

Analysis on the Rationalization of Agricultural Industrial Structure in Western China

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Abstract. The rationalization of industrial structure refers to the aggregation quality among industries. On the one hand, it can reflect the degree of coordination among industries, and on the other hand, it can also reflect the degree of effective use of resources. The measurement of rationalization of industrial structure is a measure of the coupling degree between factor input structure and output structure. Through the construction and verification of the structural rationalization model, the agricultural development in western China is evaluated and analyzed.

Keywords: agricultural industrial structure; Rationalization; Model building.

1. Model principle

1.1 Weight of rationalization of labor structure

The research on the "rationalization" of agricultural industry in China is mainly based on qualitative research and simple quantitative research, that is, the structural rationalization of agriculture, forestry, animal husbandry and fishery industry. The rationalization of agricultural industrial structure should be expressed by more integrated, more comprehensive and more targeted indicators. Compared with the current situation that the quantitative research on the rationalization of agricultural industrial structure is relatively single, the research on the "rationalization" of industrial structure shows a rising trend, such as Huang Zhongwei (2003), Liu Manfeng (2019), Li Jianping (2019) and other scholars.

Gan Chunhui et al. (2011) used the measurement method of industrial structure rationalization for the rationalization of agricultural industrial structure. According to Gan Chunhui's point of view, the rationalization of industrial structure refers to the aggregation quality among industries, which can reflect the degree of coordination among industries on the one hand, and the degree of effective utilization of resources on the other hand. The measurement of industrial structure rationalization is a measure of the coupling degree of factor input structure and output structure. The following measure formula is proposed. [1]:

$$P = \sum_{i=1}^n \left| \frac{Y_i / L_i}{Y / L} - 1 \right| = \sum_{i=1}^n \left| \frac{Y_i / Y}{L_i / L} - 1 \right| \quad (1)$$

The formula is based on the principle of structural deviation degree, according to the classical economic assumption that the economy will eventually be in equilibrium and the productivity level of each sector will be the same, where: P represents the structural deviation degree; Y represents the output value; L stands for employment; I represents industry; N represents the number of industrial sectors; Y/L stands for productivity (when the economy is in equilibrium). $Y_i/L_i = Y/L$, then $E = 0$); L_i/L : indicates the employment structure. Based on the expression of this method, the P value reflects the coupling between the output structure and the employment structure. This method synthesizes and improves many previous research results, and is a highly recognized method in the field of industrial structure rationalization.

Gan Chunhui (2011) introduced Theil entropy (Theil index) to improve the model and formed the rationalization of industrial structure. TL' The formula for the measure of is as follows:

$$YL' = \sum_{i=1}^n \left(\frac{Y_i}{L_i} \right) \ln \left(\frac{Y_i / Y}{L_i / L} \right) \quad (2)$$

Due to the limitation of data collection, the application of the formula in the field of agricultural industry can only reflect the employment structure, productivity and other information, so this paper defines the calculation results of the formula as the rationalization component of labor structure, which is also reasonable in the field of agriculture. According to the current situation of agricultural development in Western China, the comprehensive agricultural production capacity has been significantly improved. The basic position of agriculture is more stable. However, under the constraints of resources and environment, the shortage of young and middle-aged labor force is a fact, and the impact of labor force on agricultural output can not be ignored. With the rapid development of industrialization and urbanization, agricultural labor force continues to precipitate into non-agricultural industries on a large scale, which is a challenge to the degree of agricultural modernization and the productivity of agricultural machinery in the western region. The rationalization of labor input is an important direction of development. In addition, the research results of some scholars show that due to resource constraints and backward technology, the labor force creation of poor farmers in poverty-stricken areas is still relatively single, in the traditional business model (Gong Xiuyun Qinfu 2006), which is in the development of agricultural modernization in most parts of the western region. It is a common fact.

