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IMPACTS OF AGRICULTURAL INDUSTRIAL STRUCTURE ADJUSTMENT ON AGRICULTURAL ECONOMIC GROWTH – TAKING CHINA AS AN EXAMPLE

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This paper selects the relevant data of China's agricultural industry from 2009 to 2019, makes an empirical analysis from three aspects of grey correlation analysis, contribution rate and main industry elasticity, and draws relevant conclusions.

In 2015 central committee of the communist party of China put forward "in promoting agricultural structure adjustment". The same year the central rural work conference put forward "agricultural supply side structural reform" for the first time. The central rural work conference required "in-depth implementation of major agricultural products security strategy up to 2020, deepen reform of agricultural supply side structural". It reflected the attention that the country adjusted to agricultural structure and continuous attention.

1. Analysis of present situation of agricultural industrial structure in China

China is located in the east of Asia and on the west coast of the Pacific Ocean, with a land area of 9.6 million square kilometers and an inland and border waters area of 4.7 million square kilometers. It is the world's third largest country in land area with the world's largest population. The terrain is mainly mountainous, plateaus and basins. By the end of 2019, China's urbanization rate had reached 60.60%, the agricultural population was 551.62 million, and the agricultural output value reached 7356.71billion yuan, accounting for 7.4% of the country's GDP and an increase of 9.15% over the previous year. Among them, farming, forestry, animal husbandry, fishery and auxiliary industry (farming, forestry, animal husbandry and fishery professional and auxiliary activities) increased by 7.51%, 6.32%, 15.22%, 3.63% and 10.63% respectively, driving the development of agricultural economy [1]. According to the analysis of the proportion of the output value of each agricultural industry in the total agricultural output value from 2009 to 2019 (see Table 1), the internal structure of agriculture has changed to some extent. Farming and animal husbandry always occupied the dominant position. Farming presented a fluctuating trend of slow rise, while animal husbandry presented a relatively obvious trend of decline. Although forestry and fishery accounted for a relatively small proportion, they both showed a slow rising trend.

In recent years, China has increased investment in the quantity, variety and quality of agricultural crops to promote the high-quality development of agriculture. However, due to natural disasters, animal epidemic and other problems, the development of animal husbandry industry has declined. At the same time, in order to adjust the industrial structure, China has introduced a series of policies to promote the development of forestry and fishery, and the change of consumer demand also made the proportion of the output value of forestry and fishery appear slight increase. From the perspective of overall industrial structure adjustment, China's agricultural industrial structure has been optimized to a certain extent.

Table 1. – Agricultural industrial structure and its changes (%)

Department	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Farming	50.55	52.99	51.17	51.94	52.53	53.01	53.20	52.27	53.10	54.11	53.29
Forestry	3.92	3.80	3.92	3.95	4.13	4.28	4.28	4.35	4.56	4.78	4.66
Animal husbandry	32.35	30.20	31.96	30.68	29.59	28.59	28.12	28.61	26.86	25.27	26.67
Fishery	9.30	9.24	9.31	9.73	9.93	10.10	10.15	10.23	10.59	10.68	10.14
Auxiliary industry	3.88	3.77	3.64	3.70	3.82	4.03	4.26	4.53	4.90	5.16	5.23

(The data are collected from the relevant data in China Statistical Yearbook 2020)

2. Analysis on the relationship between agricultural industrial structure and agricultural economic growth

2.1 Grey correlation analysis of agricultural industrial structure and agricultural economic growth

Grey correlation theory [2] is adopted to compare the influence of the changes of various factors in China's agricultural industrial structure on the structure and rank it according to the size. The calculation process is as follows:

