method

Entropy weight method is an objective assignment method. Its basic idea is to determine the weight coefficient of the index to be weighted according to the specific information provided by the real value of the index. Entropy method has no requirement for the distribution of selected indicators, and the evaluation process is transparent and online. It is a widely used weighting method in recent years, and its operation steps are as follows:

Step 1: Calculate the entropy value of the index item *J.*

$$I=-k\sum_{i=1}^{n} p_{ij}\ln(p_{ij}),\quad j=1,2,\ldots,m \tag{1}$$

Where k>0 is a constant, which is usually taken as k= $\frac{1}{\ln(n)}$;

$$P_{ij}=\frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}},i=1,2,\ldots,m \tag{2}$$

The characteristic proportion of the *j* index, which is called the *I*-th evaluated object. When p_{ij}=0,

$$p_{ij}\ln(p_{ij})=0 \tag{3}$$

Step 2: Calculate the difference coefficient of the index item *J*.

$$r_j=1-I_j,\quad j=1,2,\ldots,m \tag{4}$$

Difference coefficient is a quantity that reflects the size of comprehensive evaluation index. The larger its value, the greater the role of index.

Step 3: Calculate the weight coefficient of the index item *J*.

$$W_j=\frac{r_j}{\sum_{k=1}^{m} r_k},\ j=1,2,\ldots,m \tag{5}$$

2.2. Weighted TOPSIS Method

TOPSIS method [1] is an efficient multi-index evaluation method. This method is a method to sort hypotheses by constructing the optimal solution and the worst solution of each index in the evaluation problem and calculating the distance between each hypothesis and the ideal hypothesis. This method has been widely used in the evaluation of consumer satisfaction. In the N-dimensional space, compare the distances between each alternative *di* in the scheme set *D* and the positive ideal solution and the negative ideal solution, and the scheme that is close to the positive ideal solution and far from the negative ideal solution is the best scheme. On the contrary, the scheme closest to the negative ideal solution and far from the positive ideal solution is the worst scheme. According to the distance between each alternative and positive

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ideal solution and negative ideal solution, the advantages and disadvantages of alternatives in scheme set *D* can be judged. The concrete calculation method of ideal solution is as follows.

Step 1: Collection of raw data. Assuming that there are *m* objects to be evaluated and *n* evaluation indexes, an *m*×*n* matrix can be established.

$$\begin{pmatrix} x_{11} & x_{12} & x_{13} & x_{1n} \\ x_{21} & x_{22} & x_{23} & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & x_{m3} & x_{mn} \end{pmatrix} \tag{6}$$

Step 2: Unify the original evaluation indexes into the same type, and the unified method is:

$$\text{For indicators } x_j, \text{ make } x_j' = \frac{1}{x_j} \tag{7}$$

Step 3: Vector normalization.

$$\text{For indicators } x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}}},\ 1 \ll i \ll n;\ 1 \ll j \ll m \tag{8}$$

After planning, get the matrix ***X.***

Step 4: Construct the weighted norm evaluation matrix.

$$Z = (z_{ij})_{n\times m} = w_j x_{ij} = \begin{pmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{pmatrix} \tag{9}$$

In the formula, w_j is the weight of the jth index. $\sum_{j=1}^{m} w_j = 1$, Is the weight calculated by entropy weight method above.

Step 5: Determine positive ideal solution and negative ideal solution.

Step 6: Calculate the Euclidean distance d^*_i and d_i from each evaluation object to the positive ideal solution, and calculate the relative closeness of each evaluation index to understanding through the calculated Euclidean distance C_i.

Step 7: rank the evaluation objects according to the calculated relative proximity. The larger the C_i+, the higher the evaluation.

