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Research on the Development of Agricultural Complex in Chinese Provinces Based on Input-Output Analysis

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Abstract: Chinese provinces and regions have huge differences in agricultural resource endowments and uneven levels of agricultural industry development, resulting in inconsistent influence of agricultural complexes on the economic development of China's provinces and regions. This paper uses the input-output model to divide the agricultural complex into four links: agricultural production input, production, agricultural product processing and final distribution of agricultural products. By estimating the GDP of agricultural complex in 30 provinces and cities in China in 2002, 2007, 2012 and 2017, the paper analyzes the structure composition and change trend of the agricultural complex's share of GDP and the four links of agricultural complex. On this basis, this paper uses the two indicators of agricultural resource abundance and agricultural product processing development to divide the agricultural complexes in 30 provinces and regions of China into four types: the first type is the area with rich agricultural resources and developed processing industry. The second category is the area with developed agricultural resources and backward processing industry. The third category is the area with poor agricultural resources and developed processing industry. The fourth category is the region with poor agricultural resources and backward processing industry, which provides a reference basis for the coordinated development of agricultural industries in various provinces and regions and complements each other's advantages.

Keywords: Agricultural complex; Input-output model; GDP accounting; Abundance of agricultural resources.

1. Introduction

With the revolutionary development of agricultural technology after World War II, agriculture has undergone a transformation from traditional self-sufficient agriculture to a generalized and specialized agricultural production model. Studying the methods of agricultural production, processing, and distribution, as well as the input factors and production functions of agricultural production, has become a new topic in the academic community.

In the process of agricultural development, traditional industry classification has revealed its limitations. This classification method divides different economic activities into independent primary, secondary, and tertiary industries, ignoring the complex relationships that exist in input, output, processing, and distribution. To overcome this limitation, Goldberg (1968) proposed the concept of "agricultural complexes", which stems from the complex relationships that exist in the input, output, processing, and distribution of agricultural production.

Furtuoso & Guilhoto (1998) proposed a basic method for estimating the GDP of agricultural complexes, which divides them into four parts: agricultural input, agricultural production, agricultural product processing industry, and final distribution. Van Leeuwen (2000) divided agricultural complexes into four parts: agricultural inputs, agricultural production, agricultural product processing inputs, and agricultural product processing inputs. He calculated the proportion of agricultural complexes GDP in major European countries to their respective GDP, with Germany, the United Kingdom, France, and Italy all having a proportion ranging from 5.1% to 8.5%. Similarly, Furtuoso & Guilhoto (2003) used the Brazilian input-output table to measure the internal structure of Brazilian agricultural complexes and their proportion to GDP. The calculation showed that in 2000, the proportion of Brazilian agricultural complexes to Brazil's GDP was 27%.

In China, literature on agricultural complexes mainly focuses on the following three aspects: firstly, studying agricultural complexes from both strategic and macro perspectives (Zhao Xia and Wu Fangwei, 2008; Geng Xianhui, 2009); Secondly, study the micro economic behaviors of small farmers, family farms, farmer cooperatives, and agricultural related enterprises (Tang Wenhua, 2019); Thirdly, using input-output models to study the relationship between agriculture and its related industries (Xue Jiliang, Li Lutang, 2011; Geng Xianhui, Zhou Yingheng, 2011).

After studying existing literature in China, the author found that there are currently shortcomings in using input-output models to study agricultural complexes. Firstly, using the China input-output table, a comparative analysis was conducted on the degree of linkages and industrial impact of China's agricultural industries. However, only forward and backward related industries were calculated, and there was insufficient research on the scale and structure of agricultural complexes. Secondly, in terms of spatial dimensions, comparisons are made between China's agricultural complexes and several developed countries with significant differences in agricultural resource endowments, such as the United States, Japan, and the Netherlands. However, there is insufficient comparison between domestic provinces (Yan Binjian, Fan Jin, Zhou Yingheng, 2011; Liang Yinghui, Jiang Zhihua, 2019).

The generalization and specialization of agriculture are occurring in various regions around the world, depending on the stage of economic and social development in each region. Among them, the degree of participation of agricultural institutions (such as farmers, providers of agricultural inputs, processors of agricultural products, and distributors of agricultural products) in economic activities will show diversity. China has a vast territory, with significant differences in agricultural resource endowments and uneven levels of agricultural industry development in different regions. Studying the GDP and internal structure of agricultural complexes in various provinces and regions of China is of practical significance for the coordinated development, complementary advantages, and enhancement of agricultural industries in each province and region.

