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Analysis of Competitiveness of Provincial Agricultural Products E-commerce Logistics Based on Information Ecological Niche Measurement

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Abstract: The logistics problem is the key issue that restricts the development of agricultural products e-commerce. Through the analysis of the competitiveness of agricultural products e-commerce logistics, the advantages and disadvantages of the development of agricultural products e-commerce in the region can be obtained, and the suggestions and countermeasures for adapting to the development of the region are proposed. This paper applies the information Ecological niche breadth measurement method to measure the e-commerce logistics index of agricultural products in each province, and takes Shanxi Province as an example to analyze the competitiveness of agricultural products e-commerce logistics, and proposes targeted countermeasures and suggestions.

Keywords: agricultural product E-commerce logistics, niche, niche breadth, competitiveness

1. MEASUREMENT BASIS OF INFORMATION ECOLOGICAL NICHE OF AGRICULTURAL PRODUCTS E-COMMERCE LOGISTICS

The concept of niche was proposed by ecologist RH Johnson in 1910, and its connotation is enriched and expanded[1]. Its meaning refers to the position of a population in its ecosystem, its position in time and space, and its function relationship and role with related populations. It contains the universal laws of survival and competition of ecological units (individuals, populations or species), which are not only applicable to the biological world, but also widely used in the fields of economy, management, education, tourism, science and technology[2][3].

The information ecological niche of agricultural products e-commerce logistics[4] in the provinces and regions refers to the position, function and relationship with the external environment of the agricultural e-commerce logistics of the provinces and regions in the national e-commerce logistics information ecosystem. On the one hand, it reflects the specific status quo, organizational structure, connection mode and functional relationship of human resources, resources and information of agricultural products e-commerce logistics in various provinces and regions, and also reflects the interaction with other components in the e-commerce logistics information ecosystem. The state reflects the adaptability of the external environment.

Information ecological niche breadth[5], also known as information ecological niche size, is one of the evaluation indicators of information ecological niche, reflecting the status of species or population adaptation to the environment or the extent of resource utilization. The information ecological niche breadth can be defined as the sum of the proportion of resources occupied by information individuals in each dimension when resources are limited. The information niche width can be described by "wide" and "narrow". The wide information ecological niche of an individual information that the information individual has a large number of resources available, and the environmental adaptability and resource coordination are high and the competitiveness is

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strong. Once resources are scarce or intensified in a resource dimension, they can be supplemented by adding additional resources. The narrow information ecological niche of information individual information indicates that the information resources available to the information individual are small, the environmental adaptability and resource coordination are low, and the competitiveness is weak.

The information ecological niche breadth is measured from three dimensions: functional niche, resource niche and spatiotemporal niche[6]. The dimension of information function niche refers to the type of information role and the number of information functions and the types and quantity of service objects. Generally includes information dissemination capabilities, information acquisition capabilities, and logistics capabilities. The dimension of information resource niche refers to the type and quantity of information resources that information people occupy in the information environment. Generally includes customer resources, capital resources, human resources, hardware and software resources. The spatial and temporal niche of information refers to the amount of space occupied by the information person in the information environment and the size of the occupied space and the length of the possession time. Generally, it includes geographic coverage, population coverage, and mobile carrier support rate. Based on the dimension of information niche, this paper selects seven main indicators to measure the niche breadth of agricultural e-commerce logistics information in provinces. Among them, the top 100 e-commerce brand of agricultural products and the top 100 cold chain logistics enterprises are selected from the niche dimension of information function. The total agricultural output value, fixed asset investment and talent quantity are selected from the niche dimension of information resources, and the Internet broadband coverage and logistics line coverage rate. Choose from the spatial and temporal niche dimension of information.

This paper introduces the information ecological niche theory into the analysis of agricultural products e-commerce logistics, analyzes the information ecological niche breadth occupied by agricultural e-commerce logistics in the national e-commerce logistics information ecosystem. And takes Shanxi agricultural products e-commerce logistics as an example, conduct competitive analysis and propose targeted countermeasures and recommendations.

