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Study on Coupling and Coordination of E-Commerce & Logistics and Urbanization Under County Agriculture and Rural Digitalization

——Take Sichuan & Shaanxi Revolutionary Base Area (Sichuan) as an Example

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Abstract. As an important part of the Rural Revitalization Strategy, e-commerce & logistics under the digitalization of county agriculture and rural areas is conducive to consolidating and expanding the achievements of poverty alleviation and continuously narrowing the development gap between urban and rural areas, and is conducive to the revitalization and development of old revolutionary areas and the realization of new urbanization. Based on the coupled development theory and coordination theory, establish reasonable evaluation indicators, and use the coupled development model to explore the coupling relationship between county urbanization, logistics economy and rural e-commerce in the Sichuan & Shaanxi revolutionary base area (Sichuan) as a sample, and analyze and study the relationship between the three and their development laws. In the implementation plan of Sichuan Province for implementing the revitalization and development plan of the old revolutionary base areas in Sichuan & Shaanxi, it is proposed to build a number of logistics parks, logistics centers, distribution centers and third-party logistics information platforms based on regional central cities for trade logistics, accelerate the construction of trade centers and professional markets, create trade towns, and incorporate the rural market circulation system into the urbanization plan; For e-commerce, we should strengthen the construction of logistics distribution and other support systems, and actively develop county e-commerce.

Keywords: Sichuan & Shaanxi revolutionary base area; county agriculture and rural digitalization; urbanization; e-commerce & logistics; coupling coordination.

1. Introduction

The old revolutionary base area of Sichuan and Shaanxi was the second largest Soviet area during the Agrarian Revolutionary War and made great contributions and sacrifices to the victory of the Chinese revolution. In June 2016, with the approval of The State Council, the National Development and Reform Commission issued the Plan for the Revitalization and Development of Sichuan-Shaanxi Old Revolutionary Base Areas (2016-2020), covering 29 counties (cities and districts) in five municipalities of Bazhong, Guangyuan, Nanchong, Dazhou and Mianyang in Sichuan Province. Sichuan actively promoted the implementation of the plan, and the Sichuan-Shaanxi old revolutionary base area showed a good situation of sustained economic growth, significant improvement of people's livelihood and all-round social progress. During the 13th Five-Year Plan period (2016-2020), when a moderately prosperous society was built in an all-round way, the Sichuan and Shaanxi old revolutionary base areas, as a special type of areas, made great achievements in their revitalization and development. However, as a weak link in the coordinated development between urban and rural areas and regions, special types of areas are faced with new situations and challenges, more complex environmental conditions and more arduous development

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tasks. The 14th Five-Year Plan period is the first five years as we embark on a new journey to fully build a modern socialist country and march toward the second centenary Goal. Regions with special types of development not only face prominent problems of unbalanced and inadequate development, but also face special difficulties. They are also key regions for high-quality development and perform special functions.

The scale of China's digital economy will grow from $4.7 trillion in 2018 to $5.4 trillion in 2020, with a year-on-year growth rate of 9.6%, ranking first in the world [1]. Based on the strategic requirements of digital China construction and agricultural and rural modernization, the Chinese government has issued a series of policies to speed up the process of digital rural construction. With the implementation of digital rural strategy, digital technology and platforms are embedded in rural infrastructure, economy, governance, life and many other areas. The county-level Digital Rural Index, jointly compiled by the Institute of New Rural Development of Peking University and Ali Research Institute, provides an application basis for measuring the digitalized development level of county agriculture and rural areas. As an important part of the rural revitalization strategy, e-commerce logistics under the digitalization of county agriculture and rural areas is conducive to consolidating and expanding the achievements of poverty alleviation and continuously narrowing the development gap between urban and rural areas and regions. It is a key way to solve the above-mentioned major contradictions and contribute to the revitalization and development of old revolutionary base areas and the realization of new urbanization. Based on the theory of coupling development and the theory of coordination (synergy) [2][3][4], this paper explores the coupling relationship between county urbanization, logistics economy and rural e-commerce with the Sichuan and Shaanxi old revolutionary Base Area (Sichuan) as the sample, establishes a reasonable evaluation index, and uses the coupling development model to analyze and study the relationship among the three and its development law.

