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The Evaluation of the Quality of Agricultural Economic Growth in China

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Abstract. Based on the connotation of the agricultural economic growth, this paper objectively evaluates the sequence development level of agricultural economic growth quality and the regional differentiation characteristics in China from four dimensions of the agricultural production efficiency, agricultural economic structure, the farmers' quality of life and the sustainable development level, and put forward to promote the adjustment and optimization of agricultural economic structure, take the resource-saving and environment-friendly sustainable development road, and improve the efficiency of agricultural production which is beneficial to the enhancement of the agricultural economic growth quality and the shift of the agricultural economic development mode.

Keywords: Agriculture, Growth Quality, Entropy Method.

1 Introduction

Agriculture is the basis of a country's economy and the foundation of a country's development. The agricultural problem has always been the focus of government and economists. Considering China, with the rapid development of economy and the continuous acceleration of urbanization and industrialization process, the transformation of the agricultural sector has been demanded.

We can see that over the past 30 years of reform and opening up, China's agriculture has achieved great success, providing sufficient sources of production factors for the rapid growth of the country's economy, and successfully feeding more than 20 percent of the world's population with less than 10 percent of the world's arable land. However, the rapid urbanization and industrialization of the transition period have caused a series of corresponding problems and a great impact on the agricultural sector. These problems can be systematically summarized as follows. First, the unit agricultural input is not proportional to output. Second, progress in agricultural technology has been slow. Third, agricultural sustainable development capacity is weak. Fourth, the quality of rural labor is not high enough.

2 Literature Overview

In modern times, many western bourgeois thinkers such as Adam Smith, David Ricardo, Freidrich Liszt and other people held the one-sided view that the development of the society is merely a kind of economic phenomenon, and the development process is the process of the material wealth growth. However, with the deepening of people's understanding, Thomas and Barro found that economic development is not equivalent to economic growth [1, 10]. Comparing with economic growth, economic development has broader contents, including the reform and improvement of social structure in terms of economy, politics, culture and law. As Liu broadly defined that improve the quality of economic growth refers to continuously improve the stability of the economic growth, the sustainability of economic growth mode, the coordination of economic growth structure and the harmony of the economic growth efficiency [7]. As Chao and Hui proposed that the extension of economic growth should be defined as the economic aspects that are closely related to economic growth, including four dimensions: the structure of economic growth, the stability of economic growth, the welfare change and the fruits distribution of economic growth, the utilization of resources and the cost of ecological environment [2].

In fact, agricultural economic growth is the growth of quantity rather than quality. In order to fundamentally realize the transformation of the quantity of agricultural economic growth to quality, we must recognize the connotation of agricultural economic growth quality.

Based on the connotation of the quality of agricultural economic growth, this paper evaluates the quality of agricultural economic growth in China. The scholars above are mainly based on the perspective of the whole national economy to study the quality of China's economic growth, but rarely discuss the quality of agricultural economic growth. Actually, we should pay more attention to the quality of agricultural growth and the transformation of agricultural development mode while focusing on the "three rural issues "(agriculture, rural areas and farmers).

3 Methods

3.1 The construction of evaluation index system of China’s agricultural economic growth quality

The quality of agricultural economic growth is the quality of economic growth during the agricultural economic growth period. The concept of agricultural economic growth quality is based on the meaning of economic development. Its content is not only limited to the improvement of the utilization efficiency of resources, labor, capital and other production factors, but should also include the optimization of the economic structure, the promotion of the quality of farmers' life, the sustainable development of ecological environment and a series of content related to the development of agriculture, rural areas and farmers. The quality of agricultural

economic growth is the development and supplement of agricultural growth mode. Therefore, when establishing the index system, we should cover all aspects of agricultural development as much as possible to establish a complete, systematic and comprehensive index system. Building an index system of assessment of agricultural economic growth quality is helpful to understand the process of agricultural development, the impetus, and resistance of agricultural economic growth and the direction of the agricultural economic growth.

Taking the connotation of agricultural economic growth quality as a starting point, following the purpose, scientific, systematic, feasibility, comparability and pertinence principles, on the basis of previous research results, this study chooses 26 comprehensive indicators which can reflect the intention and level of the quality of agricultural economic growth as the indicator elements of the study. The 26 indicators elements are not completely irrelevant, but at a certain level of abstraction to reflect the different aspects of the agricultural economic growth quality. In this paper, 26 index elements are systematically classified to establish the evaluation dimension of agricultural economic growth, namely, the dimension of agricultural production efficiency, the dimension of the agricultural economic structure, the dimension of farmers' life quality and the dimension of sustainable development.