(1) Dimensionless treatment. Taking the gross agricultural product of China as the reference sequence and the output value of each agricultural sector (farming, forestry, animal husbandry, fishery and auxiliary industry)

as the comparison sequence, we set X as a grey related subset, $X_0 \in X$ as the reference sequence and $X_i \in X$ as the comparison sequence. $X_0(k)$and $X_i(k)$are the numbers of the k point of X_0 and X_i respectively, where k= 1,2,3...m; i =1,2,3,4,5. The mean value method is used for dimensionless processing, and the formula(1) is:

$$X_i(k) = \frac{X_i(k)}{\overline{X_i}} \quad (1)$$

Among the formula(1), $\overline{X_i}$ is given by the formula(2)(n is the sequence length, that is, the number of data):

$$\overline{X_i} = \frac{1}{n}\sum_{k=1}^{n} X_i(k) \quad (2)$$

(2) Calculates the absolute value of the sequence difference between the corresponding element of the comparison sequence and the reference sequence $\Delta_i(k)$.The formula(3) is:

$$\Delta_i(k) = |X_0(k) - X_i(k)| \quad (3)$$

(3) Calculate the correlation coefficient ε_i. Find the maximum max$|X_0(k) - X_i(k)|$ and minimum min$|X_0(k) - X_i(k)|$ from the sequence difference $\Delta_i(k)$.Find the maximum maxmax$|X_0(k) - X_i(k)|$ and minimum minmin$|X_0(k) - X_i(k)|$ from the maximum and minimum values of different comparison sequences. Then the correlation coefficient ε_i is calculated according to the formula(4):

$$\varepsilon_i = \frac{minmin|\,X_0(k)-X_i(k)\,| + \rho maxmx|\,X_0(k)-X_i(k)\,|}{|\,X_0(k)-X_i(k)\,| + \rho maxmx|\,X_0(k)-X_i(k)\,|} \quad (4)$$

(Among the formula, ρ is the resolution coefficient, ρ∈ (0,1), but usually ρ is 0.5)
The calculation results are shown in Table 2.

Table 2. – Correlation coefficient of total agricultural output value and output value of each department

Year	ε_1	ε_2	ε_3	ε_4	ε_5
2009	0.8369	0.7042	0.6155	0.7413	0.6563
2010	0.9711	0.6130	0.7676	0.7000	0.5741
2011	0.8440	0.6438	0.5734	0.6858	0.4889
2012	0.9086	0.6378	0.6647	0.8292	0.4861
2013	0.9762	0.7738	0.7948	0.9320	0.5154
2014	0.9569	0.9765	0.9940	0.9501	0.6236
2015	0.9285	0.9650	0.8764	0.9129	0.8399
2016	0.9348	0.8974	1.0000	0.8541	0.7461
2017	0.9372	0.6531	0.6493	0.6707	0.4809
2018	0.8041	0.4909	0.4831	0.6273	0.3726
2019	0.8994	0.5425	0.5964	0.9003	0.3334

(4) Calculate the correlation degree γ_i. The formula (5) is:

$$\gamma_i = \frac{1}{n}\sum_{k=1}^{n} \varepsilon_i(k) \quad (5)$$

Among the formula (5), n is the sequence length, namely the number of data; γ_i (1,2,3,4,5) is used to represent the grey correlation degree between the output value of farming, forestry, animal husbandry, fishery and auxiliary industry and the total agricultural output value in China.
The calculation results are shown in Table 3.

Table 3. – Correlation degree between output value of each departments and total agricultural output value

Period	γ_1	sorting	γ_2	sorting	γ_3	sorting	γ_4	sorting	γ_5	sorting
2009-2019	0.9089	1	0.7180	4	0.7287	3	0.8003	2	0.5561	5
2010-2019	0.9161	1	0.7194	4	0.7400	3	0.8062	2	0.5461	5
2011-2019	0.9100	1	0.7312	4	0.7369	3	0.8180	2	0.5430	5
2012-2019	0.9182	1	0.7421	4	0.7573	3	0.8346	2	0.5498	5
2013-2019	0.9196	1	0.7570	4	0.7706	3	0.8353	2	0.5588	5
2014-2019	0.9102	1	0.7542	4	0.7665	3	0.8192	2	0.5661	5
2015-2019	0.9008	1	0.7098	4	0.7210	3	0.7931	2	0.5546	5
2016-2019	0.8939	1	0.6460	4	0.6822	3	0.7631	2	0.4833	5
2017-2019	0.8803	1	0.5622	4	0.5763	3	0.7328	2	0.3956	5
2018-2019	0.8518	1	0.5167	4	0.5398	3	0.7638	2	0.3530	5