2. Sample object and measure index

A total of 29 counties (cities and districts) in Sichuan Province, including Bazhong, Guangyuan, Nanchong, Dazhou and Mianyang, were selected as samples. In the measurement indicators of urbanization, logistics economy and rural e-commerce under the digitalization of county agriculture and rural areas, the urbanization rate representing county urbanization was collected from the national economic and social development statistical bulletin of each county (city or district) in 2018 and 2020 and the statistical yearbook of each county (urban area). The logistics (supply chain) index representing the logistics economy comes from the digital supply chain Index in the county-level Digital Rural Index system jointly compiled by the Institute of New Rural Development of Peking University and Ali Research Institute (in 2018, the index covers the number of logistics outlets owned by every 10,000 people and the logistics time of receiving packages. In 2020, the index increased the number of logistics outlets per square kilometer); Also, the digital production index, digital marketing index and digital consumption index in the above county digital rural index system are used to represent the development level of rural e-commerce. Among them, the digital production index covers the construction of national modern agricultural demonstration projects, the construction of national new-type industrialization demonstration bases, and the proportion of Taobao village in all administrative villages. The digital marketing index covers the e-commerce sales of agricultural products per 100 million yuan of the added value of the primary industry, whether there is live broadcast sales, whether there is e-commerce in the rural comprehensive demonstration county, and the number of online businesses per 10,000 people. The digital consumption index covers the consumption amount on the middle line of the total retail sales of social consumer goods per 100 million yuan, and the sales of e-commerce per 100 million yuan of GDP [5][6].

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3. Coupling coordination degree and its calculation method

The coupling coordination degree model is used to analyze the level of coordinated development of things. Coupling degree refers to the interaction between two or more systems to achieve coordinated development of dynamic correlation relationship, which can reflect the degree of interdependence and mutual restriction between systems. Coordination degree refers to the degree of benign coupling in the coupling interaction relationship, which can reflect the quality of coordination.

Coupling is originally a concept in physics, which refers to the phenomenon that two or more systems or motion forms affect each other through various interactions. The coupling degree model of multiple system interactions can be expressed by the following model:

$$C_n = \left\{\frac{(u_1 \cdot u_2 \cdots\cdots u_n)}{\prod (u_1+u_2)}\right\}^{1/n} \tag{1}$$

Where, Cn is the coupling degree of the n-element system; U1... un is the contribution of the first subsystem to the NTH subsystem to the order degree of the total system, and the calculation method is as follows:

$$u_i = \sum_{i=1}^{m} w_{ij}\, u_{ij} \tag{2}$$

$$\sum_{j=1}^{m} w_{ij} = 1 \tag{3}$$

Where ui is the contribution of the ith sub-system to the order degree of the total system; uij is the normalized value of the JTH index in the ith sub-system; wij is the weight of the JTH index in the ith sub-system.

Since the coupling degree index can hardly reflect the overall "efficacy" and "synergy" effect of the subsystem in some cases, the upper and lower limits of each subsystem index of coupling degree are taken from the extreme values of each index, which are dynamic and unbalanced, and it may be misleading to rely solely on the coupling degree to distinguish. Therefore, the coupling coordination degree was proposed [7][8].

Research on the coupling coordination degree of urbanization, logistics economy and rural e-commerce under the digitalization of county agriculture and rural areas. A system is usually represented by multiple indicators. In this case, you need to combine these indicators into one. The aforementioned characterization index of urbanization system is county urbanization rate (numerical range 0-100%), and the characterization index of logistics economic system is digital supply chain index (numerical range 0-100). However, there are three representative indicators of rural e-commerce system, namely, digital production index (value range 0-100), digital marketing index (value range 0-100), and digital consumption index (value range 0-100). For rural e-commerce system, it is necessary to combine multiple indicators into one. Therefore, the weights of the digital production index, digital marketing index and digital consumption index are respectively 0.4, 0.3 and 0.3, and the three indexes are combined into one representation index.

In addition, the calculation of coupling coordination degree model must carry out data normalization processing for input variables (system characterization index), and the value between 0 and 1, so that the final calculated coupling coordination degree value will be between 0 and 1, and the correct coupling coordination degree grade judgment can be obtained [9]. Therefore, the normalization processing of the representation index of logistics economic system is to multiply the digital supply chain index by 1/100, and the normalization processing of the representation index of rural e-commerce system is to multiply the combined index by 1/100. Urbanization, logistics economy and rural e-commerce are ternary coupling under the digitalization of county agriculture and rural areas. The corresponding coupling coordination model is as follows:

$$C = 3\left\{\frac{(u_1 \cdot u_2 \cdot u_3)}{(u_1+u_2+u_3)^3}\right\}^{1/3} \tag{4}$$

$$D = (C \cdot T)^{1/2} \tag{5}$$

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$$T = au_1 + bu_2 + cu_3 \quad (6)$$

Where C is the coupling degree, D is the coupling coordination degree, u1, u2 and u3 respectively represent the county urbanization rate, digital supply chain index and rural e-commerce consolidation index, a, b and c are the corresponding weights (obtained by entropy weight method).