In the second part, this paper introduces the method of using the input-output model to measure the GDP of agricultural complexes. In the third part, it estimates the GDP of modern agricultural complexes in 30 provinces and regions of China (excluding Xizang) in 2002, 2007, 2012 and 2017. At the same time, it compares and analyzes the internal structure of agricultural complexes in various provinces and regions, and on this basis, it divides agricultural complexes in various provinces and regions of China into four types. Finally, provide analytical conclusions in the fourth section.

2. Research Method

This section adopts the measurement method for agricultural complexes proposed by Zhao Xia and Wu Fangwei (2008), which is applicable to the regional input-output table in China. This method divides the GDP estimation of regional agricultural complexes in China into four stages: agricultural production input, agricultural production, agricultural product processing and manufacturing, and final distribution of agricultural products.

2.1. GDP of agricultural production input link

Use the value of agricultural inputs in the input-output table to estimate the GDP of agricultural production inputs: Multiply the sequence vectors of input value and value-added coefficient in the agricultural sector. The agricultural input value sequence is directly taken from the input-output table. The specific calculation formula is as follows:

$$GDP_I = \sum_{i=1}^{n} (Z_{ik} \times CAV_i) \tag{1}$$

In the formula, GDPl represents the GDP of the input; Z_{ik} is the consumption of the i-th product in the agricultural sector; CAV_i is the added value coefficient of sector i.

2.2. Agricultural production GDP

The estimation of GDP in the agricultural production process is the estimation of the added value of the agricultural sector. Considering that the estimation of GDP in the input process includes the added value of products or services as intermediate inputs in the sector, this duplicate value needs to be eliminated. Therefore, the estimated GDP of the production process is as follows:

$$GDP_{II} = VA_k - Z_{kk} CVA_k \tag{2}$$

In the formula: GDP_{II} represents the GDP of agricultural production, VA_k represents agricultural added value, CVA_k is the coefficient of agricultural added value, and Z_{kk} is the intermediate input of agricultural products itself.

2.3. GDP of agricultural product processing and manufacturing

Utilize the connections between departments to determine the added value of agricultural product processing and manufacturing. The agricultural product processing and manufacturing process mainly includes the following five departments: ① food and tobacco processing industry; ② Textile industry; ③ Wood furniture manufacturing industry; ④ Clothing products industry; ⑤ Paper printing and stationery manufacturing industry.

When estimating the GDP of agricultural product processing and manufacturing, it is also necessary to eliminate the double calculation impact, that is, the added value of the processing and manufacturing sector minus the value of the corresponding sector's input. The calculation formula for GDP in this stage is as follows:

$$GDP_{III} = \sum_{q} (VA_q - Z_{qk} CVA_q) \tag{3}$$

Among them, GDP_{III} is the GDP of agricultural product processing and manufacturing; q is the relevant sector in the agricultural product processing and manufacturing process; CVA_q is the added Value coefficient of agricultural product processing and manufacturing industry.

2.4. GDP of final distribution of agricultural products

The final distribution link GDP of agricultural products mainly considers the added value of agricultural sectors in transportation, commerce, and other service sectors. Assume that the added value of this part is positively correlated with the added value of the service industry in the economy, as well as with the final demand for agriculture and agricultural product processing industry. The specific calculation formula is:

$$GDP_{IV} = TM \times [\frac{FD_k + \sum_q FD_q}{TFD}] \tag{4}$$

Among them, TM is the total added value of the circulation sector, commercial trade sector, and other service sectors, that is, the added value of the service industry; TFD is the overall final demand; FD_k is the final demand in the agricultural production process; FD_q is the final demand of the q-th sector in the agricultural product processing and manufacturing process; GDP_{IV} is the GDP of the final distribution process of agricultural products. The final demand mentioned above includes consumption, investment, and net exports.

In summary, the expression for the GDP of agricultural complexes is:

$$GDP_{Total} = GDP_I + GDP_{II} + GDP_{III} + GDP_{IV} \tag{5}$$

In the formula: GDP_{Total} is the GDP of agricultural complexes.