2. MEASUREMENT OF INFORMATION ECOLOGICAL NICHE BREADTH OF COMPETITIVENESS INDICATORS

2.1 Data source

This paper selects 7 main indicators of competitiveness of gross agricultural output value, fixed assets investment, top 100 e-commerce brand of agricultural products, top 100 cold chain logistics enterprises, Internet broadband coverage, logistics line coverage and number of talents for the 2017 national agricultural product e-commerce logistics information ecological niche breadth Make measurements (excluding Hong Kong, Macao and Taiwan). Taking into account the authority, reliability and accessibility of the data, the data of information ecological niche breadth measurement of agricultural e-commerce logistics are collected from the data of the National Bureau of Statistics, the agricultural e-commerce data of the Ali Research Institute and China Logistics Technology Association Cold Chain Logistics Professional Committee[7][8][9]. The specific data is shown in Table 1.

Table 1. E-commerce logistics data of agricultural products in various provinces and regions

Index Province	Gross agricultural output value	Fixed assets investment	Top 100 e-commerce brands of agricultural products	Top 100 cold chain logistics enterprises	Internet broadband coverage	Logistics line coverage	Number of talents
Guangdong	3134.44	3032.32	5.00	12.00	100.00	100.00	81.13
Shandong	4641.35	2982.16	6.00	7.00	100.00	100.00	49.39
Shanghai	148.53	944.86	1.00	22.00	100.00	100.00	51.08
Henan	4577.16	1944.56	3.00	8.00	100.00	100.00	45.84
Hubei	2921.27	2794.23	3.00	8.00	96.00	100.00	34.97
Fujian	1782.01	2498.55	7.00	6.00	100.00	100.00	23.40
Beijing	145.20	761.37	2.00	8.00	100.00	100.00	58.23
Jiangsu	3714.64	2542.29	7.00	1.00	100.00	100.00	49.64
Sichuan	3710.97	3704.34	4.00	2.00	95.00	100.00	40.43
Liaoning	1859.55	652.69	4.00	5.00	100.00	100.00	35.16
Zhejiang	1521.19	2577.43	11.00	1.00	100.00	100.00	31.53
Chongqing	1151.77	1628.87	2.00	4.00	100.00	94.60	26.49
Anhui	2234.14	1614.16	6.00	1.00	100.00	100.00	22.93
Heilongjiang	2873.86	1127.92	3.00	2.00	94.00	100.00	27.13
Hunan	3255.11	1944.41	2.00	2.00	99.00	98.60	23.99
Shanxi	2027.56	1576.64	4.00	1.00	96.00	100.00	28.31
Yunnan	1943.65	2560.50	8.00	0.00	100.00	100.00	17.31
Guangxi	2347.90	1823.95	5.00	0.00	99.90	100.00	19.43
Xinjiang	2163.11	836.14	4.00	1.00	95.00	100.00	16.61
Shanxi	958.11	881.73	3.00	1.00	90.20	100.00	23.45
Jiling	1231.98	1162.75	3.00	1.00	100.00	100.00	16.07
Jiangxi	1446.89	958.30	2.00	1.00	99.00	100.00	20.30
Hebei	3459.39	2081.28	0.00	0.00	97.20	100.00	28.67
Tianjing	244.31	727.51	0.00	2.00	100.00	100.00	14.67
Neimenggu	1415.07	1427.71	0.00	2.00	62.50	83.10	22.78
Ningxia	311.89	357.42	1.00	2.00	100.00	91.80	3.67
Gansu	1274.71	1100.04	1.00	0.00	93.00	99.90	12.80
Guizhou	1888.64	1779.92	0.00	0.00	97.50	100.00	11.99
Hainan	695.64	467.06	1.00	0.00	100.00	100.00	6.97
Qinghai	155.52	589.92	1.00	0.00	94.40	100.00	4.28
Xizang	52.23	542.30	1.00	0.00	83.00	95.80	0.86

2.2 Measurement methods

The calculation formulas for information ecological niche width are mainly Levins formulas (including Simpson index formula and Shannon-Wiener index formula), Hurlbet formula, Schoener formula, Petraitis formula, Smith formula, Pielou formula, mapping function model and Yu Shixiao formula, Wait. It has been shown in the literature that in these formulas, the Shannon-Wiener index formula can better reflect the objective situation of the information ecological niche breadth contrast relationship[10][11][12]. This paper uses this formula to calculate the information ecological niche breadth of agricultural products e-commerce logistics in all provinces and regions of China. Its function model is shown in formula (1):

$$B_{ij} = -P_{ij} \ln P_{ij} \qquad (1)$$

The B_{ij} Indicates the information ecological niche breadth of the agricultural product e-commerce logistics in the i province under the resource j, indicating the proportion of the resource j used by the i province to the total number of resources.