4. Analysis on the coupling coordination relationship between urbanization, logistics economy and rural e-commerce under the digitalization of county agriculture and rural areas

4.1 Sample selection from 29 counties (cities and districts) in Sichuan Province

Compared with the original County Digital Rural Index (2018), the County Digital Rural Index (2020) jointly compiled by the Institute of New Rural Development of Peking University and Ali Research Institute, The number of counties (including county-level cities) has expanded from 1,880 to 2,481 (including 699 municipal districts that accounted for more than 3 percent of agricultural GDP in 2019). All the samples from 29 counties (cities and districts) of Sichuan in the old revolutionary base area of Sichuan were included in the category of County-level Digital Rural Index (2020). The county-level Digital Rural Index (2018) does not include Bazhou District and Enyang District of Bazhong, Lizhou District, Zhaohua District and Chaotian District of Guangyuan, and Tongchuan district and Dachuan District of Dazhou. Therefore, in 2018, the research samples of coupling coordination degree of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas in counties were selected from 22 counties and cities except the above regions. In 2020, the research samples of the coupling coordination degree of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas at county level were selected from all 29 counties (cities and districts) in Sichuan Province. However, in the data of 2020, the digital consumption index of Lizhou District, Zhaohua District and Chaotian District of Guangyuan City was abnormal. Therefore, In 2020, the research samples of the coupling coordination degree of urbanization, logistics economy and rural e-commerce under the digitalization of county agriculture and rural areas were finally selected from 26 other counties (cities and districts) in Sichuan except the above three districts.

4.2 Comparison of sample urbanization, logistics economy and rural e-commerce system indicators

The comparison of indicators of sample urbanization, logistics economy and rural e-commerce system in 2018 is shown in Figure 1. As can be seen from Fig 1, Jiangyou City of Mianyang has the highest urbanization rate, Kaijiang County of Dazhou and Pingwu County of Mianyang has the highest level of logistics (supply chain), Beichuan County of Mianyang has the highest digital marketing index and the highest digital consumption index, and only Cangxi County of Guangyuan, Dazhu County of Dazhou, Nanchong Nanbu County and Jiangyou City of Mianyang have the corresponding index performance.

The comparison of indicators of sample urbanization, logistics economy and rural e-commerce system in 2020 is shown in Figure 2. As can be seen from Fig 2, except for some cities and counties of Nanchong and Mianyang, the urbanization rate of other cities and counties in 2020 has increased compared with that in 2018. Except for Nanbu County, the digital production index of the original counties and cities increased in 2020 compared with 2018. The original digital marketing index of counties and cities increased in 2020 compared with 2018; In addition to the newly included samples in 2020, the digital supply chain index of the original counties and cities in 2020 increased or decreased compared with that in 2018, among which the only original counties and cities with the exponential growth of digital supply chain were Beichuan County and Jiangyou City, which increased by 13.86 and 14.21 respectively. The digital supply chain index of other original counties and cities decreased to different degrees (Pingwu County in Mianyang, Nanjiang County in Bazhong and Qingchuan County in Guangyuan had the largest decrease, which was -52.17, -38.87

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and -32.54, respectively). In addition to the newly included samples in 2020, the digital consumption index of the original counties and cities in 2020 also increased or decreased compared with that in 2018. Among them, Qingchuan County of Guangyuan (increased by +16.99), Zitong County of Mianyang (increased by +13.87), Jiangue County of Guangyuan (increased by +7.86), Wangcang County of Guangyuan (+8.70), Qingchuan County of Guangyuan (increased by +16.99), Zitong County of Mianyang (increased by +13.87), Jiangue County of Guangyuan (increased by +7.86), Wangcang County of Guangyuan (increased by +8.70), The digital consumption index of other original counties and cities had a small increase or even a slight decrease.