The data used in this article comes from the input-output tables of 42 secors in various regions in 2002, 2007, 2012, and 2017.

3. Empirical Results

This section first measures the GDP of the four links of agricultural complexes in various provinces and regions of China in 2017; Then, use the time-series regional input-output table to calculate the development status of agricultural complexes in different provinces and regions of China in different periods, and measure the correlation between the GDP of the four links of agricultural complexes; Finally, based on the accounting results of agricultural complexes, classify the development of agricultural complexes in various provinces and regions of China.

3.1. The total GDP and its composition of agricultural comprehensive bodies in each province and region

The estimated GDP results of the four links of agricultural complexes in various provinces and regions of China in 2017 are shown in Table 1. For the 30 provinces and regions in China, the total GDP of agricultural complexes is 19899.89 billion yuan. Among them, the GDP of input, production, processing, and final distribution were 1808.71 billion yuan, 5693.04 billion yuan, 6516.49 billion yuan, and 5881.64 billion yuan, respectively, with a relative structure of 9.09%, 28.61%, 32.75%, and 29.56%, respectively. The processing and final distribution of agricultural products have occupied the dominant position in agricultural complexes.

In 2017, the top three provinces in terms of GDP for agricultural complexes are Guangdong with a total of 1805.32 billion yuan, Shandong with 1743.51 billion yuan, and Jiangsu with 1639.00 billion yuan. The fourth to thirteenth provinces are Henan with 1432.65 billion yuan, Zhejiang with 1278.86 billion yuan, Fujian with 1164.67 billion yuan, Hubei with 1061.14 billion yuan, Sichuan with 1047.46 billion yuan, Hunan with 967.26 billion yuan, Hebei with 898.71 billion yuan, Anhui with 752.43 billion yuan, Guangxi with 677.77 billion yuan, and Heilongjiang with 631.85 billion yuan. The provinces with high GDP rankings in agricultural production include Shandong Province with a GDP of 468.02 billion yuan, Jiangsu Province with a GDP of 378.14 billion yuan, Sichuan Province with a GDP of 378.01 billion yuan, Henan Province with a GDP of 375.93 billion yuan, Guangdong Province with a GDP of 335.31 billion yuan, Hubei Province with a GDP of 330.45 billion yuan, Hebei Province with a GDP of 299.64 billion yuan, Hunan Province with a GDP of 274.80 billion yuan, Guangxi with a GDP of 256.26 billion yuan, Heilongjiang Province with a GDP of 245.28 billion yuan, Anhui Province with a GDP of 233.59 billion yuan, Fujian Province with a GDP of 208.28 billion yuan, Yunnan Province with a GDP.

Table 1. Summary of GDP estimates for the four links of agricultural complexes in 2017

Unit: 100 million yuan

Region	Agricultural Complex	Input	Produce	Process	Final delivery
Beijing	-434.26	60.217397	103.255	409.0152	-1006.748
Tianjin	1427.935	68.815185	151.196	868.6858	339.23769
Hebei	8987.079	794.17855	2996.36	2421.11	2775.4281
Shanxi	1528.389	318.77885	678.001	277.4001	254.20947
Neimeng	3166.863	491.85255	1431.15	339.213	904.64513
Liaoning	3641.281	685.3771	1642.25	440.2581	873.39336
Jilin	3613.736	351.38025	949.582	1273.7	1039.0741
Heilongjiang	6318.451	1066.7741	2452.79	637.7768	2161.1062
Shanghai	2176.933	67.639742	93.9825	1452.865	562.44564
Jiangsu	16390.04	1126.2947	3781.38	6352.62	5129.7429
Zhejiang	12788.58	508.4987	1991.95	5828.373	4459.7586
Anhui	7524.276	732.13481	2335.86	2255.609	2200.6756
Fujian	11646.65	579.79329	2082.84	5424.116	3559.9007
Jiangxi	5976.407	467.24277	1677.32	2058.77	1773.0707
Shandong	17435.12	1643.1942	4680.2	6395.572	4716.1516
Henan	14326.46	1195.3183	3759.28	4933.853	4438.0075
Hubei	10611.43	944.27217	3304.45	3466.093	2896.6099
Hunan	9672.58	885.21778	2748.03	3081.355	2957.9812
Guangdong	18053.2	841.914	3353.09	6920.446	6937.7464
Guangxi	6777.668	777.77614	2562.63	1489.378	1947.8793
Hainan	1716.453	169.09732	929.834	88.99527	528.52721
Chongqing	3255.966	294.87809	1208.87	967.0275	785.19331
Sichuan	10474.59	1101.2959	3780.08	2781.218	2811.994
Guizhou	5028.407	621.31713	1837.34	1281.09	1288.6584
Yunnan	5687.754	727.11433	2032.86	1572.094	1355.6844
Shanxi	4873.134	508.47998	1646.01	1406.698	1311.9472
Gansu	1846.39	271.91405	775.666	247.8638	550.94628
Qinghai	448.7436	49.416896	222.397	55.48845	121.44133
Ningxia	651.082	96.622608	233.55	129.8635	191.0461
Xiangjiang	3387.533	640.33064	1488.16	308.3699	950.67046
Total	198998.9	18087.13753	56930.4	65164.92	58816.425