Through the changes of the correlation degree of different cycles, the correlation degree of the output value of each agricultural sector and the total agricultural output value showed a trend of first rise and then decline. Among them, the correlation of forestry and animal husbandry decreased obviously, while the correlation of agriculture and fishery decreased slightly. The correlation between forestry, animal husbandry and agriculture should be controlled to ensure the stable development of agricultural economy. According to the results of grey correlation dynamic analysis, from 2009 to 2019, the correlation degree of each industry and agriculture in China is $\gamma_1 > \gamma_4 > \gamma_3 > \gamma_2 > \gamma_5$,that is, $\gamma_{farming} > \gamma_{fishery} > \gamma_{animal\ husbandry} > \gamma_{forestry} > \gamma_{auxiliary\ industry}$. It can be seen that farming has the highest correlation degree to China's agricultural output value and plays the biggest role in promoting agricultural economic growth. In 2019, the output value of fishery accounted for 10.14% of the total agricultural output value in China, which was lower than that of animal husbandry (26.67%). However, the correlation degree of the output value of fishery to the total agricultural output value in China was second only to that of farming. The correlation degree of the output value of forestry and animal husbandry to the total agricultural output value was relatively lower, and the correlation degree of the two was relatively close. It shows that the fishery sector has a great development potential and can promote the development of agricultural economy quickly. Therefore, we should consider strengthening financial and human input. Based on the above statement, it shows that the agricultural industrial structure in China is dominated by farming, and fishery has a great development potential.

2.2 Analysis on the Contribution Rate of Agricultural Industrial Structure to Agricultural Economic Growth

In order to quantitatively analyze the impact of agricultural industrial structure and its changes on agricultural economic growth, the contribution of output value ratio changes to economic growth is adopted to measure [3]. The formula (6) is:

$$M = \sum_{i=1}^{5} C_i M_i \quad (i = 1,\ 2,\ 3,\ 4,\ 5) \tag{6}$$

Among the formula (6), M is the growth rate of agricultural output value, C_i is the proportion of i industrial output value in agricultural output value (data is shown in Table 1), and M_i is the growth rate of i industrial output value. The contribution rate of the change of agricultural industrial structure to the growth rate of agricultural economy is the difference between the actual growth rate of agricultural gross output value and the growth rate M calculated by the model (the calculation result is shown in Table 4).

Table 4. – Contribution Rate of Changes in Agricultural Industrial Structure to Agricultural Economic Growth (%)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Farming	19.76	12.34	11.17	9.14	5.94	4.54	2.68	4.31	5.84	7.51
Forestry	10.78	20.09	10.17	12.93	8.90	4.02	6.37	7.44	9.08	6.32
Animal husbandry	6.65	23.13	5.15	4.08	1.42	2.45	6.32	-3.61	-2.26	15.22
Fishery	13.58	17.15	14.54	10.12	6.73	4.67	5.36	6.28	4.79	3.63
Auxiliary industry	10.88	12.48	11.17	11.30	10.83	10.17	11.23	10.86	9.57	10.63
Gross agricultural output value	14.25	16.34	9.52	7.91	4.99	4.16	4.50	2.68	3.89	9.15
M	14.56	16.54	9.61	7.98	5.05	4.18	4.55	2.86	4.03	9.28
Structural contribution rate	-0.31	-0.20	-0.09	-0.07	-0.06	-0.02	-0.05	-0.18	-0.15	-0.13

As can be seen from Table 4, the contribution rate of agricultural industrial structure to agricultural economic growth shows an overall upward trend, rising from -0.31% in 2010 to -0.13% in 2019. However, the contribution rate of agricultural industrial structure and its changes to agricultural economic growth is still weak and has a negative effect on agricultural economic growth. The task of adjusting and optimizing agricultural industrial structure is still grim.