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3. Constructing Index System

3.1. Select Index

Table 1. Evaluation index table

Element name	Indicator name	Variable symbol	Attribute
Economic indicator	Gross agricultural product (million yuan)	x1	+
	Gross forestry output value (million yuan)	x2	+
	Gross product of animal husbandry (million yuan)	x3	+
	Gross fishery product (million yuan)	x4	+
	Agricultural output (million tons)	x5	+
	Sowing and cultivation area (million mu)	x6	+
	Total investment in fixed assets (million yuan)	x7	+
Ecological index	And fertilizer and feed usage (t)	x8	+
	Oil consumption of agricultural machinery (L)	x9	+
	Forest coverage (%)	x10	+
Social indicator	Production added value (million yuan)	x11	+
	Rural population (millions)	x12	+
	Agricultural production population (millions)	x13	+
	Rural per capita disposable income (million yuan)	x14	+

There are many factors affecting the level of agricultural economic development, and the reasons leading to economic changes are often very complicated, so the selection of evaluation indicators is very important. Therefore, based on the availability, objectivity and accuracy of data, this paper refers to the research of Yanming Liang and Jiali Zhao [2]. Select 14 indicators closely related to agricultural economic development to form an evaluation system. Among the economic indicators, agricultural (planting) GDP, forestry GDP, animal husbandry GDP, fishery GDP, and the added value of four industries as a whole are selected, and data such as total investment in fixed assets, sown area of crops and total grain output are also selected as evaluation indicators. Among the ecological indicators, choose the indicators that reflect the ecological situation, such as the amount of fertilizer and feed used, the amount of sewage produced, the oil consumption of agricultural machinery, forest coverage and so on. Among the social indicators, this study chooses the rural population, the employed population of agriculture, forestry, animal husbandry and fishery, and the per capita disposable income of rural areas as indicators to reflect the social situation. Measure the level of agricultural economic development in Northeast China from three aspects: economy, ecology and society. See Table 1 for details.

3.2. Calculation of the Weight of Each Indicator

According to the entropy weight method, the weights of the above indicators in the three northeastern provinces are calculated, and the results are shown in Table 2.

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Table 2. Calculation results of the weights of each indicator

Indicator name	Variable symbol	Attributes	Weight factor		
			Liaoning Province	Jilin Province	Heilongjiang Province
Gross agricultural product	x1	+	0.06	0.06	0.07
Gross forestry output value	x2	+	0.06	0.06	0.07
Gross product of animal husbandry	x3	+	0.06	0.05	0.06
Gross fishery product	x4	+	0.07	0.06	0.05
Agricultural output	x5	+	0.07	0.05	0.06
Sowing and cultivation area	x6	+	0.06	0.06	0.06
Total investment in fixed assets	x7	+	0.04	0.03	0.04
And fertilizer and feed usage	x8	+	0.06	0.06	0.06
Oil consumption of agricultural machinery	x9	+	0.06	0.05	0.07
Forest coverage	x10	+	0.05	0.07	0.06
Production added value	x11	+	0.07	0.06	0.07
Rural population	x12	+	0.07	0.06	0.06
Agricultural production population	x13	+	0.06	0.06	0.06
Rural per capita disposable income	x14	+	0.06	0.05	0.05

4. Evaluation Results and Analysis

Each region is evaluated according to the overall comprehensive evaluation value of the agricultural economy. The larger the value of C_i, the stronger the agricultural economic strength of the region; on the contrary, the smaller the value of C_i, the weaker the agricultural economic strength of the region [3]. After consulting the data and referring to some literatures, the agricultural economic development level is rated, and the specific results are shown in Table 3.

Table 3. Grading table of agricultural economic development level

Agricultural economic division	Review Score Range
Developed	0.50-0.60
Relatively developed	0.40-0.50
Generally developed	Below 0.40

4.1. Results and Analysis of the Comprehensive Score of Agricultural Economy

By using the weighted TOPSIS method to calculate the TOPSIS scores of the three northeastern provinces, it can be seen from Table 4 that Heilongjiang Province has a score of 0.589, ranking

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first, belonging to the developed agricultural economy in Northeast China. Liaoning Province has a score of 0.525, ranking second, belonging to the comparison of agricultural economy. A developed province, Jilin province has a score of 0.489, ranking last, and it belongs to a relatively underdeveloped agricultural economy among the three northeastern provinces.