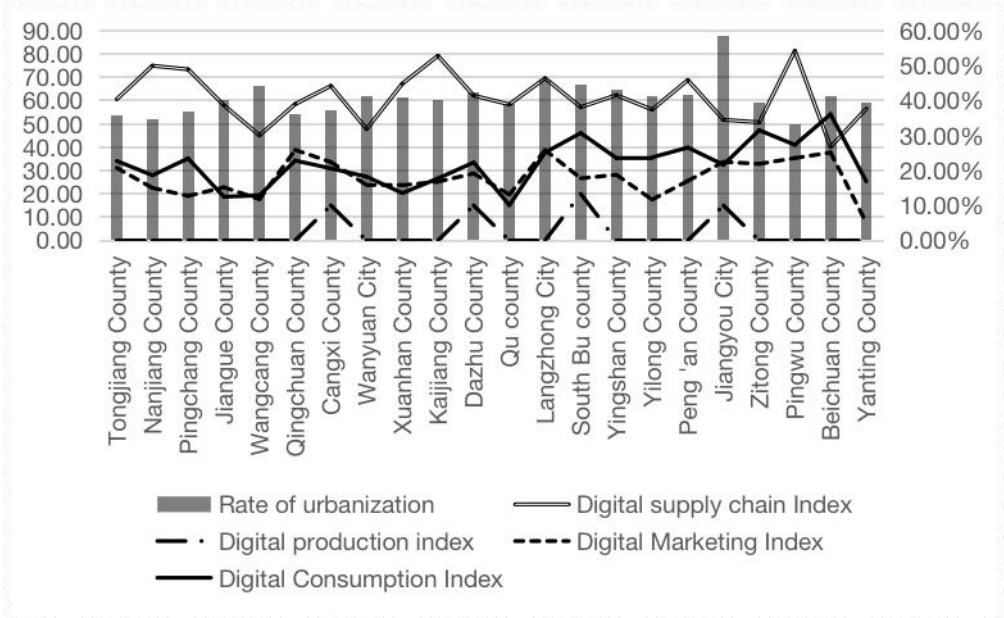

Fig. 1 Comparison of indicators of sample urbanization, logistics economy and rural e-commerce system in 2018

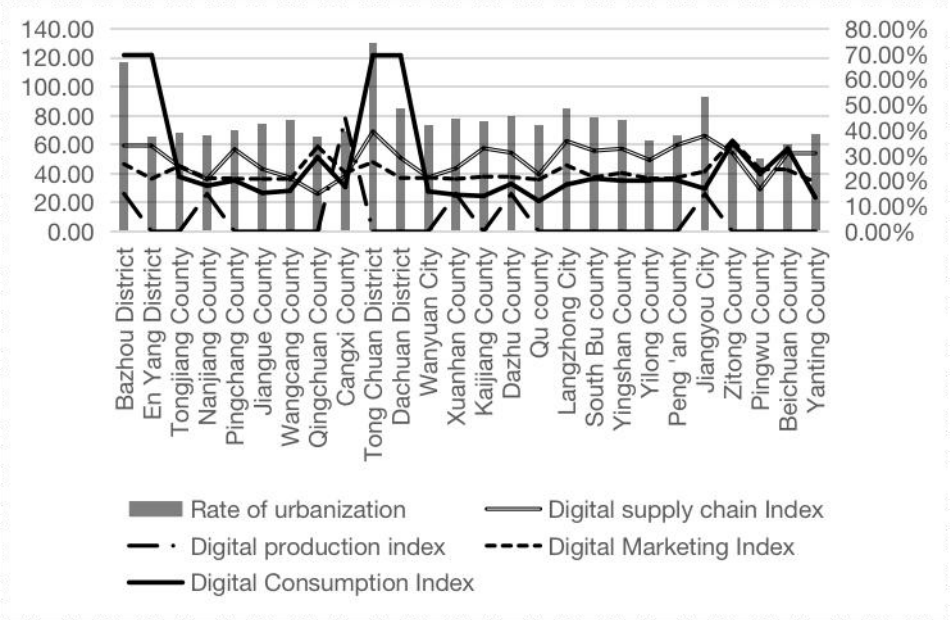

Fig. 2 Comparison of indicators of sample urbanization, logistics economy and rural e-commerce system in 2020

4.3 Calculation of coupling coordination degree of urbanization, logistics economy and rural e-commerce

In 2018, the coupling coordination calculation results of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas in the sample counties of

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Sichuan's 22 counties and cities are shown in Table 1. The coupling coordination degree is divided into 1-10 levels (corresponding to extreme disorder, severe disorder, moderate disorder, mild disorder, borderline disorder, barely coordination, primary coordination, intermediate coordination, good coordination and high-quality coordination).

