Research on the Impact of E-commerce Industry Development in Zhuhai on Rural Revitalization

Mimi Shao[1], Hongai Shi[2,*], Zicen Liao[2]

[1]Guangzhou Xinhua University, College of Economics and Trade; City University of Macau, Faulty of Humanities and Social Sciences, 999078, Macau, China
[2]Guangzhou Xinhua University, College of Economics and Trade, Guangzhou, China

*shihongai03@163.com

Abstract. The Central Document No.1 of 2024 clearly proposes to promote the comprehensive revitalization of rural areas. With the development of the social economy, the popularization of network communication, and the growth of the e-commerce industry, e-commerce has become an important driving force for rural revitalization. This article focuses on the development of the e-commerce industry in Zhuhai City and explores its impact on the rural revitalization of Zhuhai City. Using empirical analysis, we construct the Zhuhai City e-commerce development index and rural revitalization development index, and through correlation analysis, we find a positive correlation between the two. The development of the e-commerce industry in Zhuhai City mainly affects rural revitalization through aspects such as the e-commerce infrastructure and the cultivation of e-commerce talents. Finally, suggestions are provided for the government and enterprises, such as strengthening the integration of infrastructure construction and technological innovation, optimizing talent development, and improving policy support.

Keywords: Rural revitalization strategy; Zhuhai City; Development of e-commerce industry; Rural e-commerce.

1 Introduction

The issue of agriculture, rural areas, and farmers (referred to as the "san nong" issue) has long been a key topic in China. On October 18, 2017, General Secretary Xi Jinping first proposed the strategy of rural revitalization in his report to the 19th National Congress of the Communist Party of China, marking a further emphasis on the development of agriculture and rural areas by the country. The Central Document No. 1 released in 2024 emphasized the importance of promoting comprehensive rural revitalization, outlining key measures such as ensuring national food security, preventing large-scale poverty relapse, and enhancing rural industrial development and governance. The goal is to promote agricultural and rural modernization through technology and reforms, ensuring the deep implementation of the strategy for comprehensive rural revitalization.

K. Zhang et al. (eds.), *Proceedings of the 5th International Conference on Economic Management and Big Data Application (ICEMBDA 2024)*, Advances in Economics, Business and Management Research 313,
https://doi.org/10.2991/978-94-6463-638-3_26

E-commerce, as a product of the integration of modern information technology and rural economy, plays an increasingly important role in promoting the rural revitalization strategy. With the popularization of Internet technology and the continuous improvement of the e-commerce system, e-commerce has become an important way to promote the sale of agricultural products, increase farmers' income, and drive the upgrading of rural industries. With the support of government policies and the role of market mechanisms, e-commerce has injected new vitality into the development of rural economy, becoming an important means to promote rural revitalization.

As an economic special zone and experimental field, Zhuhai has achieved significant results in the implementation of the rural revitalization strategy, especially in the field of e-commerce. Through innovation-driven and policy guidance, Zhuhai has promoted the development of rural e-commerce, enhanced the market competitiveness of agricultural products, and increased the economic income of farmers. However, compared to some developed urban areas, there is still a certain gap in the application of e-commerce and industrial development in rural areas of Zhuhai. Therefore, in-depth research on the impact of e-commerce development strategy on the rural revitalization of Zhuhai is of great theoretical and practical significance for optimizing policy design and enhancing the level of rural e-commerce development.

There has been a significant amount of research conducted by scholars both domestically and internationally on the role and significance of developing rural e-commerce. Poole B (2001) [1]found that the integration of e-commerce in rural areas significantly promotes local economic development. It optimizes the marketing channels, information dissemination, and sales processes of agricultural products, effectively simplifying traditional trading modes, enhancing market transparency, and positively impacting pricing mechanisms for agricultural products. Ling Hong (2017)[2] proposed the F2A2C model, which stands for Farmer-Agent-Customer model. This model takes into account the cultural level of farmers and the operational difficulties of e-commerce, and reduces the cost for farmers to use e-commerce by introducing agents as intermediaries. Yi Ying (2019) [3]emphasized the role of cluster development models and the improvement of logistics systems in driving the rural e-commerce economy from the perspective of industrial chain development. By applying big data and reforming the supply side of agricultural products, as well as cultivating and introducing rural Internet talents, new impetus can be provided for the development of the rural e-commerce economy.

