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Evaluation of development of agricultural modernization in central China

Yuancong Wang^{1,a} and Qingyuan Zhou^{2,b,*}¹*School of Political Science, Sichuan University, China*²*Center for Rural Development, Sichuan University, China*^a*yuancongwang@yeah.net*, ^b*qingyuanzhou@foxmail.com***Corresponding author*

Abstract.

Based on multiple-index comprehensive evaluation, the evaluation system of agricultural modernization was constructed, and the level of agricultural modernization in central China was evaluated. As results showed, central China as a whole is still in the beginning stages of the modernization of agriculture, lagging behind the eastern region significantly. To promote agricultural modernization of central China, differently local resource endowments and levels of development on current situation must be considered, and measures should be taken in a line with the local condition and step-by-step, exerting their comparative advantages and selecting the dominant mode, strategic focus and implementation path of agricultural modernization.

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1. Introduction

In recent years, as the studies on “Sannong problems” (issues concerning about rural, agriculture, farmers) are booming, the researches on the design and evaluation of agricultural modernization index system from China's macroeconomic management sector and academia are getting further.

In the perspective of the index system design, the principles of various types of research are different, one type origin from the connotation of agricultural modernization, designing indicators and trying to fully reflect

its contents, but often leading to a lack of operability for poor indicator data accessibility; the other is based on statistical data, designing in accordance with the agricultural modernization core connotation, drawback is the lack of systematicness and comprehensiveness in the index system.

From designed index systems, most of the researches get design from agricultural production conditions, the level of agricultural science and technology, agricultural management, the quality of life of farmers, rural ecological environment. Representatively: Mei Fangquan(1999) proposed a system of seven major categories with 22 indicators, and the four stage of the modernization of agriculture [1]; Ke Binsheng(2000) designed nationally basicly-achieved agricultural modernization index system with 10 indicators [2]; Jiang Heping(2006) established evaluation index system of agricultural modernization with four criteria indicators and 15 individual indicators [3]; Cheng Zhiqiang, et al (2003) established agricultural modernization index system from the level of modernization and modern quality [4]; Zhao Jingyang (2007) established generalized agricultural modernization evaluation index system that include the modernization of agriculture, rural and farmers [5]. However, because the natural, economic and social conditions of the various regions are quite different objectively, and subjectively, the researchers' understanding of the connotation of agricultural modernization was different, the agricultural modernization index systems are quite different.

Although the existing research is voluminous, but its breadth, reliability, the effect is still unsatisfying. Based on reality, the nature and implications of agricultural modernization, to improve agricultural modernization comprehensive evaluation index system, get a comprehensive evaluation of the level of development of regional agricultural modernization, definite the stage of regional agricultural modernization, and find out short plate and constraints of agricultural modernization in different region, have important theoretical value and practical significance for the regional development of the future development of agricultural modernization goals and select the correct mode of agricultural modernization.

2. Construction of evaluation index system of Agricultural modernization index

2.1 Choose evaluation indicator

After comprehensively considering systematicness, comprehensiveness, orientation, operability, comparability of the indicators, take multi-index comprehensive assay, by strict hierarchical screening to determine the comprehensive evaluation index system for the modernization of agriculture. The first layer is a composite indicator representing the level of agricultural modernization, indicated as agricultural modernization composite index. The second layer is the main indicators representing the level of the main aspects of agricultural modernization, the main indicators consist of four components which are agricultural production conditions indicators, comprehensive agricultural output capacity indicators, the level of social development indicators in rural areas and agricultural resources and environment conditions indicators respectively. The third level is the groups indicators that reflect the basic content of the main indicators, the specific indicators to measure the level of agricultural modernization are 22 (see Table 1).

2.2 Determination of index weights of all levels

Combine the advantage of Delphi method and analytic hierarchy process, to determine index weights of the various levels. First, based on expert's opinion, with respect to the composite indicator, construct a comparison of the main indicators of discrimination matrix; contrast to the main indicators, construct the group indicators discriminant matrix. Secondly, do consistency test on the discriminant matrix. Tell if the discriminant matrix can pass logical consistency test. Finally, calculate the weight of the main indicators and groups of indicators (see Table 1).