Table 1. Calculation results of coupling coordination degree of urbanization, logistics economy and rural e-commerce in 2018

Area	C value of coupling degree	Coordinate index T value	Coupling coordination degree D value	Level of coordination	Degree of coupling coordination
Tongjiang County	0.809	0.362	0.541	6	Be in tune with
Nanjiang County	0.615	0.390	0.489	5	On the verge of disorder
Pingchang County	0.795	0.424	0.581	6	Be in tune with
Jiangue County	0.900	0.283	0.504	6	Be in tune with
Wangcang County	0.750	0.213	0.399	4	Mild disorder
Qingchuan County	0.824	0.391	0.568	6	Be in tune with
Cangxi County	0.821	0.521	0.654	7	Primary coordination
Wanyuan City	0.976	0.266	0.510	6	Be in tune with
Xuanhan County	0.864	0.377	0.571	6	Be in tune with
Kaijiang County	0.845	0.505	0.653	7	Primary coordination
Dazhu County	0.960	0.544	0.722	8	Intermediate level coordination
Qu county	0.666	0.237	0.398	4	Mild disorder
Langzhong City	0.990	0.623	0.785	8	Intermediate level coordination
South Bu county	0.922	0.619	0.755	8	Intermediate level coordination
Yingshan County	0.993	0.466	0.680	7	Primary coordination
Yilong County	0.995	0.342	0.584	6	Be in tune with
Peng 'an County	0.957	0.505	0.695	7	Primary coordination
Jiangyou City	0.881	0.690	0.780	8	Intermediate level coordination
Zitong County	0.884	0.406	0.600	6	Be in tune with
Pingwu County	0.338	0.550	0.431	5	On the verge of disorder
Beichuan County	0.351	0.406	0.377	4	Mild disorder
Yanting County	0.454	0.223	0.318	4	Mild disorder

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From the results of Table 1, the coupling degree of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas in Nanjiang County of Bazhong, Pingwu County of Mianyang, Beichuan County and Yanting County is low in the sample of 22 counties and cities in Sichuan's old revolutionary base area in 2018. Because of the low coordination index, the calculated coupling coordination degree of Wangcang County and Daqui County of Guangyuan is also low. The coupling coordination levels of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas in these counties are on the verge of or slightly disordered, while the coupling coordination levels of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas in other counties and counties are barely coordinated or above, among which, Dazhu County, Nanchonglangzhong City and Nanbu County in Dazhou, and Jiangyou City in Mianyang have the highest coordination level of urbanization, logistics economy and rural e-commerce coupling under the digitalization of agriculture and rural areas.

The calculation results of the coupling coordination of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas in the sample counties of 26 Sichuan and Shaanxi old revolutionary Base areas in 2020 are shown in Table 2, where the coupling coordination degree is divided into 1-10 levels (the same as above). From the results of Table 2, the coupling degree of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas in Qingchuan County of Guangyuan, Daqui County, Pingwu County of Mianyang and Yanting County is low in the sample of 26 counties and cities in Sichuan's Sichuan-Shaanxi old revolutionary base area in 2020. Due to the low coordination index, the calculated coupling coordination degree is also low in Jiangue and Wangcang counties of Guangyuan, Wanyuan and Kaijiang counties of Dazhou and Yilong County of Nanchong. In these counties, the coupling coordination levels of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas are at the verge of imbalance, mild imbalance and moderate imbalance, while the coupling coordination levels of urbanization, logistics economy and rural e-commerce under the digitalization of agriculture and rural areas in other counties and counties are barely coordinated or above, among which, In Bazhong Bazhou District and Dazhou Tongchuan District, the highest coordination level of urbanization, logistics economy and rural e-commerce coupling under the digitalization of agriculture and rural areas is high quality coordination. In Mianyang Jiangyou City, the coupling coordination level of urbanization, logistics economy and rural e-commerce coupling under the digitalization of agriculture and rural areas is intermediate coordination.