2.3 Determination of indicator weights

Different indicators have different influences on the information ecological niche of agricultural products e-commerce logistics in the provinces. Therefore, the weight of each indicator needs to be determined. In this paper, the principal component analysis method is used to determine the weight value of each index, so as to more accurately measure the total width value of the eco-location of agricultural products e-commerce logistics information in each province[13][14].

Principal Component Analysis of 7 Indicators in Table 1 by SPSS Analysis Software[15]. The total variance and composition matrix obtained are shown in Table 2 and Table 3.

Table 2. Explains the total variance

Components	Initial eigenvalue			Extract square sum loading			Rotation square sum loading		
	Total	Percentage of variance%	Cumulative percentage %	Total	Percentage of variance%	Cumulative percentage %	Total	Percentage of variance%	Cumulative percentage %
1	3.012	43.025	43.025	3.012	43.025	43.025	2.309	32.984	32.984
2	1.464	20.912	63.936	1.464	20.912	63.936	1.837	26.246	59.230
3	1.333	19.045	82.981	1.333	19.045	82.981	1.663	23.752	82.981
4	.596	8.512	91.494						
5	.242	3.462	94.955						
6	.207	2.959	97.914						
7	.146	2.086	100.000						

Table 3. Component matrix

	Components		
	1	2	3
Gross agricultural output value	.724	-.309	-.364
Fixed assets investment	.788	-.366	-.343
Top 100 e-commerce brands of agricultural products	.673	.080	-.393
Top 100 cold chain logistics enterprises	.404	-.247	.841
Internet broadband coverage	.579	.719	.168
Logistics line coverage	.582	.719	.055
Number of talents	.758	-.366	.435

It can be seen from Table 2 that the cumulative variance contribution rate of the first three principal components reached 82.981%, exceeding80%. Therefore, the first three principal components can basically reflect the information of all indicators.The number of loads of the first three principal components for all indicators can be seen from Table 3. It reflects how each index is expressed by three principal components.

Table 4 gives the principal components expressed by linear combinations of indicator. Based on this, the weight values of each indicator are calculated and normalized, as shown in Table 4.

Table 4. Weights of indicators

The coefficient of the indicator in each linear combination				Weights	Normalized weight
	Components				
	1.0000	2.0000	3.0000		
Gross agricultural output value	0.4172	-0.2554	-0.3153	0.8100	0.0540
Fixed assets investment	0.4540	-0.3025	-0.2971	1.0182	0.0617
Top 100 e-commerce brands of agricultural products	0.3878	0.0661	-0.3404	-0.1942	0.0947
Top 100 cold chain logistics enterprises	0.2328	-0.2041	0.7284	-0.2802	0.1604
Internet broadband coverage	0.3336	0.5942	0.1455	4.0838	0.2416
Logistics line coverage	0.3353	0.5942	0.0476	12.4741	0.2270
Number of talents	0.4368	-0.3025	0.3768	-0.8029	0.1606

2.4 Measurement results

According to the measurement formula, the breadth value of each indicator in each province and region is calculated, and then the total breadth of the information ecological niche of agricultural products e-commerce logistics in each province is obtained by simply adding the weights of each indicator. As shown in Table 5.

Table 5. Information ecological niche width of agricultural products e-commerce logistics in various provinces and region