Based on the above principle and previous research, and combining the requirements of the agricultural economic development status, we set up an evaluation indicator system of agricultural economic growth quality (see Table 1).

Table 1. The evaluation index system of China's agricultural economic growth quality.

First grade indexes	Order	Second-grade indexes	Unit	Index nature
Agricultural production efficiency	1	Agricultural GDP	100million yuan	positive
	2	Farmers per capita net income	Yuan/100 hundred people	positive
	3	Agricultural labor productivity	100million yuan/100 hundred people	positive
	4	Agricultural land productivity	Kg/ha	positive
	5	Per capita grain production	100 hundred tons/100 hundred people	positive
	6	TFP growth rate	%	positive
	7	Industrial structure adjustment capability index	%	positive
	8	Per capita water resources	100million cubic meters/100hundred people	positive
	9	Unit sown area production value	100million yuan/thousand	positive
	10	Unit area machinery total power	100hundred kW/thousand hectares	positive

	11	Per capita electricity consumption	100hundred kw/100hundred	positive
Agricultural economic structure	12	Effective irrigation rate	%	positive
	13	Acres of arable land water resources	100million cubic meters/thousand hectares	positive
	14	Rural minimum subsistence allowance	100hundred yuan	positive
	15	Urbanization rate	%	positive
	16	Engel coefficient	%	positive
Famers' quality of life	17	Per hundred people above junior high school	%	positive
	18	Rural employment rate	%	positive
	19	Illiteracy and semi-illiteracy rate	%	negative
	20	Chemical fertilizer usage	100hundred tons/thousand hectares	negative
	21	Pesticide usage	Tons/thousand	negative
	22	Disaster rate	%	negative
	23	Forest cover	%	positive
Sustainable development	24	Soil erosion control area	Thousand hectares	positive
	25	Health personnel	Person	positive
	26	Percentage of investment in science and technology education	%	positive

3.2 The determination of evaluation method of China's agricultural economic growth quality

After establishing the evaluation index system for the transformation of agricultural development mode, we should first determine the weight of each index. At present, the method of determining index weight is divided into two categories: subjective weight assignment and objective weight assignment. The subjective weight assignment mainly includes Delphi method, analytic hierarchy process and so on. The objective weight assignment method mainly contains factor analysis method, entropy method, optimal sequence diagram method and variation coefficient method. This paper adopts the entropy method.

Entropy method is mainly used to determine the weight by obtaining information entropy of each index. If the information entropy is smaller, the degree of disorder of information is lower, the index variance is bigger, the more information is transmitted, and the more weight is given to the index. On the other hand, if the information entropy is greater, the degree of disorder of information is higher, the

index variance is smaller, the less information is transmitted, the less weight is assigned to the index. Information entropy is an objective description of the degree of divergence between indicators, and it does not add any man-made factors. Therefore, the results are objective, authentic and scientific by using information entropy to determine the weight of the index and to evaluate the transformation of agricultural development mode.

In order to evaluate the level of agricultural economic growth quality of m year in a certain area, the evaluation index system has n indexes, and establishes mathematical model: The domain is $U = \{u_1, u_2, ..., u_m\}$, each sample consists of data representation of m indicators, namely $u_i = \{X_{i1}, X_{i2}, ...X_{im}\}$, and can get the original data matrix of the evaluation system $X = (x_{ij})_{m \times n}$, the data standardization matrix is $B = \{b_{ij}\}_{m \times n}$, The larger the gap between index value x_{ij}, the more important the index is in the comprehensive evaluation. The information entropy value of x_j is $e_j = -k \sum_{i=1}^{m} b_{ij} \ln b_{ij}$ the constant k in the formula is related to the sample number m of the system. If the index value is all equal, then the index will not function in the comprehensive evaluation, the higher the order degree of a system, the greater the information entropy, conversely, the lower the information entropy. Therefore, we can calculate the weights of each index according to the difference degree of each index value and the tool of information entropy, providing the basis for multiple indexes comprehensive evaluation.

For a system with a complete disorder of information, $e = 1$; When the m-sample is in a completely disordered state of distribution, $b_{ij} = 1/m, k = 1/\ln m$, $0 \le e \le 1$.The information utility value of the index of the item j is determined by the difference between the information entropy e_j and 1. By using the entropy value method to estimate the weights of each index, the essence is to calculate the value coefficient of the index information, the higher the value coefficient, the greater the importance to the evaluation, the weight of index of the item j is $w_j = d_j / \sum_{j=1}^{m} d_j$.