At the same time, scholars have proposed various innovative models and strategies for the sustainable development of rural e-commerce. KabandaS, BrownI (2017)[4] conducted a structured analysis to explore the adoption of e-commerce by small and medium-sized enterprises (SMEs), especially the challenges and opportunities in terms of technology and market environment. RuizGarcia (2010) [5]focused on solving the problems of agricultural products during transportation, proposing a visual and controllable logistics system to improve logistics efficiency and reduce losses. JangW, KleinCM (2011) [6]addressed issues in the supply chain of small farmers and proposed corresponding solutions to promote their sustainable development. Li Yanli (2022)[7] developed strategies for the development of agricultural e-commerce, including improving product supervision channels, strengthening service brand building, promoting agricultural product standardization, integrating online and offline channels, and developing

cold chain logistics to address issues such as weak brand awareness, incomplete product quality and safety supervision system, intense homogenized competition, and insufficient traditional logistics channels. Kong Yan (2023)[8] believes that the sustainable development of e-commerce must adhere to the five development concepts of innovation, coordination, green, openness, and sharing, and suggests establishing a multi-party participation model, enhancing farmers' technological literacy and e-commerce awareness, while the government should play a supervisory role and unify agricultural product and processing standards. These studies indicate that the development of rural e-commerce requires not only technological innovation and model innovation but also policy support and talent cultivation to achieve the diversification of rural economy and the smooth implementation of rural revitalization strategies.

2 Empirical Analysis of the Development Level of E-commerce in Zhuhai on the Rural Revitalization

2.1 Data Sources and Construction of Evaluation System Indicators

2.1.1 Selection of Indicators for the Development Level of E-Commerce.

Based on the availability of data, this article selects data from the Zhuhai Municipal Bureau of Statistics for the years 2021 to 2022, as well as research data from the Alibaba Research Institute, and refers to the research results of Zhang Wei (2023)[9] and Hao Jinlei et al.(2016)[10] to construct the index of e-commerce development level in Zhuhai City, as shown in Tables 1 and 2.

Table 1. Construction of Indicators for the Development Level of E-commerce in Zhuhai City

Dimension	Indicators	unit	Indicator attribute
Network Infrastructure Construction	Number of Internet broadband subscriptions	Ten thousand households	+
	Mobile phone ownership (including SIM cards)	Ten thousand households	+
Level of Rural E-commerce	Number of Taobao villages	One	+
Logistics Infrastructure Construction	Road mileage	kilometer	+
	Transportation financial expenditure	ten thousand yuan	+
Government support level	Education financial expenditure	ten thousand yuan	+

Table 2. Construction of Indicators for the Development Level of E-commerce in Zhuhai City

Year (Indicator unit is the same as in Table 1)	Number of Internet broadband subscriptions	Mobile phone ownership (including SIM cards)	Number of Taobao villages	Road mileage	Transportation financial expenditure	Education financial expenditure
2012	59.69	290.75	0	1448.42	130977	438581
2013	65.85	350.54	0	1446.71	105781	510801
2014	72.61	363.96	0	1446.71	136304	490867

Year (Indicator unit is the same as in Table 1)	Number of Internet broadband subscriptions	Mobile phone ownership (including SIM cards)	Number of Taobao villages	Road mileage	Transportation financial expenditure	Education financial expenditure
2015	83.9	369.89	0	1446.71	153724	528762
2016	89	337.27	0	1461.66	81131	572555
2017	96.37	332.46	0	1452.93	100083	742206
2018	107.27	367.9	1	1560.54	117923	764116
2019	112.01	386.9	1	1463.42	88928	1042080
2020	106	359	3	1472.57	334137	1104658
2021	114.09	376.89	3	1472.57	514255	1149756
2022	122.71	385.22	9	1505.2	265017	1167355

2.1.2 Entropy Method for Measuring the Level of E-Commerce Development in Zhuhai.

Due to the dimensional differences of different indicators, it may lead to certain indicators dominating the results numerically, thus affecting the outcome of data selection. In order to eliminate this dimensional effect, non-dimensional processing is carried out first, followed by the use of entropy method to calculate the comprehensive score, constructing the E-commerce Development Index of Zhuhai City, as shown in Tables 3 and 4.

First, Dimensionless Processing:

Positive indicators:$X'_{ij} = \frac{X_{xj} - \min(X_{xj})}{\max(X_{xj}) - \min(X_{xj})} + 0.0001$ and Negative indicators:

$$X'_{ij} = \frac{\max(X_{xj}) - X_{xj}}{\max(X_{xj}) - \min(X_{xj})} + 0.0001$$

Then, calculate the weight of each indicator: $P_{ij} = \frac{X_{xj}}{\sum_{i=1}^{m} X_{xj}}$

Then, calculate the information entropy of each indicator:

$$e_j = -k \sum_{i=1}^{m} P_{ij} \ln (P_{ij}), K = \frac{1}{\ln m}, 0 \le e \le 1$$

Take the differentiation coefficient of each indicator: $g_i = 1 - e_j$;

Finally, calculate the weight of each indicator $w_j = \frac{g_j}{\sum_{j=1}^{n} g_j}$; and obtain the comprehensive score $v_i = \sum_{j=1}^{n} (w_j \times x_{ij})$.