1.2 Rationalization of production configuration

For agricultural industrial structure, because of its huge system and complex evaluation, the rationalization of labor structure can only reflect one aspect. Based on the theory of industrial layout, this paper constructs the rationalization index of production allocation for comprehensive consideration. Based on the analysis of location quotient and shift-share method, this paper holds that for agricultural production in the western region, Whether to focus on the development of industries with advantages and potential is the evaluation criterion of rationalization, which can be understood as the degree of regional attention to advantageous industries, and it is reasonable to take this factor into consideration of rationalization development. At the same time, through the analysis of location quotient, we can know that agriculture, forestry and animal husbandry in the western region have the ability of self-sufficiency. It has relatively good development potential and advantages, on the contrary, fishery has no advantage in the proportion and location quotient index of the western industry, so it compares the ratio of the growth rate of agricultural, forestry and animal husbandry production resources input with that of the national industry input, and constructs the rationalization component of production allocation. *E* The sustainable development of advantageous industries is conducive to the development of agricultural economy. The calculation formula is as follows:

$$T_i = \frac{(Q_t - Q_{t-1}) - (W_t - W_{t-1}) / 4}{|(W_t - W_{t-1}) / 4|} \quad (3)$$

$$E = \frac{\sum_{i=1}^n T_i}{n} \quad (4)$$

Where *T* stands for *i* Industry (*i* Bring in agriculture, forestry and animal husbandry to calculate separately) the incremental input of production resources and the whole country *i* The ratio of the average input increment of industry can be expressed as the growth index of the input of industrial production resources relative to the national average level (in the statistical yearbook, the whole country is divided into the eastern, central, western and northeastern regions, so the national average increment is calculated by dividing by 4), *T* = 0 indicates that the resource allocation of the industry in the western region is at the national level. *T* > 0 indicates that the resource allocation of the industry in the western region is better than the national average level, and the factor input is higher than the national average level. On the contrary, it is lower than the national average. *Q* stands for the input of production factors of the industry, and *W* stands for the input of production factors of the industry

in the whole country. As the calculation of growth rate, this paper takes the year and the previous year as the reference object, t stands for reporting period, and $t-1$ stands for base period. E If it is positive, it means that the allocation of production resources in the western region is more reasonable and that it is developing its own superior industries. E If the value is negative, it indicates that the allocation of production resources in the western region is unreasonable and does not provide corresponding resources for the dominant industries.

1.2.1 Model construction

Based on the consideration of agricultural natural environment and agricultural industry characteristics, combined with comparative advantage theory and dual structure theory, this paper defines the rationalization of agricultural industry structure as the rationality of the allocation of labor capital and natural resources, which is a comprehensive index reflecting the coordination and initiative of regional resource allocation and consists of the rationalization of labor force and production allocation.

Rationalization of agricultural industrial structure = rationalization of labor force structure + rationalization of production allocation

It can be expressed as:

$$TL = TL' + E \quad (5)$$

The specific calculation formula is:

$$YL = \sum_{i=1}^n \left(\frac{Y_i}{L_i} \right) \ln \left(\frac{Y_i}{L_i} / \frac{Y}{L} \right) + \left(\frac{\sum_{i=1}^n T_i}{n} \right) \quad (6)$$