For the evaluation of the sample, it is possible to use the product f_{ij} of the weight w_j of item-j index and the evaluation index proximity x'_{ij} of item-j of sample-i in the standard matrix as the evaluation value of, namely $f_{ij} = w_j x'_{ij}$, The evaluation value of sample-i is $f_i = \sum_{j=1}^{m} f_{ij}$.

For the evaluation system of the multilayer structure, according to the additive of information entropy, using the index information utility value of the lower structure, the weight W_j corresponding to the upper structure is determined according to the proportion. The utility value of each index of the lower structure is summed up, the sum D_k of utility value of different kinds of indexes, is obtained, and then the sum of

utility values of all indexes. The weight of the corresponding subsystems of $W_k = D_k / D$, the weight of the index corresponding to the upper structure is $W_j = d_j / D$, therefore, the evaluation value of the index corresponding to the upper structure is: $f'_{ij} = \sum_{i=1}^{n} W_j x'_{ij}$, if a high level contains k points, then the evaluation value of the upper structure: $F = \sum_{i=1}^{k} \sum_{j=1}^{n} W_j p_{ij}$.

3.3 The steps of comprehensive evaluation by entropy method

Firstly, process the value of each index dimensionless. Convert each index value x_{ij} into a relative number x'_{ij} without units, while the numerical specification is within [0, 1]. In this analysis, the dimensionless method of sampling linear type is: for the positive index (the larger the better index), $x'_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)}$; for the reverse index (the smaller the better index), $x'_{ij} = \frac{\max(x_j) - x_{ij}}{\max(x_j) - \min(x_j)}$.

Secondly, the coordinate translation and normalization of dimensionless data. In order to eliminate the effect of the normalized logarithmic calculation, coordinate translation for x'_{ij}, the formula is: $b_{ij} = x'_{ij} + A$, A is the translation amplitude, $A > \min(x'_{ij})$. The closer the value of A is to $\min(x'_{ij})$, the more significant the evaluation result is (A = 0.01). After the coordinate translation normalized the data according to the calculation formula is: $p_{ij} = b_{ij} / \sum_{i=1}^{m} b_{ij}$, and the normalized matrix $P = (p_{ij})_{m \times n}$ is obtained.

Finally, calculate the entropy value e_j and redundancy of the index d_j. Among them: $e_j = -k \sum_{i=1}^{m} p_{ij} \ln p_{ij}, k = 1 / \ln n; d_j = 1 - e_j$, measured the difference between the indexes, the smaller the entropy value e_j is, the larger the differential coefficient d_j is, the more important the indexes are. On this basis, calculate the

weight $w_j = d_j / \sum_{i=1}^{n} d_j$ and further can get the comprehensive evaluation score of agricultural economic growth quality in the i year $F_i = \sum_{j=1}^{n} (w_j \times p_{ij})$.

4 Results

4.1 Analysis of the evaluation index system of China's agricultural economic growth quality

Based on the formula of entropy method above, the regional disparity of the quality of agricultural economic growth in China from 2000 to 2012 was calculated to evaluate the regional distribution of agricultural economic growth quality.

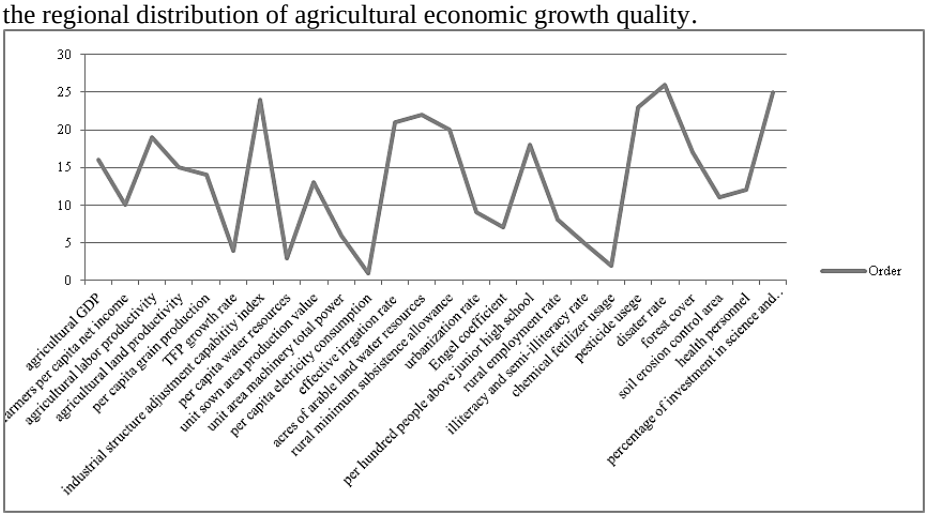

Fig. 1. The weight of each evaluation index of China's agricultural economic growth quality.