Data source: Calculated based on the regional input-output table of 30 provinces and cities in China in 2017

The GDP of agricultural production in 2017 is 5693.04 billion yuan, while the GDP of agricultural complexes is 19899.89 billion yuan, which is 3.50 times that of the former. Excluding Beijing (due to the special nature of administrative functions), there is a significant difference in the ratio between different provinces and regions. The wealthier the province, the higher the ratio. Provinces greater than 4 include Shanghai 23.16, Tianjin 9.44, Zhejiang 6.42, Fujian 5.59, Guangdong 5.38, and Jiangsu 4.33; The provinces between 3 and 4 are Henan 3.8, Jilin 3.81, Shandong 3.73, Jiangxi 3.56, Hunan 3.52, Anhui 3.22, Hubei 3.21, and Hebei 3.00; The provinces between 1 and 2 are Shaan 2.96, Yun 2.80, Ning 2.79, Chuan 2.77, Gui 2.74, Yu 2.69, Gui 2.64, Hei 2.58, Gan 2.38, Xin 2.28, Jin 2.25, Liao 2.22, Inner Mongolia 2.21, Qing 2.02, and Qiong 1.85. This also indicates to some extent that the development direction of agricultural complexes is constantly extending towards areas such as deep processing of agricultural products, convenient logistics, and thoughtful services.

3.2. The proportion of agricultural complexes in GDP in each province and region

The GDP of China's agricultural complexes is more than three times that of agricultural production links, and there is a trend of increase. In 2002, the GDP of agricultural production was 1404.60 billion yuan, while the GDP of agricultural complexes was 4413.22 billion yuan, which is 3.14 times that of the former; In 2007, the GDP of agricultural production was 2392.81 billion yuan, while the GDP of agricultural complexes was 8363.42 billion yuan, which is 3.49 times that of the former; In 2012, the GDP of agricultural production was 4475.87 billion yuan, while the GDP of agricultural complexes was 16476.5 billion yuan, which is 3.68 times that of the former; The GDP of agricultural production in 2017 is 5693.04 billion yuan, while the GDP of agricultural complexes is 19899.89 billion yuan, which is 3.50 times that of the former.

Table 2. Summary of the proportion of agricultural complexes to GDP

region	2002	2007	2012	2017	region	2002	2007	2012	2017
Beijing	0.1008	0.0393	0.0063	-0.0155	Henan	0.411	0.3838	0.362	0.3216
Tianjin	0.202	0.0886	0.1209	0.0770	Hubei	0.4224	0.3879	0.3222	0.2991
Hebei	0.3903	0.3539	0.2915	0.2642	Hunan	0.4386	0.4268	0.3524	0.2853
Shanxi	0.2078	0.1025	0.1193	0.0984	Guangdong	0.303	0.2669	0.2685	0.2037
Neimeng	0.5335	0.3168	0.2147	0.2136	Guangxi	0.5243	0.4767	0.4154	0.3667
Liaoning	0.2584	0.2468	0.2501	0.1555	Hainan	0.651	0.5136	0.4389	0.3846
Jilin	0.4336	0.2836	0.3607	0.2441	Chongqing	0.2841	0.2504	0.2154	0.1676
Heilongjiang	0.3234	0.2894	0.3926	0.3973	Sichuan	0.4371	0.4173	0.3553	0.2826
Shanghai	0.1743	0.158	0.1499	0.0711	Guizhou	0.4622	0.3499	0.3597	0.3714
Jiangsu	0.3555	0.254	0.2136	0.1909	Yunnan	0.6181	0.4782	0.4199	0.3473
Zhejiang	0.3978	0.3283	0.3165	0.2439	Shanxi	0.3021	0.2216	0.2143	0.2266
Anhui	0.4894	0.3865	0.3534	0.2570	Gansu	0.3202	0.2759	0.2802	0.2518
Fujian	0.4132	0.3788	0.425	0.3608	Qinghai	0.2679	0.1726	0.1679	0.1710
Jiangxi	0.4338	0.4026	0.319	0.2947	Ningxia	0.2866	0.2538	0.1975	0.2007
Shandong	0.4448	0.3288	0.313	0.2412	Xiangjiang	0.3494	0.318	0.3319	0.3028