2. Rationalization and demonstration

2.1 TL' Index calculation

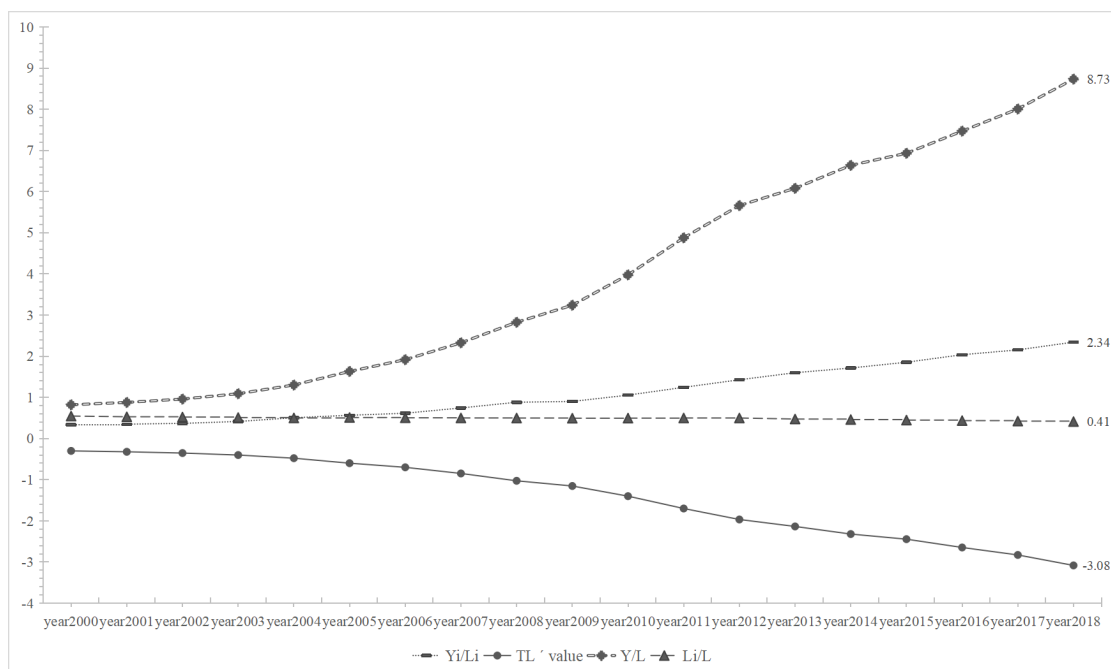


Fig. 1 Comparison trend of TL value and various indicators from 2000 to 2018

TL' The index involves the relevant data of the total output value of the western region, the total output value of the primary industry, the total number of employment in the western region and the total number of employment in the primary industry. Through searching, it is calculated according to formula (2) from the implementation of the western development strategy in 2000 to 2018. TL' Value

and related ratio results (the value of e in the logeformula is calculated according to 2.71828), on the other hand, the value of agricultural industrial productivity and TL' The calculation results of the value can reflect that since the implementation of the western development strategy, the agricultural production efficiency, agricultural mechanization and agricultural modernization in the western region have been improved. The evolution trend of Y_i/L_i (productivity of the primary industry in the west), Li/L (employment structure), Y/L (productivity in the west) and the value of TL' are comprehensively compared and analyzed. As shown in the figure:

From the change trend of TL' value, we can see that since the implementation of the western development strategy, the rationalization degree of agricultural labor input has become more and more "unreasonable" with the passage of time from the state of zero in 2000, and the structural deviation has become more and more serious. According to the actual situation of the development of the western region, according to the data, in 2000, The output value of the primary industry in the western region is 370.678 billion yuan, but the number of people engaged in the primary industry is 11079 0.8 million. By 2018, the labor input in agriculture will gradually decrease. The correlation analysis between productivity and employment structure is as follows:

1) Y/L value: productivity value in the west

Since the implementation of the western development strategy, the productivity (Y/L) of the western region has gradually increased since 2000, which is the most significant and largest growth rate among the indicators. In 2018, the total productivity index of the first, second and third industries in the western region reached 8.73, which is 10.65 times the productivity index of 0.82 in 2000. Since 2009, it has maintained a high growth rate, indicating that the western region has been developing for 20 years. The development mode of accelerating production efficiency and promoting regional GDP has made great contributions to the development of regional economy.

2) Y_i/L_i : the productivity of the primary industry in western China

Through data analysis, it is found that the productivity of the primary industry in the western region has gradually increased from 2000 to 2018, from the initial 0.33 to 2.34 in 2018, compared with the growth rate of all industries in the region. The growth rate of the primary industry in the western region is below the average level. In the regional economic development, the continuous transition to the secondary and tertiary industries is also a manifestation of the upgrading of the industrial structure.

3) Li/L Employment Structure

The proportion of employment in the primary industry in the western region fluctuates slightly from 2000 to 2018, which is the most stable group among the four indicators, indicating that the proportion of employment in the primary industry in the western region has been about 50%, and the data in the chart has gradually decreased in the last seven years. This situation is related to the increase of population in the western region and the development of industrialization, and the flow of population to the secondary and tertiary industries. At the same time, the outflow of labor force in the western region has an impact on the stable development of the employment structure in the primary industry.