Index Provdince	Gross agricultural output value	Fixed assets investment	Top 100 e-commerce brands of agricultural products	Top 100 cold chain logistics enterprises	Internet broadband coverage	Logistics line coverage	Number of talents	Total width
Guangdong	0.1554	0.1708	0.1498	0.2544	0.1136	0.1117	0.2243	0.1627
Shandong	0.1994	0.1690	0.1688	0.1861	0.1136	0.1117	0.1654	0.1464
Shanghai	0.0150	0.0754	0.0461	0.3331	0.1136	0.1117	0.1690	0.1432
Henan	0.1977	0.1269	0.1052	0.2021	0.1136	0.1117	0.1575	0.1390
Hubei	0.1483	0.1620	0.1052	0.2021	0.1104	0.1117	0.1313	0.1335
Fujian	0.1053	0.1505	0.1861	0.1688	0.1136	0.1117	0.0989	0.1284
Beijing	0.0147	0.0641	0.0782	0.2021	0.1136	0.1117	0.1837	0.1269
Jiangsu	0.1736	0.1522	0.1861	0.0461	0.1136	0.1117	0.1659	0.1232
Sichuan	0.1735	0.1937	0.1288	0.0782	0.1095	0.1117	0.1449	0.1212
Liaoning	0.1086	0.0570	0.1288	0.1498	0.1136	0.1117	0.1318	0.1196
Zhejiang	0.0940	0.1536	0.2428	0.0461	0.1136	0.1117	0.1222	0.1174
Chongqing	0.0766	0.1121	0.0782	0.1288	0.1136	0.1074	0.1081	0.1083
Anhui	0.1235	0.1114	0.1688	0.0461	0.1136	0.1117	0.0975	0.1054
Heilongjiang	0.1467	0.0860	0.1052	0.0782	0.1087	0.1117	0.1100	0.1050
Hunan	0.1593	0.1269	0.0782	0.0782	0.1128	0.1106	0.1007	0.1049
Shanxi	0.1154	0.1096	0.1288	0.0461	0.1104	0.1117	0.1134	0.1028
Yunnan	0.1120	0.1530	0.2021	0.0000	0.1136	0.1117	0.0793	0.1002
Guangxi	0.1279	0.1214	0.1498	0.0000	0.1135	0.1117	0.0864	0.0952
Xinjiang	0.1208	0.0688	0.1288	0.0461	0.1095	0.1117	0.0769	0.0945
Shanxi	0.0667	0.0716	0.1052	0.0461	0.1056	0.1117	0.0991	0.0921
Jiling	0.0805	0.0880	0.1052	0.0461	0.1136	0.1117	0.0751	0.0920
Jiangxi	0.0906	0.0762	0.0782	0.0461	0.1128	0.1117	0.0892	0.0913
Hebei	0.1658	0.1330	0.0000	0.0000	0.1113	0.1117	0.1144	0.0878

Index Provdince	Gross agricultural output value	Fixed assets investment	Top 100 e-commerce brands of agricultural products	Top 100 cold chain logistics enterprises	Internet broadband coverage	Logistics line coverage	Number of talents	Total width
Tianjing	0.0226	0.0619	0.0000	0.0782	0.1136	0.1117	0.0701	0.0816
Neimenggu	0.0892	0.1021	0.0000	0.0782	0.0808	0.0978	0.0970	0.0810
Ningxia	0.0276	0.0355	0.0461	0.0782	0.1136	0.1051	0.0235	0.0757
Gansu	0.0826	0.0844	0.0461	0.0000	0.1079	0.1116	0.0632	0.0756
Guizhou	0.1098	0.1194	0.0000	0.0000	0.1116	0.1117	0.0601	0.0753
Hainan	0.0522	0.0439	0.0461	0.0000	0.1136	0.1117	0.0394	0.0690
Qinghai	0.0156	0.0527	0.0461	0.0000	0.1091	0.1117	0.0267	0.0644
Xizang	0.0062	0.0494	0.0461	0.0000	0.0995	0.1083	0.0070	0.0575

The result shows:

With the interval of 0.01, the provinces and regions of the country can be roughly divided into four categories.

The first category of information ecological niche width is between 0.12-0.17: includes nine provinces and regions, including Guangdong, Shandong, Shanghai, Henan, Hubei, Fujian , Beijing, Jiangsu and Sichuan. The development of each ecological niche in each province is relatively balanced and highly coordinated. The overall agricultural product e-commerce logistics has a wide information ecological niche and is highly competitive in the national agricultural e-commerce logistics. The second category of information ecological niche width value is between 0.10 and 0.12: includes 8 provinces and regions about Liaoning, Zhejiang, Chongqing, Anhui, Heilongjiang, Hunan, Shaanxi and Yunnan. The development of each dimension of the information ecological niche in each province is general and the coordination is general. In addition to the low information ecological niche width of individual indicators in the provinces in this category, the information ecological niche width of other indicators is at a higher value. The overall agricultural product e-commerce logistics has a relatively wide information ecological niche and is relatively high competitive in the national agricultural e-commerce logistics. The third category of information ecological niche width value is between 0.08-0.10: includes eight provinces and regions of Guangxi, Xinjiang, Shanxi, Jilin, Jiangxi, Hebei, Tianjin and Neimenggu. The development of each dimension of the information ecological niche in each province is relatively poor and the coordination is relatively poor. Except for the better development of individual indicators in these eight provinces and regions, the remaining indicators have developed relatively poor. The overall agricultural product e-commerce logistics information ecological niche is relatively narrow, and its competitiveness in agricultural e-commerce logistics is relatively weak. The fourth category of information ecological niche width value is between 0.05 and 0.08: includes Ningxia, Gansu, Guizhou, Hainan, Qinghai, and Xizang.The provincial information ecological niche development balance in this category is poor and the coordination is also poor. At the same time, the information ecological niche width value of each dimension is low, which is at a disadvantage in the development of national agricultural e-commerce logistics.