2.3 Date normalization

Due to the different dimensions of the original data, after comparison, use the optimal state value method to standardize the raw data. First, calculate the value of indicators of the regional groups based on statistical data. Secondly, find out the optimal value. The maximum value of positive indicators is the optimal state value; minimum value of the inverse indicators is the optimal state value. Finally, take the optimal state value of various indicators as coefficient 1, calculate percentage coefficient of various regional groups indicators relative to the optimal index.

2.4 Construction of evaluation model

According to the index system settings, as well as indicators of level analysis, build the evaluation model of agricultural modernization, its formula is $Z = \sum_{j=1}^4 W_j Y_j$

In the formula, Z is comprehensive evaluation index for the agricultural modernization, reflecting the overall level of agricultural modernization in a certain stage, the size of the composite index is positively correlated with the level of modernization. W_j represents the weight of the main indicators, Y_j indicates the values of the main indicators.

Table 1 Weights of various indicators in evaluation index system of agricultural modernization.

	Main index (weight)	Canopy index	Weight
Comprehensive evaluation index of agricultural modernization(Z)	Agricultural production input conditions Y ₁ 0.2404	Per capita rural fixed assets investment	0.2303
		Agricultural science and technology personnel accounts for the proportion of agricultural labor force	0.3229
		Farmland effective irrigation rates	0.1160
		Ensure stable yields despite drought or excessive rain rate	0.0813
		Total power of agricultural machinery in Unit area of cultivated land	0.0695
		Total power of agricultural machinery for per labor	0.1160
		Fertilizer Consumption of per unit cultivated area	0.0640
	Comprehensive agricultural output capability Y ₂ 0.1472	Integrated rural commodity rate	0.2749
		Output rate of arable land	0.1300
		Agricultural productivity	0.5355
		Output of meat milk eggs per capita	0.0597
	Rural social development level Y ₃ 0.5479	Urbanization rate	0.0898
		Per capita net income of rural households	0.2016
		Rural Engel's coefficient	0.0630
		Number of doctors per thousand people	0.1259
		Labour-culture conditions of rural households	0.3308
		Number of village (street)culture centre per thousand people	0.0630
	Agricultural resources and environment condition Y ₄ 0.0646	Rural Informatization level	0.1259
		Forest coverage	0.7258
Agricultural disaster rate		0.1721	
	Marsh gas usage	0.1020	

$$Y_j = \sum W_i X_i \times 100$$

Wherein, W_i representing the weight of groups indicators, X_i indicates the standardized values of the groups of indicators.

According to the foregoing analysis, and the value of Z and Y_j is determined by the following formula:

$$Z = 0.2404Y_1 + 0.1472Y_2 + 0.5479Y_3 + 0.0646Y_4$$

$$Y_1 = (0.2303X_1 + 0.3229X_2 + 0.1160X_3 + 0.0813X_4 + 0.0695X_5 + 0.1160X_6 + 0.0640X_7) \times 100$$

$$Y_2 = (0.2749X_8 + 0.1300X_9 + 0.5355X_{10} + 0.0597X_{11}) \times 100$$

$$Y_3 = (0.0898X_{12} + 0.2016X_{13} + 0.0630X_{14} + 0.1259X_{15} + 0.3308X_{16} + 0.0630X_{17} + 0.1259X_{18}) \times 100$$

$$Y_4 = (0.7258X_{19} + 0.1721X_{20} + 0.1020X_{21}) \times 100$$

2.5 Partition of agricultural modernization Stages

According to the course and characteristics of the agricultural development in the developed countries, the modernization of agriculture can be divided into the preparation stage (0-30), starting stage (30-50), (50-70) of the initial implementation stage, basic implementation stage (70-90) developed stage (90), reflecting the degree of modernization of agriculture from low to high dynamic development process.

3. Quantitative evaluation and analysis of the level of development of agricultural modernization in the central region of China

Take data from China Statistical Yearbook (1979 to 2010), China Rural Statistical Yearbook "(1979 to 2010)," China's Agricultural Yearbook "(1979 to 2010)," Sixty years of New China Statistical Information "and Yearbook in various provinces as the basis for evaluation data, supplement and repair the missing raw data for some indicators according to the the Year or region around the reference in this part of the data.

