Agriculture Development in Western Region Based on Principal Component Analysis

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Abstract: Agriculture is the Basic Industry to Support the Economic Construction and Development of a Region, is an Important Industrial Sector, and Contributes Greatly to the Overall Development of Organic Agriculture. in Recent Years, the Development of Organic Agriculture Has Produced Obvious Effects on Chinese Industrial Structure Adjustment, Farmers' Income Increase and Environmental Protection, and Has Become an Advantageous Industry with Great Potential. However, Due to the Restriction of Many Factors, There is Still a Big Gap between the Development of Chinese Organic Agriculture and That of Developed Countries. Based on the Relevant Data in the Statistical Yearbook of the Western Region, This Paper Selects Seven Economic Indicators to Measure the Development of Agricultural Organic Agriculture, and Makes a Comprehensive Evaluation and Ranking of the Development of Agricultural Organic Agriculture in the Western Region through Spss Software. the Western Region is Divided into Four Levels According to the Comprehensive Development Level of Agricultural Economy, and Puts Forward the Policy Suggestions That the Western Region Should Pay Attention to the Development of Ecological Agriculture, Characteristic Agriculture and Other Policies, So as to Provide Reference for the Development of Agricultural Economy in the Western Region.

1. Introduction

The Western Region of Our Country Includes Southwest and Northwest Regions, with Vast Territory, But Most of Them Are Sparsely Populated and Economically Backward [1]. the Development of Organic Agriculture in the Western Region Has Become an Important Part of Chinese Organic Agriculture Development. in Order to Promote the Coordinated Development of Chinese Eastern, Central and Western Regions, the State and Government Have Taken a Series of Measures to Improve the Development Conditions of Organic Agriculture in the Western Region over the Past Ten Years. the Focus of the Development of the Western Region is to Speed Up Infrastructure Construction as the Foundation, to Strengthen the Construction of Ecological Environment Protection as the Foundation, to Adjust the Industrial Structure as the Key, to Science and Technology Education and Personnel Training as Important Conditions, to Continue to Deepen the Reform and Expand the Opening Up as a Powerful Driving Force for the Development of Organic Agriculture [2]. Optimize the Balanced Utilization of Resources by Various Plants and Animals on the Same Land. the Development of Organic Agriculture is Conducive to Improving Soil Ecosystem, Agricultural Ecosystem and Natural Ecological Environment.

Organic Agriculture Emphasizes the Harmony and Unity of Biology and Environment under the Premise of Following Natural Laws and Ecological Principles. While Protecting the Genetic Diversity of Biology, It Also Rationally Develops and Utilizes Renewable Resources, Coordinates the Balance between Planting and Breeding, and Realizes the Coordinated Development of Economy, Environment and Society [3]. According to the Latest Statistical Data in, This Paper Uses the Principal Component Analysis Method and Statistical Analysis Software Spss 19. 0 to Make a Comparative Analysis of the Necessity and Favorable Conditions for the Development of Organic Agriculture in the Western Region, Find out the Characteristics of Its Agricultural Organic Agriculture Development and the Reasons for the Differences, and Make a Comprehensive Evaluation of the Development of Agricultural Organic Agriculture in the Western Region.

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2. Principal Component Analysis

2.1 Principle of Principal Component Analysis

In 1901, Karl Pearson first introduced the concept of principal component analysis. Principal component analysis explains the variance and covariance structure of a group of variables through several linear combinations of the variables to achieve the purpose of data compression and data interpretation [4]. Try to replace the original indexes with a new set of unrelated comprehensive indexes. The basic principle is to reduce the dimension of high-dimensional variable space through mathematical transformation under the principle of ensuring the minimum loss of data information. In order to avoid subjective arbitrariness, several independent indicators with relatively few original variables are selected for dimensionality reduction, so that the selected indicators can more typically, accurately and concisely express most of the information of the object to be studied. The mathematical model of principal component analysis is as follows:

$$\begin{cases} F_1 a_{11} X_1 + a_{21} X_2 + \cdots a_{p1} X_p \\ F_2 a_{12} X_1 + a_{22} X_2 + \cdots a_{p2} X_p \\ \cdots \\ F_m a_{1m} X_1 + a_{2m} X_2 + \cdots a_{pm} X_p \end{cases} \quad (1)$$