2.2 Rationalization index E Measure and calculate

According to the calculation formula of production allocation rationalization index E , it is necessary to collect the relevant production input index data of agriculture, forestry and animal husbandry. In this paper, the total sown area of crops, afforestation area and livestock stock at the end of the year are selected for analysis. The specific indicators are shown in Table 1:

Table 1. Details of Relevant Indicators for Production Configuration Rationalization E Calculation

Indicator representation	Indicator name	Indicator meaning	Source of data
QI (Agriculture)	Agricultural (narrow sense) production factor input	Total sown area of crops in the western region (thousand hectares)	Collated from the column of "Planting (Breeding) Area and Output of Major Agricultural Products" in China Rural Statistical Yearbook
QI (Forestry)	Forestry production factor input	Afforestation area in the western region (thousand hectares)	
QI (animal husbandry)	Production factor input of animal husbandry	Livestock on hand at the end of the year in the western region (10,000)	
W _i	Input of production factors of national i-industry	National data for the above indicators	

Through data collation

It is shown in the following trend chart of each indicator from 2000 to 2018:

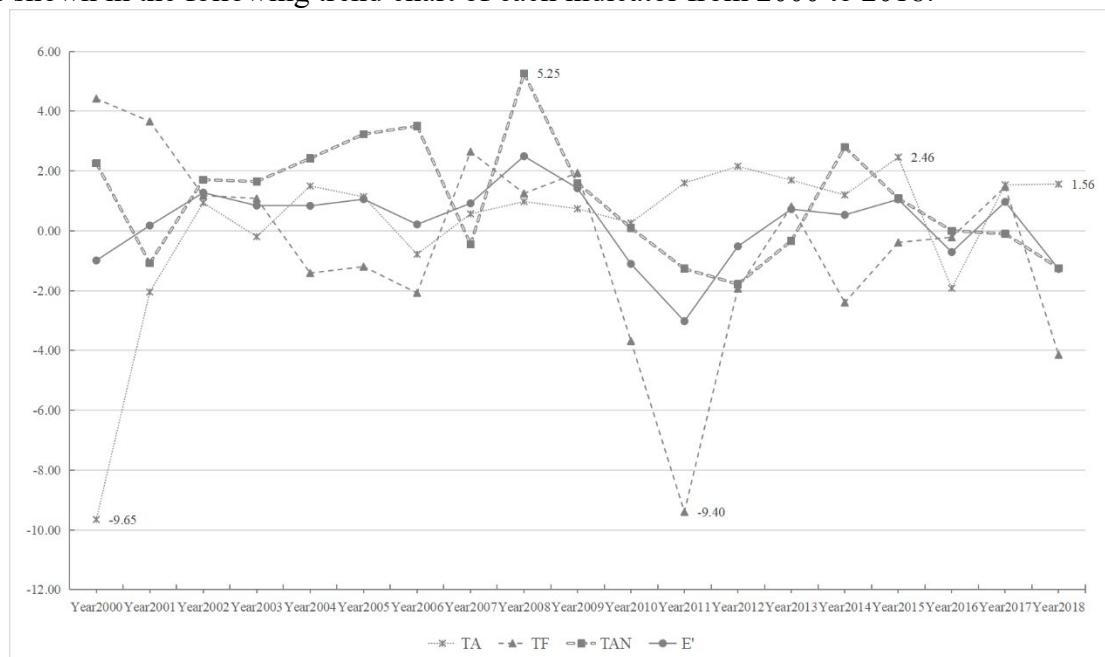


Figure 2. Growth Trend of Industrial Production Resources

According to the calculation principle of the formula, the value of each index of production allocation rationalization is analyzed, and two lowest values -9.65 and -9.40 can be seen as a whole, which respectively reflect the growth rate index of crop sown area in the western region in 2000 and the growth rate index of afforestation area in the western region in 2011. The analysis of the original data shows that the total sown area increment of crops in the western region in 2000 is -194.4 thousand hectares. The total increment of the whole country was -73 thousand hectares, with an average increment of -18.25 thousand hectares. Although the sown area of crops decreased in the whole country, the rate of decrease in the sown area of crops in the western region in that year greatly exceeded the national average increment. In 2011, the total afforestation area increased by 86.7 thousand hectares, with an average increase of 21.68 thousand hectares. However, the increment in the western region was -182 thousand hectares, which was much lower than the national average increment, and the growth rate was negative, so the agricultural allocation in that year was unreasonable. Corresponding to the lowest value of the growth rate index, the animal husbandry in the western region had a peak in 2008, when the livestock stock decreased by 586000 at the end of

the year, while the western region still maintained an increase of 623000 in that year, with a growth rate index of 5.25. It far exceeds the national average level, indicating that the western region has intensified the development of animal husbandry in that year, and the production resources are obviously inclined to animal husbandry.

Rationalization index of production allocation *E* It is a comprehensive index of crop sown area, afforestation area and livestock stock. *E* The value has been in a relatively fluctuating state from 2000 to 2018, and the lowest value appeared in 2011, with a value of -3.02, indicating that the comprehensive input of all industries in the western region in that year was lower than the national average level, and the production allocation of agricultural development was unreasonable. In 2008, the rationalization index was 2.49, higher than the national average, mainly from the stock of livestock in animal husbandry. In that year, the western region maintained the leading level of production input in the country due to the development of animal husbandry.

2.3 Calculation of Rationalization Index TL

According to formula (5), the calculation result is shown in the figure below. This indicator can more accurately reflect the initiative of regional agricultural development and the coordination degree of labor force and natural resources.