Table 4. Comprehensive evaluation table of agricultural economic development

Province	Weighted topsis score	Rank
Liaoning Province	0.525	2
Jilin Province	0.489	3
Heilongjiang Province	0.586	1

Heilongjiang Province has the strongest comprehensive strength in agricultural economy. The main reasons include: First, according to the observation of the original data, it is found that the province's agricultural, forestry, animal husbandry and fishery output value, the total power of rural machinery, the number of agricultural, forestry, animal husbandry and fishery workers and other important indicators have invested a lot. higher than Liaoning and Jilin. Secondly, from the perspective of land resources, Heilongjiang Province has a large area of arable land, fertile land and rich land types, including plains, hills, mountains and other types, suitable for the growth of various crops; secondly, Heilongjiang Province is one of the main grain producing areas in China There are large grain production areas such as "Sanjiang Plain" and "Songnen Plain" in the province. Heilongjiang Province has a high degree of modern agricultural mechanization and is at the leading level in China. Advanced modern agricultural technology has promoted the comprehensive strength of Heilongjiang Province's agricultural economy. Thirdly, Heilongjiang Province has convenient transportation and developed high-speed, railway and air transportation networks, which can transport agricultural products to their destinations better and faster; in addition, the province's agricultural development is relatively good, and it is inseparable from the development of the province's characteristic agriculture , such as the cultivation of special products such as edible fungi and mountain treasures, which have driven the development of agricultural economy in Heilongjiang Province. Combined with the calculation results of the comprehensive evaluation method, Heilongjiang Province belongs to the developed area of agricultural economy in Northeast China. In Jilin Province, due to its relatively small land area, small rural population and population engaged in agricultural production activities, and relatively insufficient use of modern agricultural machinery, the land area for planting crops is small, and the agricultural products are relatively single, resulting in Jilin Province's agricultural production. The level of development is affected.

4.2. Score Results and Analysis of Agricultural Economic Indicators

Using the entropy TOPSIS method to calculate the economic indicators of the three provinces from 2011 to 2020, the results are shown in Table 5.

Table 5. Evaluation table of economic indicators for agricultural economic development

Province	Weighted topsis score	Rank
Liaoning Province	0.498	2
Jilin Province	0.436	3
Heilongjiang Province	0.523	1

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It can be seen from Table 5 that in the evaluation of economic indicators, Heilongjiang scored 0.523, ranking first, Liaoning Province scored 0.498, ranking second, and Jilin Province scored 0.436, ranking third. From an economic point of view, in the ten years from 2011 to 2020, Heilongjiang Province has developed the best agricultural economy in the three northeastern provinces. It is an important food production area in China; Heilongjiang Province has relatively high output of aquaculture, fishery, animal husbandry and other industries compared with the other two provinces, therefore, the agricultural economic indicators are relatively high. Liaoning Province is a relatively developed area in Northeast China, with a strong industrial base, convenient transportation and rich tourism resources, and is more inclined to the development of secondary and tertiary industries. Well, it ranks second in the three northeastern provinces; Jilin Province has a small area of arable land, and the serious loss of agricultural labor force causes its agricultural economy to lag behind the other two provinces.

4.3. Agro-ecological Index Score Results and Analysis

The agricultural economy of the three provinces is evaluated from the perspective of ecological indicators. The higher the index score, the better the growth environment in the region, and the lower the evaluation score, the worse the growth environment in the region. The evaluation results of ecological indicators are shown in Table 6.

Table 6. Evaluation form of ecological indicators of agricultural economic development

Province	Weighted topsis score	Rank
Liaoning Province	0.521	3
Jilin Province	0.552	1
Heilongjiang Province	0.546	2

It can be seen from Table 6 that in the ecological indicators, Jilin Province ranks first with a score of 0.552, Heilongjiang Province ranks second with a score of 0.546, slightly lower than Jilin Province, and Liaoning Province ranks third with a score of 0.521. Judging from the scores of ecological indicators, the ecological conditions of all provinces in Northeast China are relatively good, indicating that Northeast China still has great potential for agricultural development and is an ideal place for the development of agricultural industries. The agricultural infrastructure in each province should be further improved, the appropriate scale of agricultural operations and modern agricultural management measures should be improved; at the same time, farmers should be given more convenience and welfare in order to promote the better development of the agricultural economy in Northeast China.