Using entropy method, we can obtain the weight of 26 indexes according to the collected data (see **Chyba! Nenalezen zdroj odkazů.**). Most of the data of this article from "China Statistical Yearbook", "China Compendium of Statistics 1949-2008", etc., some information can be directly obtained by the data, and some of the data which cannot be directly acquired is obtained by simple calculation and transformation.

From the perspective of the evaluation index weight of China's agricultural economic growth quality in Fig. 1, the weights of per capita electricity consumption, fertilizer application rate, per capita water resources, TFP growth rate, illiteracy and semi-illiteracy rate, etc., were higher. It means the above indexes have an important influence on the quality of agricultural economic growth. On the whole, the four aspects of agricultural production efficiency, agricultural economic structure, farmers'

life quality and sustainable development of China's agricultural economic growth is not negligible importance, anyone will affect the quality of China's agricultural economic growth.

4.2 The comprehensive evaluation of agricultural economic growth quality of different regions in China

According to the weight of each index in the evaluation system of the process of China's agricultural economic growth quality, the comprehensive scores of each subsystem and the quality of agricultural economic growth are calculated, and the results are shown in Tab. 2.

Table 2. The comprehensive evaluation of China's agricultural economic growth quality.

District	Agricultural production efficiencv		Agricultural economic structure		Farmers' quality of life		Sustainable development		Weighted total factor	
	Score	Order	Score	Order	Score	Order	Score	Order	Score	Order
Beijing	0.14497	1	0.11186	4	0.12467	6	0.06716	28	0.44866	3
Tianjin	0.12787	3	0.115	3	0.08844	29	0.06231	29	0.39362	8
Hebei	0.09319	11	0.07603	8	0.12199	7	0.11101	12	0.4022	6
Shanxi	0.05362	19	0.02922	19	0.1014	21	0.12933	7	0.31357	20
Inner	0.0426	23	0.01796	26	0.10193	20	0.15169	1	0.31418	19
Liaoning	0.09837	9	0.05732	11	0.09509	25	0.12577	9	0.37654	9
Jilin	0.09389	10	0.01842	25	0.09073	27	0.12523	10	0.32826	13
Heilong	0.06034	18	0.00546	31	0.10031	22	0.14281	3	0.30892	21
Shanghai	0.13944	2	0.16968	1	0.09071	28	0.04933	30	0.44916	2
Jiangsu	0.12446	4	0.09011	6	0.12119	9	0.06981	27	0.40556	5
Zhejiang	0.10755	6	0.1114	5	0.13763	1	0.10263	15	0.45922	1
Anhui	0.04033	27	0.03078	17	0.12478	5	0.09464	21	0.29053	24
Fujian	0.10402	7	0.06536	10	0.10643	17	0.04023	31	0.31603	18
Jiangxi	0.04371	22	0.0307	18	0.09856	24	0.11172	11	0.28469	26
Shandong	0.11454	5	0.07113	9	0.12675	3	0.09457	22	0.40698	4
Henan	0.06921	14	0.04276	12	0.1335	2	0.09386	23	0.33933	12
Hubei	0.08034	12	0.0257	20	0.09404	26	0.09552	20	0.29559	23
Hunan	0.07752	13	0.03626	16	0.10254	18	0.10235	16	0.31867	15
Guangdong	0.06505	16	0.08279	7	0.11054	15	0.08514	25	0.34352	11
Guangxi	0.04042	26	0.02309	23	0.10244	19	0.09684	19	0.2628	29
Hainan	0.09929	8	0.03817	14	0.07436	31	0.0719	26	0.28371	27
Chongqing	0.03308	29	0.01623	28	0.09924	23	0.10127	17	0.24982	31
Sichuan	0.04127	25	0.01905	24	0.10891	16	0.14856	2	0.31779	16

Guizhou	0.00661	31	0.006	30	0.11752	11	0.12684	8	0.25695	30
Yunnan	0.04219	24	0.01613	29	0.11668	12	0.13378	6	0.30879	22
Tibet	0.00732	30	0.15961	2	0.11835	10	0.11082	13	0.39611	7
Shaanxi	0.06734	15	0.02319	22	0.12516	4	0.13998	5	0.35567	10
Gansu	0.03572	28	0.01685	27	0.12163	8	0.14217	4	0.31636	17
Qinghai	0.05226	20	0.04213	13	0.11508	13	0.11035	14	0.31982	14
Ningxia	0.05117	21	0.02321	21	0.1144	14	0.09788	18	0.28665	25
Xinjiang	0.06264	17	0.03694	15	0.08192	30	0.09347	24	0.27497	28