2.3 Regression analysis of agricultural industrial structure to agricultural economic growth

Combined with the calculation results of the contribution rate of agricultural industrial structure change to agricultural economic growth, using statistical software Stata.13 and regression analysis method, a regression model is constructed with the growth rate of agricultural total output value *y* as the dependent variable and the growth rate of output value of farming, forestry, animal husbandry, fishery and auxiliary industry (x_1, x_2, x_3, x_4 ,x_5) as the independent variables. It is concluded that at the significance level of 5%, auxiliary industry has not passed the significance test, so the insignificant variable is eliminated. The analysis results are shown in Table 5.

Table 5. – Regression analysis of the influence of changes in agricultural industrial structure on agricultural economic growth

y	Coef.	Std.Err.	t	p>|t|
x_1	0.4959	0.0114	43.67	0.000
x_2	0.0786	0.0156	5.03	0.004
x_3	0.2823	0.0055	51.55	0.000
x_4	0.0988	0.0176	5.63	0.002
_cons	0.0034	0.0009	3.83	0.012

After eliminating the insignificant variables, the statistic F value=4349.10, and the significance test of the equation P=0.0000, indicating that the linear relationship of the model is significant. The goodness of fit coefficient R^2=0.9997, close to 1, indicating that the model has a good fitting effect. The regression model is as follows:

$$y = 0.0034 + 0.4959x_1 + 0.0786x_2 + 0.2823x_3 + 0.0988x_4 \quad (7)$$

The regression coefficients of each variable in the model reflect the elasticity of the influence of agricultural sectors on agricultural economic growth in China. The coefficients of farming, forestry, animal husbandry and fishery are 0. 4959, 0. 0786, 0. 2823 and 0. 0988 respectively, that is, the growth rate of agricultural output value will increase 0. 4959% if the growth rate of farming output value increases by 1%; the growth rate of agricultural output value will increase by 0. 0786% if the growth rate of forestry output value increases by 1%; the growth rate of agricultural output value will increase by 0. 2823% if the growth rate of animal husbandry output value increases by 1%; the growth rate of agricultural output value will increase by 0.0988% if the growth rate of fishery output value increases by 1%.

3. Conclusions

(1) From the results of grey correlation analysis, farming is still the most important factor affecting the growth of agricultural economy in China. Fishery correlation degree is the next, and its potential influence on economic growth needs to be further explored. Forestry and animal husbandry have a relatively small impact on economic growth, but higher than auxiliary industry, and are still the industries that cannot be ignored in the process of structural adjustment of agricultural economy.

(2) Since 2009, the proportion of farming in China's agricultural structure has been more than 50% and shows a trend of slow rise, and it is still the leading industry in China's agriculture. The proportion of animal husbandry in the agricultural industrial structure is second only to farming, but there is an obvious trend of decline. Forestry and fishery accounted for a relatively small, and there is a slow upward trend, the development is lagging behind. On the whole, the negative effect of China's agricultural industrial structure adjustment on the contribution of agricultural economic growth is gradually weakening. The internal structure of China's agriculture is not coordinated, and the outstanding problems are too high proportion of farming, lagging development of fishery and forestry. The single internal structure of agriculture is not conducive to making full use of China's abundant natural resources and improving the ecological environment, nor is it conducive to improving the ability of agricultural production to resist natural and market risks.

(3) Through the regression analysis of the main factors of agricultural economic growth, it can be seen that the growth rate of China's agricultural gross product will increase by 0.4959%, 0.0786%, 0.2823% and 0.0988% if the output value growth rate of farming, forestry, animal husbandry and fishery increases by 1%, respectively. It can be seen that the growth of agricultural economy in China still mainly depends on the growth of output value of farming and animal husbandry. Single agricultural structure is still the main factor restricting the healthy development of its agricultural economy.

In general, the current adjustment of agricultural industrial structure in China still has a certain space for development, and the economic benefits brought by the optimization of agricultural industrial structure have the potential for further development.

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