Table 3. Calculation result of the level of e-commerce development in Zhuhai City

Dimension	Indicators	unit	Information entropy	Weight	Indicator Weight
Network Infrastructure Construction	Number of Internet broadband subscriptions	Ten thousand households	0.9044	0.0699	0.1083

Dimension	Indicators	unit	Information entropy	Weight	Indicator Weight
Level of Rural E-commerce	Mobile phone ownership (including SIM cards)	Ten thousand households	0.9473	0.0395	0.3388
	Number of Taobao villages	One	0.5361	0.3388	
Logistics Infrastructure Construction	Road mileage	kilometer	0.6724	0.2392	0.4353
	Transportation financial expenditure	ten thousand yuan	0.7316	0.1960	
Government support level	Education financial expenditure	ten thousand yuan	0.8391	0.1175	0.1175

Table 4. Comprehensive Score Table of E-commerce Development Level in Zhuhai City from 2012 to 2022

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Overall Score	0.0262	0.0538	0.0770	0.1059	0.1041	0.1230	0.4297	0.2701	0.4679	0.5728	0.7702
Ranking	11	10	9	7	8	6	4	5	3	2	1

2.1.3 Selection of Indicators for Rural Revitalization Development.

This article refers to the index selection of rural revitalization development by Xu Xue (2022) [11]and Wang Zicheng (2023)[12], establishing indicators from five dimensions: prosperous industries, livable ecology, civilized rural customs, effective governance, and affluent living. It combines data from the Zhuhai Statistics Bureau and the Guangdong Provincial Statistics Bureau, as detailed in Table 5.

Table 5. Construction of Indicators for Rural Revitalization Development in Zhuhai City

Dimension	Indicators	unit	Indicator attribute
Prosperous industries	Per capita total power of agricultural machinery	kilowatt	+
	Total output value of agriculture, forestry, animal husbandry and fishery	Ten thousand households	+
Livable ecology	Forest coverage rate	%	+
	Number of public toilets	one	
Civilized rural customs	Number of rural cultural stations	one	+
	Proportion of village heads and secretaries who shoulder the responsibility alone	%	+
Effective governance	Per capita net income of farmers	RMB	+
Affluent living	Number of cars per 100 households	vehicles	+

2.1.4 Entropy Method for Measuring the Level of Rural Revitalization in Zhuhai.

According to the entropy method mentioned above, the level of rural revitalization development in Zhuhai is calculated, and the results are shown in Table 6 and Table 7. To more intuitively demonstrate the trend of rural revitalization and development, Figure 1 is drawn.

Table 6. Calculation result of Rural Revitalization Development in Zhuhai City

Dimension	Indicators	unit	Information entropy	Weight	Indicator Weight
Prosperous industries	Per capita total power of agricultural machinery	kilowatt	0.8734	0.1287	0.2124
	Total output value of agriculture, forestry, animal husbandry and fishery	Ten thousand households	0.9176	0.0837	
Livable ecology	Forest coverage rate	%	0.8836	0.1182	0.2648
	Number of public toilets	one	0.8558	0.1466	
Civilized rural customs	Number of rural cultural stations	one	0.8829	0.1190	0.1190
Effective governance	Proportion of village heads and secretaries who shoulder the responsibility alone	%	0.9129	0.0885	0.0885
Affluent living	Per capita net income of farmers	RMB	0.8968	0.1049	0.3152
	Number of cars per 100 households	vehicles	0.7930	0.2103	

Table 7. Comprehensive Score Table of Rural Revitalization Development in Zhuhai City from 2012 to 2022

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Overall Score	0.1067	0.0508	0.2539	0.2964	0.5030	0.3332	0.5001	0.5689	0.4868	0.8019	0.9887
Ranking	10	11	9	8	4	7	5	3	6	2	1