In principal component analysis, each principal component is selected according to the variance. when the cumulative variance contribution rate of n (n < m) principal components exceeds 85%, the first n principal components can be considered to contain most of the information of the original p indexes. In this way, the original P indexes are changed into N comprehensive indexes which are not related to each other, thus not only avoiding the multicollinearity between the indexes, but also achieving the function of dimension reduction, reducing the number of indexes and simplifying the calculation.

2.2 The Steps of Principal Component Analysis

Principal component analysis is often solved through the following four steps: (1) Standardize the original P indicators to eliminate the influence of variables on the order of magnitude or dimension. (2) Calculate covariance or correlation matrix according to the normalized data matrix. (3) Finding the eigenvalues and eigenvectors of covariance matrix. (4) Determine the principal components and give appropriate explanations to the information contained in each principal component.

3. Comprehensive Evaluation on Necessity and Favorable Conditions of Organic Agriculture Development in Western Region

3.1 Selection of Evaluation Indexes

There are many factors affecting the development of agricultural organic agriculture, so there are also many evaluation indexes. The selection of evaluation index and the construction of index system should follow the principles of scientificity, measurability, systematicness and conciseness. Scientific principle means that the index system should not only objectively reflect the connotation of the development level of agricultural organic agriculture, but also better evaluate the current situation of agricultural organic agriculture development [5]. Using statistical methods, through the processing of multiple original variables, several independent indicators with less representative meaning are selected to reduce the dimension, so as to avoid subjective arbitrariness of human beings, make the selected indicators more typical, more accurate and more concise to express most of the information of the object to be studied, establish a systematic concept, and make the evaluation objectives and evaluation indicators form an organic whole; The principle of conciseness means that the key points should be emphasized when constructing the index system, and the indexes with strong representativeness should be selected to prevent the redundancy of the index system.

The key of principal component analysis is whether it can give new meaning to principal component and give a reasonable explanation, which should be based on the calculation results of principal component combined with qualitative analysis. The initial data collected were standardized. The purpose of this is to eliminate the difference in dimensionality and order of magnitude of each index and improve accuracy and contrast. Referring to many articles on comprehensive evaluation of agricultural organic agriculture development at home and abroad, according to the influence of various factors, the availability of data and the requirements of the model, the following 7 indexes are selected as explanatory variables of the model [6]. Through these indexes, the comprehensive strength of agricultural economy in a region can be scientifically and reasonably evaluated (Table 1).

Table 1 the Name of the Variable and Its Economic Significance

Variable	Name	Unit	Reflected economic significance
X 1	Total power of agricultural machinery	Ten thousand kilowatts	Agricultural production conditions
X 2	Fertilizer application (pure)	Ten thousand tons	
X3	Rural electricity consumption	Billion kilowatt hours	
X 4	agricultural acreage	Ten thousand hectares	
X5	Planting area of crops	Thousands of hectares	
X6	Sowing area of grain crops	Thousands of hectares	
X 7	Total grain output	Ten thousand tons	

Agriculture here refers to agriculture in a broad sense, including five industrial forms of planting, forestry, animal husbandry, fishery and sideline. The deterioration of the agricultural ecological environment needs to be solved urgently by establishing and restoring a virtuous circle of the agricultural ecological system and maintaining the sustainable development of agriculture. The development of organic agriculture is the best way to solve the deterioration of the ecological environment [7]. It can provide people with nutritious, high quality, good taste and pollution-free health and environment-friendly food: organic agriculture emphasizes the application of organic fertilizer and biological pest control measures. With the continuous improvement of living standards, people pay more attention to the quality of life and physical and mental health, and pursue green, pollution-free and pollution-free food. The development of organic agricultural production and the development of organic agricultural products and food can meet this requirement.