3.1 The overall evaluation of the level of development and development stage in the central region of China

From 1978 to 2009, the process of agricultural modernization in the central region has experienced two major stages, the preparation stage (1978 to 1986) and the starting stage (1987 to 2009). From 1978 to 2009, the development of agricultural modernization level of the central region showed a steady upward trend overall, the comprehensive index of the agricultural modernization grew from 26.11 in 1978 to 49.00 in 2009, with an average annual growth rate of 2.05%. Since 2003, the comprehensive index of the agricultural modernization in the central region enjoyed rapid growth, with an average annual growth rate of 4.57%. In accordance with the analysis of the structure and stage of the country's economic development of Chenery and Salguiyin, central China stepped into the middle stage of industrialization in 2009. According to the relationship between the stage of economic development and industrial structure, the intermediate stage of industrialization generally corresponds to the starting stage and the initial stage of the agricultural modernization, and it is basically consistent with the conclusions drawn from Chenery standards. Overall, agricultural modernization of the central region has experienced a preparation stage, is at a higher level in the beginning stages, and is striding

forward the initial stage (see Figure 1). Point of view, the overall level of development in the central region is lower than the eastern and northeastern regions, and is slightly higher than the western region.

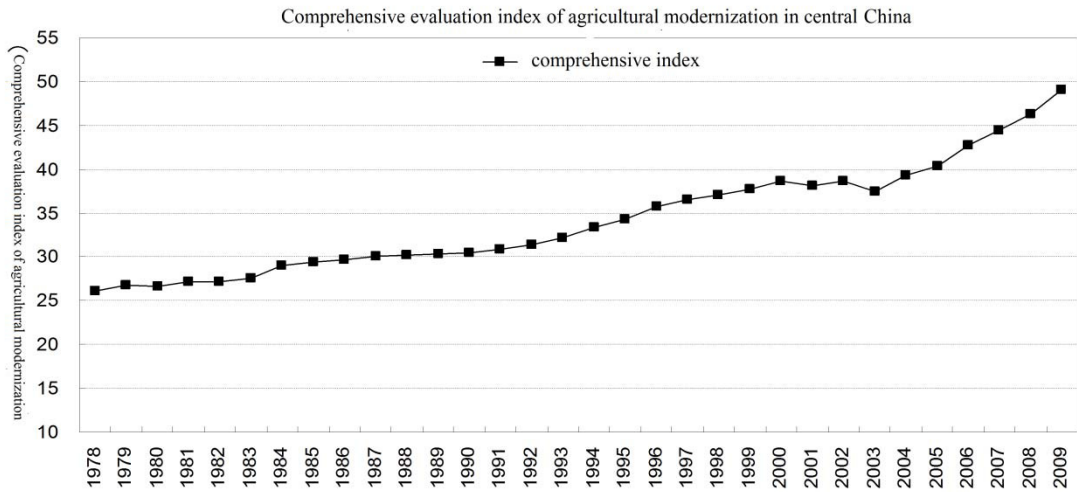


Figure 1. Comprehensive evaluation index of agricultural modernization in central China

At the same period, the eastern region has experienced the preparation stage and the initial stages, and has entered the initial implementation stage of the of agricultural modernization, the average agricultural modernization comprehensive evaluation index rose from 28.23 to 62.59, with an average annual growth of 2.60%; Northeast region also has experienced a preparation stage ,entered the beginning stages, and the initial implementation stage of agricultural modernization of the lower level, the average agricultural modernization comprehensive evaluation index rose from 30.18 to 54.69, with an average annual growth of 1.94%; the average western region agricultural modernization comprehensive evaluation index increased from 22.31 to 44.18, the average annual growth rate of 2.23% (see Figure 2).