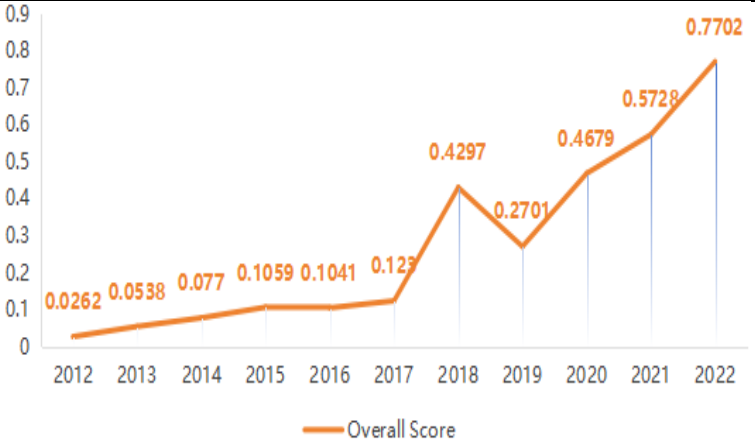

Fig. 1. Trend chart of comprehensive evaluation scores for rural revitalization development in Zhuhai City

2.2 The Impact of the Development Level of E-Commerce in Zhuhai on the Rural Revitalization

Grey correlation analysis is a method for evaluating the correlation between factors based on the similarity of the development trends between the factors. Studying the impact of Zhuhai's development level on the development level of rural revitalization, grey correlation analysis can be conducted on the two development levels. Referring to the grey correlation degree level table compiled by Zhao et al.(2021) [13]if there is a strong correlation between Zhuhai's e-commerce development and rural revitalization development, it indicates that the improvement of Zhuhai's e-commerce development level has a positive impact on rural revitalization.

Firstly, normalize the data: $y_i' = \frac{y_i}{y_{i1}}$;

Then calculate the grey relational degree and difference sequence $\Delta_i(d) = |y_0'(d) - y_i'(d)|$; calculate the maximum difference, $M = Max_i Max_d \Delta_i(d)$;minimum difference,$m = Min_i Min_d \Delta_i(d)$

And then compute the correlation coefficient $r\big(y_0(d), y_i(d)\big) = \frac{m+\xi M}{\Delta_{0i}(d)+\xi M}, \xi = 0.5$; obtain the degree of correlation$r(y_o, y_i) = \frac{1}{n}\sum_{d_i}^{n} r\big(y_0(d), y_i(d)\big)$.Derive the correlation between the level of e-commerce development in Zhuhai City and the concept of rural revitalization, as shown in Table 8.

Table 8. Gray correlation results

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Connection count	1	0.9314	0.8797	0.8235	0.8267	0.7851	0.4797	0.6039	0.4572	0.4050	0.3333
Gray correlation degree						0.6841					

2.3 Empirical Results Analysis

By constructing the E-commerce Development Index of Zhuhai City, it can be seen from the specific data in Table 4 that the overall level of e-commerce in Zhuhai City is showing an upward trend. This indicates that there is vast room for the development of the e-commerce industry. Starting from 2019, the development speed of the e-commerce industry in Zhuhai City has accelerated, compared to the slow growth from 2012 to 2017. 2019 marks a turning point, indicating a deepening emphasis on the e-commerce industry in Zhuhai City. By constructing the Rural Revitalization Development Index, we can see from the specific data in Table 7 that there have been fluctuations in some years, but overall there is a positive trend. This indicates that Zhuhai City has shown a proactive attitude in promoting the rural revitalization strategy, whether in terms of industrial prosperity, ecological livability, rural civility, effective governance, or affluent living. This trend is of great significance for improving the quality of life in rural areas and narrowing the urban-rural gap, which will help achieve the overall goal of rural revitalization and realize common prosperity. According to the grey correlation analysis, the grey correlation degree between the development level of e-commerce in

Zhuhai and the development level of rural revitalization is approximately 0.6841 based on the results in Table 8. Combining with the classification table of grey correlation degree (0.35 < value ≤ 0.65 is moderate correlation; 0.65 < value ≤ 0.85 is strong correlation), it can be seen that there is a strong correlation between the development level of e-commerce industry in Zhuhai and the rural revitalization development. This means that factors affecting the development level of e-commerce also influence the development of rural revitalization, especially the construction of urban logistics infrastructure and the number of Taobao villages, which account for nearly 70% of the weight.

3 Research Findings and Recommendations

3.1 Research Findings

This article is based on constructing the E-commerce Development Index and Rural Revitalization Development Index of Zhuhai City, and analyzing the grey correlation between the two, resulting in the following conclusions:

The development of the e-commerce industry is closely related to the strategy of rural revitalization: empirical results show a strong correlation between the level of e-commerce development in Zhuhai City and the development of rural revitalization. Especially since 2019, the rapid development of the e-commerce industry has become an important force driving rural revitalization. This indicates that the rapid development of the e-commerce industry can not only promote local economic growth but also support the goal of achieving common prosperity by improving the quality of life in rural areas and narrowing the urban-rural gap.