We found that China's agricultural economic growth quality differences between provinces from Tab. 3, the comprehensive score of agricultural economic growth quality factor of the national 31 provinces (autonomous regions and municipalities) are between 0.249819 ~ 0.459216 in the 12 years from 2000 to 2012. The main characteristic is the eastern provinces, especially the southeast coastal areas, have the highest quality of agricultural economic growth, the second in the central region and the lowest in the western region. Among them, the eastern region accounted for 9 of the 11 provinces with high-quality factors for agricultural economic growth, and 2 in the west. The central provinces accounted for 6 of the 10 provinces that at the middle level, 3 in the west and 1 in the east. Of the 10 provinces with lower scores, 5 were in the west, 4 in the central and 1 in the east.

The four subsystems of agricultural production efficiency, agricultural economic structure, the farmers' quality of life, agricultural sustainable development all have different degrees of contribution to China's agricultural economic growth quality. Moreover, the farmers' quality of life and sustainable agricultural development are the main factors that affect the quality of agricultural economic growth process, and achieved remarkable results. Farmers' life quality subsystem contributed 32.29% of the increase in the 12 years, and the agricultural sustainable development subsystem contributed 30.97% of the increased score., this shows that from 2000 to 2012 with the development of the economy, China has made great progress in per capita electricity consumption, fertilizer application rate, per capita water resources , TFP growth rate, illiteracy and semi-illiteracy rate, per unit area agricultural machinery total power, Engel's coefficient and rural employment rate. The agricultural production efficiency subsystem contributed 21.29% of the increase in score, while the agricultural economic structure subsystem contributed 15.43% of that. The contribution of the agricultural economic structure subsystem is less than the weight of its own, which indicates that the change of agricultural economic structure lags behind economic development. In addition, the contribution of agricultural production efficiency subsystem is less than its weight as well, which proves that the agricultural development in the 12 years is extensive and not sustainable. The rural developed at the cost of resource consumption and environmental pollution, and only achieved the growth of agricultural output, but not the corresponding economic development and social progress, resulting from the less attention being paid on the elevation of the living standards of rural residents.

5 Conclusion

For one thing, innovating the technological level of agricultural production and improving the technical efficiency. This includes three aspects, first of all, to increase innovation and development of new technologies. We should speed up the construction of a modern agricultural technology system, vigorously train scientific and technological leaders, deepen the Production-Study-Research cooperation, and improve the development of agricultural science and technology. Besides, we should vigorously develop diversified, socialized agro-technology, popularize the service organizations and farmers' cooperative organizations, regularly conduct professional training and cultivate practical talents on the labor force in the countryside. Secondly, strengthen the contact between scientific research institutions and agricultural production personnel, so that the research of agricultural science and technology can be applied to agricultural production to a greater extent, and promote the development of actual productivity of agriculture. To deepen reform of rural science and technology system, increase the investment in agricultural scientific research, increase subsidies for farmers using agricultural technology, encourage scientific research institutions and technical personnel at all levels to increase the research and development for the agricultural products market, and promote the construction of folk scientific research organizations. Thirdly, perfect the agricultural technology promotion system. We should strengthen the promotion of advanced practical agricultural technologies, focusing on the promotion of good varieties, water-saving irrigation, formula fertilization, integrated pest control, crop cultivation and management. Besides, we should establish the novel diversified system of agricultural technology promotion, strengthen the public welfare function of agro-technical extension service, promote the agricultural sci-tech household project comprehensively, foster the agricultural science and technology demonstration household and enhance their ability of radiation-driven. We should strengthen the construction of agricultural sci-tech service platform, perfect the network of the agricultural sci-tech trade market and accelerate the transformation of sci-tech achievements.

For the other thing, improve the quality of agricultural labor force. Attaching importance to the education and cultivation of the quality and competence of the rural labor force, we should pay attention to the following aspects: first, we should continue to increase the investment in rural education, pay attention to the education in rural and backward areas, realize the improvement of rural education in Shaanxi province, and improve the education age and level of the agricultural population. Second, improve the efficiency of investment in education. We should increase the input of basic education in rural areas and improve the effectiveness and efficiency of the investment; we should strengthen the cultivation of the students majoring in agriculture and forestry, and encourage them to join in the actual production and operation. Third, we should pay attention to the training of farmers ' professional skills, and make them change from experience-based to knowledge-based, from go-it-alone to an organizational type, from an identity style to a professional style.

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