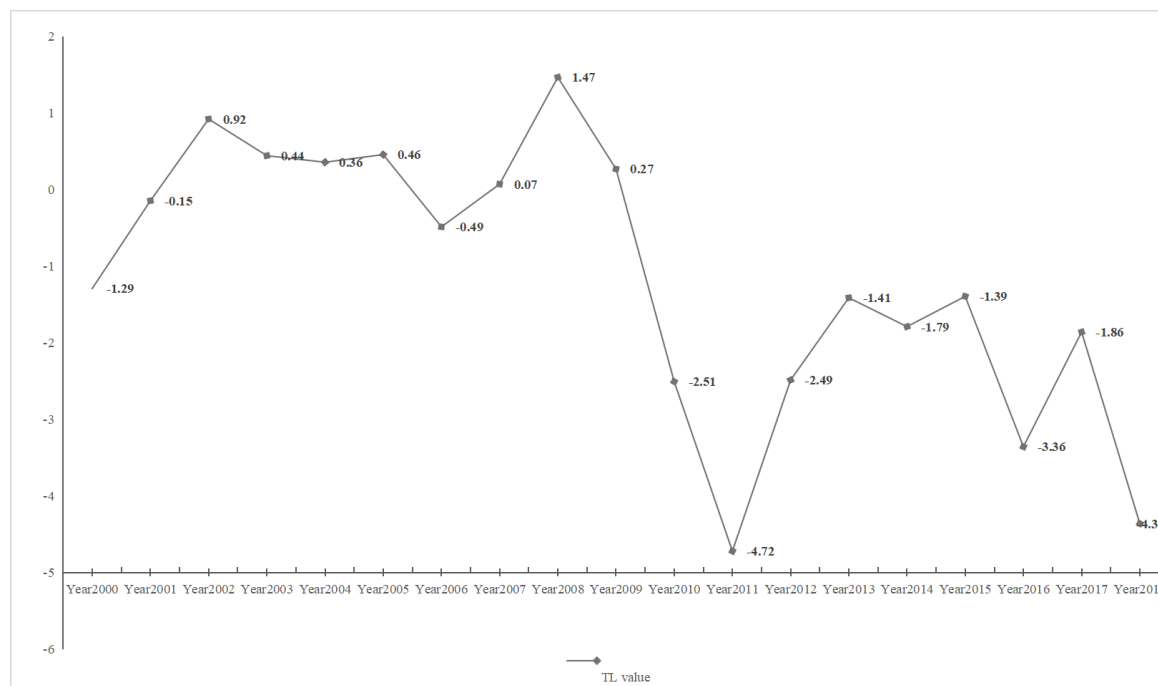


Fig. 3 Rationalization indicator TL value trend chart

As shown in the figure, before 2010, the rationalization index of the western region was higher. According to the analysis of the rationalization index of labor force and production allocation, we know that the reason for the higher rationalization index in this period is that 1. The labor shortage is not serious. At the initial stage of the implementation of the western development strategy, the outflow of labor force in the primary industry was not obvious during this period. 2. The input of production resources is higher than the national average level, and the situation of developing superior agricultural industry is better. Based on the above two reasons, the input of labor force and production resources has reached a more coordinated state, thus showing a higher degree of rationalization. Since 2010, the degree of rationalization has deviated greatly. Through the analysis of specific weight, we can find that the reason lies in the aggravation of labor shortage, and human resources are the factors that can not be ignored in agricultural development. During this period, the situation of developing superior industries and promoting industrial layout in the western region is better, and the input of production resources is basically higher than the national average level, but in the case of serious

shortage of labor supply. On the contrary, increasing investment in production resources has aggravated the unreasonable structure. In addition, by comparing the rationalization index with the development trend of agricultural economy, it is found that the development speed of agricultural economy is accelerated in the lower rationalization interval. The reasons can be analyzed from the following points: 1. Since 2010, the degree of agricultural modernization has been significantly improved. Although the unreasonable degree of labor supply increased during this period, due to the development of agricultural modernization, mechanization and technology can effectively replace human resources, thus promoting productivity, so the trend of agricultural economy shows a sustained growth trend. 2. The shortage of labor force will promote the input of local production resources and the modernization of agriculture. According to the initiative analysis of regional agricultural development, in the case of labor shortage, regional enterprises and individuals have to speed up the investment of agricultural mechanization technology and focus on the development of superior industries, in order to make up for their own labor limitations.

3. Conclusion and development suggestions