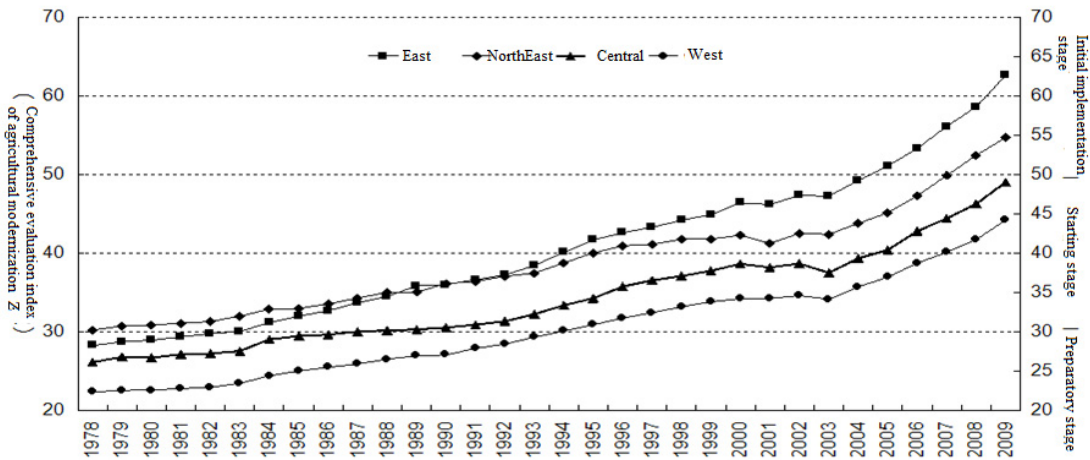


Figure 2. Comparison chart of comprehensive index of agricultural modernization in four regions in China

Look at each province in central China, the development imbalance exists within. Among them, Anhui has the highest average growth rate of agricultural modernization comprehensive evaluation index, 2.50%; Shanxi Province is the slowest, 1.63%; followed by Jiangxi Province, 2.32%, Henan Province, 2.17%, Hubei Province, 1.91%, Hunan Province 1.86%. From the absolute level of development in 2009, the order of the central provinces is, Jiangxi (52.64), the country ranked 14; Hunan (49.88), the country ranked 15; Henan (49.31), the country ranked 17; Shanxi (48.36), the National ranked 19; Hubei (47.31), the country ranked 22; Anhui (46.52), the country ranked 25. The central region is in the level of the middle and lower reaches of the country as a whole, in which, Jiangxi has taken the lead into the modernization of agriculture the initial implementation stage and reach the national average level of development (see Figure 3).

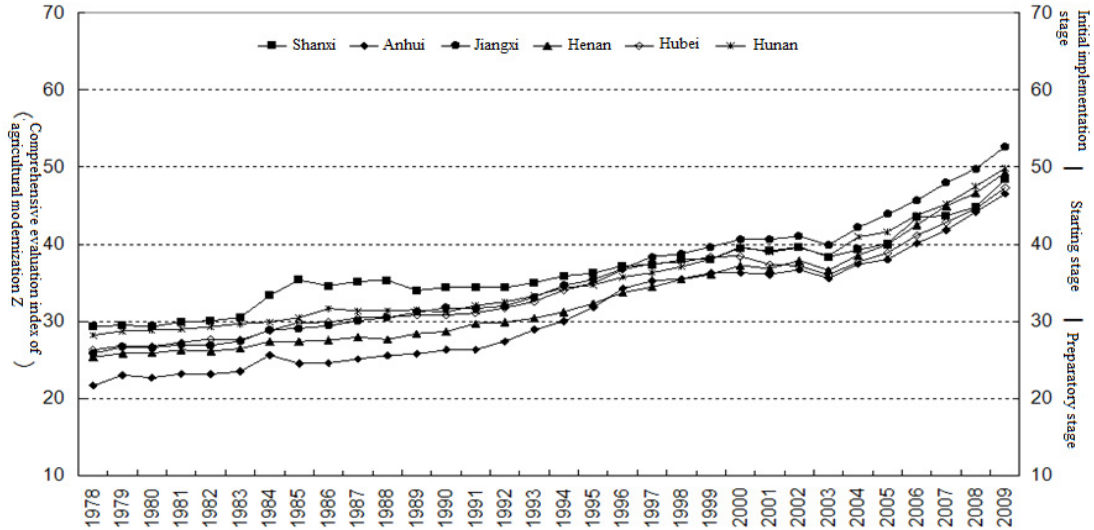


Figure 3. Development level of agricultural modernization in provinces of central China

3.2 Analysis of agricultural production inputs conditions of the central region

To some extent, input determines output. There has been a certain degree of volatility in agricultural production inputs conditions in the central provinces in about 1991 and 2001, in Hubei Province, the growth was almost stagnant in the period 2001 to 2008, mainly due to slowing down rural fixed asset investment, the decline of the proportion of agricultural science and technology personnel and the decline of irrigation level. Take horizontal comparison with other regions, from 1978 to 2009, the central region, the average annual growth rate of agricultural production inputs index was 2.47%, lower than the growth rate of 2.85% of the eastern, northeastern growth rate of 2.65%, even lower than the 2.63 percent increase in the western speed. Compared with the developed areas in the east, the gap is further widening, inadequate investment is still one of the major constraints on the development of central agricultural modernization. Specifically, in 2009, agricultural production inputs index level sort order is Jiangxi (33.76), Henan (31.55), Hunan (31.50), Anhui (28.19), Shanxi (27.61) and Hubei (21.99). About growth rate, from 1978 to 2009, the average annual growth rate of the order is Henan (3.20%) in Shanxi (3.07%), Anhui (2.98%) the Jiangxi (2.88%), Hunan (1.78%) and Hubei (1.09 %).