4.4. Calculation and Analysis of Agricultural Economic and Social Score

The agricultural economic development level of the three provinces is evaluated from the perspective of social indicators. The higher the evaluation score of each indicator, the more social investment in the region, and the better the agricultural economic development. The specific evaluation results are shown in Table 7.

Table 7. Evaluation form of social indicators of agricultural economic development

Province	Weighted topsis score	Rank
Liaoning Province	0.535	1
Jilin Province	0.496	3
Heilongjiang Province	0.529	2

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It can be seen from Table 7 that in the social indicators, Liaoning Province ranks first with a score of 0.535, Heilongjiang Province ranks second with a score of 0.529, slightly lower than Liaoning Province, and Jilin Province ranks third with a score of 0.496. From the perspective of the number of people engaged in agricultural production, Liaoning and Heilongjiang have more rural population engaged in agricultural production than Jilin, and the production scale is larger; in terms of industrial chain extension and brand building, Liaoning and Heilongjiang pay more attention to the deep processing and production of products. Therefore, the added value of agriculture, forestry, animal husbandry and fishery production in Liaoning Province and Heilongjiang Province is obviously higher than that in Jilin Province, the agricultural products are diversified, and the disposable income of rural people is higher. However, Jilin Province has few rural employees, less arable land, relatively less social investment, and relatively slow agricultural economic development.

5. Conclusions and Policy Recommendations

5.1. Conclusion

According to the entropy TOPSIS model, the agricultural economic development level of the three northeastern provinces of China is evaluated, and the agricultural economic development level of each province is ranked. The higher the score, the stronger the agricultural economic strength of the province. Through the above calculation and analysis, it can be concluded that there are certain differences in the level of agricultural economic development among provinces due to different location conditions, natural and economic and social conditions.

5.2. Policy Recommendations

5.2.1. Adjust Agricultural Production Methods and Improve Agricultural Production Efficiency

Improving the efficiency of agricultural production requires the modernization of agricultural production equipment. Under the conditions of advanced mechanical automation, the production capacity of farmers' agricultural products will be enhanced, and the supply of agricultural products will become more and more sufficient [4]. Therefore, the actual efficiency of agricultural production can be greatly improved; the second is industrialized production and operation. Each province should establish an agricultural industrial chain suitable for the development of the province, and benefit from accelerating the cooperation between various agricultural production departments, so as to improve agricultural production efficiency. Therefore, the government should introduce corresponding policies and measures to promote the modernization of agricultural production and advance the development of the agricultural economy.

5.2.2. Optimize Agricultural Policy Insurance and Reduce Agricultural Production Losses

Compared with other industries, agriculture is a high-risk and low-return industry, and is highly dependent on the natural environment. To resolve the contradiction between high risk and low income, farmers need to be supported by a sound agricultural insurance system [5]. Farmers have always been the biggest victims of natural disasters, and agricultural insurance can provide protection and compensation for farmers to develop production. At present, the overall demand for agricultural insurance in China is large, but the supply of insurance products is insufficient and the coverage of insurance is small. Therefore, through the design of agricultural insurance products and the calculation of risk levels, the central government will give a certain proportion of financial subsidies, with policy-based agricultural insurance as the main body, supplemented by commercial agricultural insurance, and more agricultural

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insurance varieties can be introduced to protect the health of the agricultural industry. stable development.

5.2.3. Promote Inter-regional Collaboration and Exchanges to Enhance Farmers' Production Skills

Various provinces and cities should strengthen agricultural economic exchanges and cooperation, and form large-scale agricultural cooperation between regions through the sharing of agricultural resources. The exchange of resources and mutual assistance in agricultural cooperation can effectively promote the development of the agricultural economy of both parties [6]. Thereby promoting the agricultural economic development of both sides. At the same time, it is necessary to promote the exchange of agricultural production technology among farmers, hire more experts in the field of agriculture to provide guidance, promote scientific and efficient agricultural production technology, cultivate a group of new farmers who understand technology and love agriculture, and mobilize farmers' enthusiasm for production. Promote agricultural economic development.

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