Data source: Calculated based on regional input-output tables of various provinces and cities in 2002, 2007, 2012, and 2017

As shown in Table 2, the proportion of agricultural complexes to GDP in the vast majority of provinces is showing a downward trend. Out of 30 provinces and cities, 29 have experienced a decline, with only Heilongjiang experiencing a slight increase. The largest decrease was in Inner Mongolia, which decreased by 31.99 percentage points. Secondly, Yunnan decreased by 27.88 percentage points, Anhui decreased by 23.24 percentage points, and Shandong decreased by 23.36 percentage points. There are 13 provinces and cities with a decline range of 10% to 20%, namely Jilin, Jiangsu, Guangxi, Sichuan, Zhejiang, Hunan, Jiangxi, Hebei, Tianjin, Hubei, Chongqing, Beijing, Shanxi, Shanghai, and Liaoning. Although the decline in these provinces is relatively small, they account for the majority of all provinces in the country. The other 9 provinces and cities have decreased by less than 10%, namely Guangdong, Qinghai, Guizhou, Henan, Ningxia, Shaanxi, Gansu, Xinjiang, and Heilongjiang.

The reasons for the changing trends in various provinces and regions are different: for example, the proportion of GDP in agricultural input, production, and distribution in Heilongjiang has increased, although the proportion of processing has decreased, overall it still rises; For Fujian, the main reason is that the proportion of GDP in the processing sector has increased, although the proportion of input, production, and distribution sectors has decreased, overall it still rises; However, the proportion of GDP in agricultural input, production, processing, and distribution in Inner Mongolia has decreased, and overall, it has naturally declined.

Table 3 shows the ratio of input, production, processing, and distribution in agricultural complexes to GDP. On average, in 2002, the ratio was 0.048, 0.138, 0.079, and 0.085, indicating an advantage in the production process. By 2017, the ratios will be 0.021, 0.067, 0.077, and 0.070 respectively, with the processing sector accounting for the highest proportion of GDP, followed by the final distribution sector. The production sector is relatively less important. Based on Table 1, it is not difficult to see that in the process of optimizing industrial structure, the proportion of agricultural complexes in GDP has decreased in each province and region, but the deep processing and distribution services of agricultural products continue to develop and grow.

3.3. The correlation between the four link GDP of agricultural complexes in various provinces and regions

The four stages of input, production, processing, and final distribution are relatively independent, but also closely related. Its independence is reflected in the different divisions of economic activities, and its closeness is reflected not only in the chronological order of the four links, but also in the interdependence between input and output in each link.

Calculating the correlation between the four stages of GDP has two purposes: firstly, indicators with strong correlation can predict each other. When one indicator is easy to calculate while the other is difficult to measure, indicators that are easy to calculate can be used to predict indicators that are difficult to calculate. Secondly, simplify the internal structure of agricultural complexes, making it easy to divide cross-sectional data into regions.