3.3 The comprehensive production capacity of the agriculture in the central regions

Comprehensive agricultural production capacity is the comprehensive output with relatively stable agricultural production factors, which formed in agricultural reproduction process. It indicates the efficiency and effectiveness of agricultural production. On the whole, the central provinces showed an upward trend. Shanxi Province, however, has shown some fluctuations since 2000. The main reason is that the production rate of arable land and labor productivity declined under external factors. From the horizontal comparison with other regions, during the time from 1978 to 2009, the average annual growth rate of the comprehensive agricultural output index in central regions was 3.36%, lower than the growth rate of eastern part (4.68%), the growth rate of northeast part (3.93%) and the growth rate of western part (3.63%). Specifically, in 2009, the sort order of the comprehensive output index of agriculture in the central regions is Hunan (39.92), Jiangxi (39.70), Anhui (39.34), Henan (38.84), Hubei (38.20) and Shanxi (29.71). From 1979 to 2009, the sort order of the average annual growth rate is Jiangxi (3.62%), Henan (3.52%), Hubei (3.38%), Anhui (3.28%), Hunan (3.23%) and Shanxi (3.12 %), which has no significance difference.

3.4 *The social development level analysis of rural areas in central regions*

The level of social development in rural areas is the core indicator of agricultural modernization and it reflects the requirements of the Scientific Outlook on Development in order to improve people's livelihood. From an overall point of view, the rural social development index of central provinces showed an upward trend but also has some fluctuations to some extent in 2003. From 1978 to 2009, the average annual growth rate of the social development index in rural areas of the central region is 1.82%, lower than the eastern growth rate (2.31%) and the western growth rate (1.96%), but higher than the growth rate in Northeast China (1.62%). Specifically, in 2009, the sort order of social development index level in the rural areas of central region is Shanxi (65.29), Henan (61.14), Jiangxi (61.00), Hubei (59.94), Hunan (58.62) and Anhui (56.55). From 1979 to 2009, the sort order of the average annual growth rate is Anhui (2.25%), Jiangxi (2.05%), Hubei (1.88%), Hunan (1.77%), Henan (1.76%) and Shanxi (1.35 %).

3.5 *The analysis of agricultural resource and environment conditions of the central regions*

The agricultural resource and environment index reflects the sustainable development level in the modernization of agriculture and the harmony degree between man and nature. From an overall point of view, the agricultural resource and environment index of central provinces is increasing slowly with fluctuations, but the overall upward trend is less obvious. Especially, from 1984 to 1988, Shanxi Province has a great fluctuation, mainly due to the relatively large fluctuation of forest coverage. From 1978 to 2009, the average annual growth rate of agricultural resource and environment index in the central regions is 1.84%, less than the western growth rate (2.24%), but higher than the eastern growth rate (1.45%) and the Northeast growth rate (0.80%). Specifically, in 2009, the sort order of agricultural resource and environment index in central regions is Jiangxi (81.44), Hunan (66.73), Hubei (55.05), Anhui (45.87), Henan (38.84) and Shanxi (24.46). From 1979 and 2009, the sort order of the average annual growth rate is Henan (2.95%), Anhui (2.79%), Jiangxi (2.15%), Hubei (1.78%), Hunan (1.21%) and Shanxi (0.32%).

4. **Conclusion**

Based on multiple-index comprehensive evaluation, the evaluation system of agricultural modernization was constructed, and the level of agricultural modernization in central China was evaluated. As results showed, central China as a whole is still in the beginning stages of the modernization of agriculture, lagging behind the eastern region significantly.

In the vast rural areas in central regions, the agricultural development is uneven. To promote the agricultural modernization, we must adhere to the local conditions, move forward step by step, utilize their comparative advantages and actively explore the multivariate model of building modern agriculture. Follow the laws of nature and the economic and social development, based on their own resource advantages and different levels of development in these areas; explore their distinctive modes and practical paths of agricultural development.

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