3.2 Correlation Analysis

Table 2 Correlation Coefficient Matrix

	X 1	X 2	X3	X 4	X5	X6	X 7
X 1	1.034	0.970	0.776	0.925	0.948	0.923	0.892
X 2	0.781	1.000	0.815	0.781	0.892	0.804	0.863
X3	0.763	0.850	1.000	1.004	0.748	0.732	0.781
X 4	0.938	0.784	0.663	0.991	0.993	0.934	0.951
X5	0.557	0.892	0.745	0.910	0.909	1.000	0.962
X6	0.982	0.728	0.739	0.824	1.000	0.983	1.000
X 7	0.774	0.884	0.772	0.872	0.891	0823	0.791

Before analysis, all original data should be standardized to eliminate dimensional influence. The results are shown in Table 2. From Table 2, it can be seen that the total power of agricultural machinery has extremely significant correlation with chemical fertilizer application, cultivated land area, sown area of crops, sown area of grain crops and other indicators, and also has relatively significant correlation with total grain output, total output value of agriculture, forestry, animal husbandry and fishery. The extraction of principal components is subjective to some extent. in order for principal components to reflect the information of original indexes, it is generally required to extract cumulative contribution rate >=185% and eigenvalue >=1; From this, we can see that there is overlap between the information reflected by these indicators, and many indicators have

significant correlation with each other. Organic agriculture is a labor-intensive industry and requires a large amount of labor. China has incomparable advantages over other countries in this respect. It has abundant agricultural labor resources and has the potential to develop a variety of organic products.

3.3 Principal Component Analysis

Eigenvalue can be regarded as an index to measure the degree of influence of the principal component to a certain extent. If the eigenvalue is less than 1, then the explanatory power of the principal component is small, and it is better to directly introduce the average value of the original index. After the principal component analysis method is improved, the factor analysis method is used for comprehensive evaluation. The workload of index selection can be reduced. For other evaluation methods, it is difficult to eliminate the correlation between evaluation indexes, so much energy is spent in index selection, while principal component analysis can eliminate this correlation. Therefore, the eigenvalue is generally greater than 1 as the standard for extracting principal components, and the first M principal components corresponding to the eigenvalue greater than 1 are extracted [8]. Table 3 arranges the characteristic roots corresponding to each principal component in descending order, and lists the variance contribution rate and cumulative variance contribution rate of each principal component.

Table 3 Variance Decomposition Principal Component Extraction Analysis Table

Component	Initial eigenvalue			Select sum of squares to load		
	Total	Contribution rate of variance/% Cumulative contribution rate/%	Total	Contribution rate of variance/%	Cumulative contribution rate/%	
1	7.834	78.446	77.942	7.883	78.446	78.325
2	1.054	10.561	88.014	1.098	10.603	889.102
3	0.615	6.078	94.952			
4	0.337	2.995	98.016			
5	0.157	1.634	99.014			

Therefore, extracting two principal components can basically reflect the information of all indexes, and two variables can be used to replace the original seven variables. In general, the number of principal components is equal to the number of original indexes. if the number of original indexes is large, it is more troublesome to carry out comprehensive evaluation. principal component analysis method is to select as few k principal components (k<p) as possible to carry out comprehensive evaluation, and at the same time, to make the amount of information lost as small as possible. In addition, it is known from the law of large numbers in mathematical statistics that with the increase of evaluated objects, the average level and dispersion degree of evaluation indexes tend to be stable, thus the covariance matrix tends to be stable, increasing the accuracy of evaluation results. Therefore, principal component analysis is suitable for comprehensive evaluation of large sample size. Table 4 is the initial factor load matrix, and each load quantity represents the correlation between the principal component and the corresponding variable. Divide the data in Table 4 (marked as B 1 and B 2) by the square root of the characteristic value corresponding to each principal component to obtain the coefficient corresponding to each index in the two principal components (marked as A 1 and A2) [9]. The calculation formulas are as follows: $A_1 = \frac{B_1}{\sqrt{7.841}}$, $A_2 = \frac{B_2}{1.085}$, The feature vectors A1 and A 2 can be obtained, as shown in Table 5.