Table 3. Summary of the proportion of each link to GDP in 2002 and 2017

Region	2002 input	produce	process	Delivery	2027 input	produce	process	Delivery
Beijing	0.014	0.017	0.044	0.026	0.002	0.004	0.015	-0.04
Tianjin	0.016	0.040	0.057	0.089	0.004	0.008	0.047	0.018
Hebei	0.048	0.133	0.094	0.115	0.023	0.088	0.071	0.082
Shanxi	0.038	0.083	0.048	0.038	0.021	0.044	0.018	0.016
Neimeng	0.079	0.248	0.047	0.159	0.033	0.097	0.023	0.061
Liaoning	0.041	0.094	0.057	0.067	0.029	0.070	0.019	0.037
Jilin	0.063	0.168	0.073	0.130	0.024	0.064	0.086	0.070
Heilongjiang	0.038	0.110	0.078	0.097	0.067	0.154	0.040	0.136
Shanghai	0.010	0.015	0.079	0.070	0.002	0.003	0.047	0.018
Jiangsu	0.044	0.088	0.119	0.104	0.013	0.044	0.074	0.060
Zhejiang	0.022	0.079	0.156	0.140	0.010	0.038	0.111	0.085
Anhui	0.057	0.213	0.079	0.140	0.025	0.080	0.077	0.075
Fujian	0.034	0.131	0.136	0.112	0.018	0.065	0.168	0.110
Jiangxi	0.056	0.203	0.047	0.127	0.023	0.083	0.102	0.087
Shandong	0.041	0.131	0.168	0.105	0.023	0.065	0.088	0.065
Henan	0.073	0.142	0.110	0.086	0.027	0.084	0.111	0.100
Hubei	0.042	0.127	0.127	0.126	0.027	0.093	0.098	0.082
Hunan	0.060	0.164	0.078	0.137	0.026	0.081	0.091	0.087
Guangdong	0.026	0.065	0.108	0.104	0.009	0.038	0.078	0.078
Guangxi	0.063	0.212	0.075	0.174	0.042	0.139	0.081	0.105
Hainan	0.093	0.338	0.035	0.185	0.038	0.208	0.020	0.118
Chongqing	0.035	0.142	0.028	0.079	0.015	0.062	0.050	0.040
Sichuan	0.062	0.176	0.076	0.123	0.030	0.102	0.075	0.076
Guizhou	0.064	0.191	0.083	0.124	0.046	0.136	0.095	0.095
Yunnan	0.062	0.185	0.197	0.174	0.044	0.124	0.096	0.083
Shanxi	0.044	0.122	0.052	0.084	0.024	0.077	0.065	0.061
Gansu	0.057	0.143	0.027	0.093	0.037	0.106	0.034	0.075
Qinghai	0.034	0.118	0.037	0.079	0.019	0.085	0.021	0.046
Ningxia	0.048	0.138	0.025	0.076	0.030	0.072	0.040	0.059
Xiangjiang	0.075	0.113	0.035	0.126	0.057	0.133	0.028	0.085

Data source: Calculated based on the input-output tables of various provinces and cities in China in 2007 and 2022

Table 4. Summary of correlation coefficients of GDP in the four links of agricultural complexes in 2017

correlation coefficient	input	produce	process	Delivery
input	1.0000	0.9628	0.6495	0.7486
produce	0.9628	1.0000	0.7552	0.8445
process	0.6495	0.7552	1.0000	0.9445
Delivery	0.7486	0.8445	0.9445	1.0000

Data source: Calculated based on Table 1 data

It is not difficult to find from Table 4 that the GDP correlation between the input and production links is 0.9628, and the GDP correlation between the processing and distribution links is 0.9445. The correlation between these two groups of links is relatively high.

Under China's national economic accounting system, the GDP of the production and processing links of agricultural products is released every year, so these two indicators do not require input-output table data for measurement. The input and distribution stages need to be approximated using input-output tables. In regions below the provincial level, input-output tables are rarely compiled, making it difficult to estimate the GDP of input and distribution links at the regional scale. However, considering the correlation of the four indicators, most of the information for GDP accounting of agricultural complexes can be extracted from the production and processing of agricultural products.

3.4. Classification of agricultural complexes in various provinces and regions

This section uses the proportion of GDP in regional production links to obtain the indicator of agricultural resource abundance (B1), which reflects the agricultural production situation. The larger the indicator, the richer the agricultural resources in the region. Conversely, the poorer the agricultural resources. By comparing the GDP of regional processing links with the GDP of regional production links, the indicator of agricultural product processing development level (B2) is obtained. This indicator reflects the development level of agricultural product processing industry. The larger the value, the more developed the agricultural product processing industry in the region, and vice versa, the more backward it is.