3.   TAKING SHANXI PROVINCE AS AN EXAMPLE FOR TARGETED ANALYSIS

3.1 Analysis of competitiveness indicators

Firstly, from the perspective of seven indicators, the information ecological niche breadth value of gross agricultural output value in Shanxi Province is 0.667, which is at a low level nationwide, indicating that the overall level of agricultural development in Shanxi Province is low; the information ecological niche breadth of

fixed assets investment value of 0.0716, the number one in Guangdong Province is more than twice that of Shanxi Province, indicating that the government is insufficient in the investment in agricultural products e-commerce logistics; the information ecological niche breadth of the top 100 e-commerce brands of agricultural products is 0.1052. In the middle position in the country, it shows that Shanxi Province has achieved good results in developing agricultural product e-commerce brands; the information ecological niche breadth of the top 100 cold chain logistics enterprises is 0.0461, which is in the middle-lower position nationwide. It shows that the development of agricultural products logistics technology in Shanxi Province is relatively slow, which restricts the development of agricultural products e-commerce logistics; the information ecological niche breadth of Internet broadband coverage is 0.1056, which is in a lower position nationwide, indicating that Shanxi Province has shortcomings in the construction of Internet infrastructure; information ecological niche breadth value of logistics line coverage 0.1117, up to 100% coverage; number of talents information ecological niche breadth is 0.0991, in the middle position in the country. Secondly, from the overall point of view, the information ecological niche value of agricultural products e-commerce logistics in Shanxi Province is 0.0921, which is 0.07 different from the first Guangdong Province, 20 in 31 provinces and cities in the country, and 5th in the central region. The overall agricultural product e-commerce logistics information ecological niche is relatively narrow, the competitiveness is relatively weak, and the logistics industry is developing slowly.

3.2 Suggestions and countermeasures

From the analysis of competitiveness indicators, we can see that Shanxi Province has reached 100% in the coverage of logistics routes, and is in the middle of the country in terms of top 100 e-commerce brands of agricultural products and number of talents. while in terms of gross agricultural output value, investment in fixed assets, top 100 enterprises in cold chain logistics and broadband coverage of the Internet, it is in a lower position in the whole country. In view of the above situation, this paper puts forward some pertinent suggestions and countermeasures.

Strengthen investment in fixed assets[16]. Give full play to the leading role of the government, the government should increase investment in fixed assets in agricultural e-commerce logistics, ensure that investment and development level grow synchronously. Improve the construction of logistics system of agricultural products e-commerce. For Shanxi Province, the main task is to improve the logistics distribution technology, especially cold chain distribution. Promoting infrastructure construction. To speed up the construction of Internet infrastructure in rural areas, government subsidies, bandwidth enhancement and additional servers will be subsidized to build a suitable network platform for e-commerce transactions in areas with large output of agricultural products and demand for online sales. In addition, we need to constantly strengthen the brand of agricultural e-commerce. Although Shanxi's agricultural products e-commerce brand is in a good position, it still needs to make continuous progress. At the same time, we are constantly introducing talents for the construction of agricultural e-commerce informatization. Increase the construction of logistics talents for agricultural products e-commerce, and build a high-quality, professional and comprehensive talent team.

4.   RESEARCH SUMMARY

1. This paper only takes Shanxi Province as an example to analyze the competitiveness of e-commerce logistics of agricultural products. The method can be extended to other provinces and regions for analysis.

2. In the selection of indicators, only seven representative indicators were selected, and the other indicators with less influence were not listed. The specific calculation process of determining weight by principal component analysis method is limited to the length without detailed description.

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