Table 4 Initial Factor Load Matrix

	Component	
	1	2
X 1	0.947	0.043
X 2	0.893	0.241
X3	0.924	-0.176
X 4	0.802	-0.177
X5	0.886	-0.086
X6	0.947	-0.425
X7	0.984	0.134

Table 5 Factor Score Coefficient Matrix

	Component	
	1	2
X 1	0.324	0.097
X 2	0.335	0.226
X3	0.284	-0.174
X 4	0.304	-0.148
X5	0.237	-0.083
X6	0.339	-0.237
X7	0.157	0.128

The expression of the principal component can be obtained by multiplying the obtained feature vector with the normalized data (denoted as ZX1, i =1, 2, 3,..., 7):

$$F_1 = 0.342ZX_1 + 0.336ZX_2 + 0.286ZX_3 + 0.314ZX_4 + 0.315ZX_5 + 0.339ZX_6 + 0.337ZX_7 \quad (2)$$

$$F_2 = 0.048ZX_1 + 0.025ZX_2 - 0.174ZX_3 - 0.148ZX_4 - 0.083ZX_5 - 0.237ZX_6 + 0.128ZX_7 \quad (3)$$

Here, F 1 is first principal component, i.e. comprehensive strength factor; F 2 is the second principal component, that is, the yield factor of non-grain agricultural products. The principal component synthesis model can be calculated by taking the ratio of the eigenvalue of each principal component to the total eigenvalue of the extracted two principal components as the weight:

$$F = 0.886F_1 + 0.114F_2 + 0.314F_3 + 0.336F_4 + 0.257F_1 \; 0.412F_6 + 0.237F_7 \quad (4)$$

According to the principal component comprehensive model, the comprehensive principal component value can be calculated, and after sorting, the development of organic agriculture in the west can be comprehensively evaluated and compared.

3.4 Result Analysis

Judging from the comprehensive score of the development of agricultural organic agriculture in the western region, there are significant differences in the development of agricultural organic agriculture. Through systematic cluster analysis, the agricultural economy in the western region is divided into four grades, as shown in Table 6. In order to improve the carrying capacity of local agricultural water resources under the current situation; The rest of the regions with medium carrying capacity of agricultural water resources have relatively general water use and water saving measures, and some water saving measures can be appropriately taken to improve the carrying capacity of local agricultural water resources when the economic conditions in these regions permit.

Table 6 Classification of Agricultural Economy in Western Region

Level of development of organic agriculture	Evaluation of development level of organic agriculture
The first level	Areas with developed agricultural economy
The second level	Areas with more developed agricultural economy
The third level	Less developed areas of agricultural economy
The fourth level	Areas with underdeveloped agricultural economy

As the comprehensive index F reflects various information, it can be used to comprehensively evaluate the innovation capability of the western regions and sort them according to the comprehensive principal component value, thus comprehensively evaluating and comparing the innovation capability of the western regions. It is easier to convert into organic agriculture than in the east. Therefore, developing organic agriculture on an appropriate scale in the west and developing organic food are conducive to the local environmental protection and construction. At the same time, it can protect the rich biodiversity in the west and the rare gene bank in the world, and it can also become a way for farmers in the west to become rich. In the future development of agricultural organic agriculture, attention should be paid to increasing the cultivation of agricultural products other than grain.