This article uses data from 2017 to calculate the above two indicators for agricultural complexes in each province and region, dividing them into four categories (see Table 5 for details). Category I: Rich agricultural resources and developed processing industry; Category II: Rich agricultural resources and backward processing industry; Category III: Poor agricultural resources and developed processing industry; Category IV: Poor agricultural resources and backward processing industry. No province belongs to Class I region; The regions belonging to Class II include Hebei, Shanxi, Inner Mongolia, Liaoning, Heilongjiang, Anhui, Hubei, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang; The regions belonging to Class III include Beijing, Tianjin, Jilin, Shanghai, Jiangsu, Zhejiang, Fujian, Jiangxi, Shandong, Henan, and Guangdong; Hunan belongs to the fourth category of provinces and cities.

Table 5. Summary of Agricultural Resource Abundance and Processing Development in Various Provinces and Regions of China in 2017

region	B1	B2	Type	region	B1	B2	Type
Beijing	0.630	3.461	III	Henan	0.917	1.147	III
Tianjin	0.370	5.019	III	Hubei	1.089	0.916	II
Hebei	1.165	0.706	II	Hunan	0.993	0.980	IV
Shanxi	1.551	0.357	II	Guangdong	0.649	1.803	III
Neimeng	1.580	0.207	II	Guangxi	1.322	0.508	II
Liaoning	1.576	0.234	II	Hainan	1.894	0.084	II
Jilin	0.919	1.172	III	Chongqing	1.298	0.699	II
Heilongjiang	1.357	0.227	II	Sichuan	1.261	0.643	II
Shanghai	0.151	13.505	III	Guizhou	1.277	0.609	II
Jiangsu	0.806	1.468	III	Yunnan	1.249	0.676	II
Zhejiang	0.544	2.556	III	Shanxi	1.181	0.747	II
Anhui	1.085	0.844	II	Gansu	1.468	0.279	II
Fujian	0.625	2.275	III	Qinghai	1.732	0.218	II
Jiangxi	0.981	1.072	III	Ningxia	1.254	0.486	II
Shandong	0.938	1.194	III	Xiangjiang	1.536	0.181	II

Data source: Calculated based on the regional input-output table of various provinces and cities in China in 2022

4. Conclusion

The empirical results can infer the complexity of agricultural complexes. This article uses the input-output tables of various provinces and cities in China for 2002, 2007, 2012, and 2017 to calculate. It is found that the GDP of agricultural complexes is significantly higher than that of agriculture, with the former being 3.14, 3.49, 3.68, and 3.50 times that of the latter. The ratio varies greatly among different provinces and regions, and the wealthier the province, the higher the ratio. This also indicates to some extent that the development direction of agricultural complexes is constantly extending towards areas such as deep processing of agricultural products, convenient logistics, and thoughtful services.

Agricultural complexes have played an important role in the Chinese economy. For China in 2017, the proportion of agricultural GDP (production) is 6.73%, while the proportion of agricultural complex GDP is 23.52%. When the agricultural industry takes agricultural complexes as the research object, its multiplier effect is amplified. When examining agricultural complexes in various provinces and regions, the proportion of agricultural GDP ranged from 0.31% to 20.84%, and the proportion of agricultural complex GDP ranged from 7.11% to 39.73%. There are significant differences among different provinces and regions.

In the four links of agricultural complexes, the share of agricultural product processing and final distribution continues to expand, while the proportion of input and production decreases. In 2002, the structural coefficients of the four links were 11.58%, 31.83%, 27.28%, and 29.31%, respectively; By 2017, the structural coefficients will be 9.09%, 28.61%, 32.75%, and 29.56%, respectively. In the process of optimizing industrial structure in various provinces and regions, the proportion of agricultural complexes in GDP has decreased, but the deep processing and distribution services of agricultural products continue to develop and grow.

There are differences in the correlation between the four links of agricultural complexes. The input and production processes are highly correlated, while the processing and final distribution processes are highly correlated. This article calculates the two indicators of agricultural resource abundance and processing development, and divides agricultural complexes in 30 provinces and regions of China into four types based on the relative sizes of the two indicators. This can provide reference for the coordinated development and complementary advantages of agricultural industries in each province and region.

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