Table 2. Calculation results of the coupling coordination degree of urbanization, logistics economy and rural e-commerce in 2020

Area	C value of coupling degree	Coordinate index T value	Coupling coordination degree D value	Level of coordination	Degree of coupling coordination
Bazhou District	0.994181	0.859401	0.924338	10	High quality coordination
En Yang District	0.850923	0.549323	0.68369	7	Primary coordination
Tongjiang County	0.931895	0.283529	0.514023	6	Be in tune with
Nanjiang County	0.983468	0.255147	0.500928	6	Be in tune with
Pingchang County	0.751418	0.356572	0.517624	6	Be in tune with
Jiangue County	0.726993	0.251037	0.427202	5	On the verge of disorder
Wangcang County	0.785826	0.218035	0.413929	5	On the verge of disorder

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Qingchuan County	0.469495	0.19168	0.299988	3	Moderate disorder
Cangxi County	0.860119	0.445071	0.61872	7	Primary coordination
Tong Chuan District	0.992896	0.915155	0.953234	10	High quality coordination
Dachuan District	0.982122	0.567669	0.746673	8	Intermediate level coordination
Wanyuan City	0.819336	0.210028	0.41483	5	On the verge of disorder
Xuanhan County	0.986498	0.34417	0.582685	6	Be in tune with
Kaijiang County	0.605913	0.36668	0.471356	5	On the verge of disorder
Dazhu County	0.954125	0.453348	0.657685	7	Primary coordination
Qu county	0.472046	0.206617	0.312302	4	Mild disorder
Langzhong City	0.801677	0.476225	0.617882	7	Primary coordination
South Bu county	0.803141	0.38941	0.559241	6	Be in tune with
Yingshan County	0.805033	0.397629	0.565778	6	Be in tune with
Yilong County	0.792423	0.273955	0.465927	5	On the verge of disorder
Peng 'an County	0.719455	0.366038	0.513174	6	Be in tune with
Jiangyou City	0.919235	0.595837	0.740077	8	Intermediate level coordination
Zitong County	0.794082	0.408763	0.569729	6	Be in tune with
Pingwu County	0.581207	0.09174	0.230911	3	Moderate disorder
Beichuan County	0.816637	0.358833	0.541328	6	Be in tune with
Yanting County	0.423852	0.299108	0.356058	4	Mild disorder

5. Closing Remarks

(1) Due to the different construction time of the data set, the data accessibility of the "County Digital Rural Index Database" of Peking University New Rural Development Institute and Ali Research Institute is different, among which the specific indexes included in the calculation of digital supply chain index have been added. Therefore, The longitudinal comparison of Logistics (supply chain) Index (Digital Supply Chain Index), which represents logistics economy in 22 counties and cities of Sichuan in 2018-2020, is not recommended for too many references. The cross-sectional comparison results of urbanization, logistics economy and rural e-commerce system index of 22 counties and cities in Sichuan in 2018 can be used for reference, and the cross-sectional

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comparison results of urbanization, logistics economy and rural e-commerce system index of 26 counties (cities and districts) in Sichuan in 2020 can be used for reference.

(2) From the construction of the National new-type urbanization Plan (2014-2020) to the proposal of "Opinions on Promoting the Urbanization Construction with county towns as the important Carrier". Against the background of the rapid development of digital technology, digital economy has become an important force to promote the county to make up for the development weaknesses according to local conditions, promote the quality and efficiency improvement of county industries, and realize the high-quality development of county economy [10]. In the special type of Sichuan-Shaanxi old revolutionary base area to promote new urbanization and rural revitalization, it is necessary to strengthen the analysis of the coupling coordination relationship between e-commerce logistics and urbanization under the digitalization of county agriculture and rural areas and the understanding of their development evolution. While improving the level of county economic development, it is helpful to narrow the gap between urban and rural development and break the boundaries of regional development. We will ensure that the fruits of development will benefit all people in a more equitable manner, so as to promote integrated urban and rural development and advance the construction of a new type of urbanization.

(3) After The State Council issued the Opinions on Supporting the Revitalization and Development of Old Revolutionary Base Areas in the New Era, the Development Plan of Sichuan Province for the 14th Five-Year Plan for Sichuan and Shaanxi Old Revolutionary Base Areas was successively issued, making it clear that the achievements in poverty alleviation should be effectively linked with rural revitalization. Based on the implementation plan for the revitalization and development of Sichuan-Shaanxi old revolutionary base Area implemented by Sichuan Province, it is proposed to build a batch of logistics parks, logistics centers, distribution centers and third-party logistics information platforms relying on regional central cities, accelerate the construction of business centers and professional markets, build business towns, and incorporate the rural market circulation system into the urbanization planning[11]. For e-commerce, suggestions such as strengthening the construction of logistics and distribution support system and actively developing county e-commerce will provide strong support for the implementation of the strategy of expanding domestic demand, coordinated promotion of new urbanization and rural revitalization[12].

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