4. Conclusions and Suggestions

4.1 Conclusions

From the above analysis results, it can be seen that the development level of agricultural organic agriculture in the western region of China is uneven, and the factors leading to this difference are various, both subjective and objective. However, subjective factors such as policies can be changed. Only timely and appropriate measures can be taken to promote the agricultural development in the underdeveloped areas of western China. In the adjustment of agricultural economic structure, we should vigorously strengthen the development and research of organic agriculture, increase the consultation service capacity of organic food production, improve the quality standard system of organic food, and promote the improvement and enhancement of agricultural production mode, industrial structure and variety quality. I believe that in the near future organic agriculture will become a strong basic guarantee for sustainable development and further improve the economic, social and ecological benefits of comprehensive agricultural development.

4.2 Suggestions

4.2.1 Vigorously Develop Ecological Agriculture

Although the western region of our country is rich in resources, the ecological environment is very fragile, which is also one of the important reasons restricting the development of organic agriculture in the western region. It requires farmers to have corresponding scientific and cultural qualities and a strong concept of green environmental protection. To this end, the western region must strengthen the understanding of farmers' green environmental protection, and make use of numerous relevant media from the central and local governments to actively publicize it and make it a household name. The agricultural development in the western region is to speed up the process of agricultural specialization, industrialization and marketization. The development of organic agriculture and the establishment of production, processing and trade bases for organic food are conducive to the protection and construction of the ecological environment in the western region. At the same time, the local government also needs to strengthen the organization and coordination, the guarantee system of organic agricultural production, the provision of technical guidance and guarantee in prenatal and childbirth, the matching system of testing and certification of organic food, and the provision of adequate sales channels. The development of ecological agriculture is the focus and breakthrough point to solve the long-term and far-reaching problems facing the development of western agriculture, and is the fundamental outlet for the development of organic agriculture in western agriculture [10].

4.2.2 Protect Cultivated Land and Agricultural Resources

Cultivated land is the most important agricultural resource. It is not only the basis for protecting and developing agriculture, but also the minimum condition for farmers to survive and provide them with living security. Organic agriculture requires strict technology and management, and is suitable for development in areas with relatively developed economy and higher education level of farmers. Areas with relatively large per capita arable land and fertile land will be given priority. We must face the market, rely on science and technology, and continuously push forward the breadth and depth of production, focusing on optimizing varieties, improving quality and increasing benefits, vigorously adjusting the structure of agricultural products, and improving the processing level and benefits of agricultural products. The western region, especially the northwest region, is very short of water resources. Water is a limiting factor to the development of social organic agriculture and the ecological environment. In particular, a large number of agricultural and forestry products in western China are distributed in mountainous areas, remote mountainous areas and poverty-stricken areas where the environment is not polluted and synthetic substances such as fertilizers, pesticides and herbicides are not used. This is a good place to develop organic agriculture. We will strengthen our understanding of the importance and urgency of biodiversity, environmental protection, resource conservation and organic agriculture in improving people's living standards.

4.2.3 Strengthen Scientific and Technological Support, Train Agricultural Talents and Improve Agricultural Comprehensive Production Capacity

All countries in the world protect and support agriculture, putting agricultural science and technology support in an important position. Only by improving the level of agricultural science and technology can we increase production, improve labor productivity and reduce costs, and improve the competitiveness of agricultural products at home and abroad. Breeding local fine varieties according to local conditions and actively carrying out scientific research on cultivation techniques, rotation system, means of production, agricultural machinery and deep processing of agricultural products. The western region should make full use of this advantage and combine the advantages of high-quality agricultural products, deeply processed native products and manual processes, so as to transform the advantages of organic resources and technologies into the advantages of organic products. Strengthening scientific and technological support is not only the foundation for strengthening agriculture, but also a major measure to fundamentally protect and promote agriculture. The government should increase scientific research investment in organic agricultural production technology, and invest in encouraging agricultural universities to develop higher organic agricultural production technology to provide better technical support for production enterprises. In order to improve the agricultural industrial structure, improve the agricultural ecological environment, increase farmers' income, and make our due contribution to Chinese overall economic modernization.

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