The rationalization of agricultural industrial structure is the basis of all structural adjustments, and the structural deviation of insufficient labor supply leads to insufficient endogenous power of agricultural development and limited growth. Combined with the research conclusion of rationalization and advancement, the problems and advantages faced are synthesized, and the following development plans are put forward: 1. We will vigorously promote entrepreneurship and employment in returning home and encourage the development of secondary and tertiary industries in agriculture. The development resources of the secondary and tertiary industries of agriculture are different from those of the primary industry of agriculture, which requires more investment in technology, manpower and science and technology, and relatively high requirements for the quality of manpower. The current shortage of agricultural labor force will affect the development of agriculture in the western region in the coming decades or longer. So in the present case, The western region must attract more labor to return to the west and the countryside for employment and entrepreneurship, while the rich natural and human resources in the western region also provide natural advantages for the development of agricultural tertiary industry. The western region should grasp the advantages of natural resources endowment, foster strengths and circumvent weaknesses, give priority to characteristic agriculture, and develop rich forms of agricultural employment and management. 2. Continue to focus on the development of advantageous subdivision industries. Agriculture, forestry, animal husbandry and fishery together constitute the main sub-industries of agriculture in the western region, but agricultural natural resources are limited, regional agricultural development should be focused on, which is conducive to more efficient development of agriculture on the basis of rational allocation. The results show that the allocation of agricultural production in the western region is reasonable. Compared with the national level, the development and utilization of natural resources in agriculture, forestry and animal husbandry have the initiative of development. In the planning of future agricultural development, we should also have the tendency to develop superior industries. 3. Pay attention to the development of agricultural modernization and increase investment in scientific and technological research and development. In the analysis result of the TL index, Agricultural modernization and agricultural mechanization can make up for the shortage of labor supply, increase the elasticity of agricultural economic growth, and reduce the fluctuation of industrial environment. Therefore, in the future agricultural development, it is very important to pay attention to the innovative research and development of agricultural science and technology and build modern agriculture.

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