Infrastructure construction is the key support for the development of the e-commerce industry: Internet broadband access and mobile phone ownership are important indicators of network infrastructure construction, which directly affect the development foundation of the e-commerce industry. In addition, the construction of logistics infrastructure, such as road mileage and transportation fiscal expenditure, is also an indispensable condition for the development of the e-commerce industry. Therefore, strengthening the construction of these infrastructures is of great significance for improving the hard environment of the e-commerce industry and promoting rural revitalization.

Government support and talent cultivation are important guarantees for the development of the e-commerce industry: Increasing education and financial support can have a positive impact on the development of the e-commerce industry, especially in terms of talent cultivation and the construction of e-commerce culture. Enterprises need professional talents to formulate and implement scientific development strategies, while government support and management ensure the effective implementation of e-commerce industry policies. In addition, the number of Taobao villages serves as an indicator of the level of rural e-commerce development, and its improvement can bring positive effects to the e-commerce development in Zhuhai City.

3.2 Recommendations

Based on the above research findings, this article provides recommendations from both government and corporate perspectives. Enhancing the integration of infrastructure construction and technological innovation:

The government should continue to invest in network and logistics infrastructure to support the rapid development of the e-commerce industry. Enterprises should actively adopt new generation information technologies such as 5G, big data, artificial intelligence, etc., to improve operational efficiency and service quality. The government can promote technological innovation by providing research and development subsidies, tax incentives, and other incentive measures, while enterprises should also explore new business models such as social e-commerce, live-streaming e-commerce, etc., to adapt to changes in consumer behavior.

Optimize talent training and introduction mechanisms: The government needs to cooperate with educational institutions to strengthen the construction of e-commerce related disciplines and talent training, and provide continuing education and professional training for employees. Enterprises should pay attention to talent training and introduction, especially in key areas such as data analysis, supply chain management, and new media marketing. The government can attract and retain high-end talents in the e-commerce field through measures such as the "Zhuhai Talent Plan". Enterprises should also establish mechanisms to attract and retain talents, including providing competitive salary and benefits, career development paths, and innovative work environments.

Improve policy support and regulatory system: The Zhuhai government should further improve policy support for the e-commerce industry, including financial support, tax incentives, industrial park construction, etc., to provide a good development environment for e-commerce enterprises. At the same time, strengthen market supervision to ensure fair competition in the e-commerce market and protect consumer rights. By establishing and improving laws and regulations in the e-commerce field, regulating the order of the e-commerce market, cracking down on counterfeit goods and unfair competition, and enhancing the transparency and credibility of the e-commerce market. In addition, the government should strengthen guidance and services for e-commerce enterprises, help solve problems encountered in development, and promote the healthy development of the e-commerce industry.By implementing these measures, the e-commerce industry in Zhuhai will be effectively promoted, providing strong support for the implementation of the rural revitalization strategy and achieving high-quality economic development.

Acknowledgments

This project is supported by the following projects: the Zhuhai Philosophy and Social Science Planning Project "Research on the Path of Empowering Zhuhai's High-quality Economic Development through the Integration of 'Traveling Culture Village' Industry" (No.2023YBB029);Philosophy and Social Science “14th Five-Year Plan” in Chaozhou City for the year 2023 (No.2023-C-26). And This paper is also sponsored by the projects: "Crisis Response Mechanisms and Policy Research for Small and Medium

Enterprises in Guangdong Province in the Post-epidemic Era" (No.2021ZDJS141), and Characteristic Key Discipline “Public Administration” in Guangdong Province in 2016(No. 2017STSZD01).

References

1. Pool B. How will agricultural E-Markets evolve?[J]. Agricultural Outlook Forum, 2001, 22(2): 33108.
2. LingHong, Analysis of Rural E-commerce Development Models from the Perspective of Internet Economy[J]. Journal of Commercial Economics,2017,(03):108-110.
3. Yi Ying. Rural E-commerce Economic Development Strategy[J].The Farmers Consultant,2019,(11):27.
4. Kabanda S, Brown I. A structuration analysis of Small and Medium Enterprise (SME) adoption of E-Commerce: The case of Tanzania[J]. Telematics and Informatics, 2017, 34(4): 118-132.
5. Ruiz-Garcia L, Steinberger G, Rothmund M. A model and prototype implementation for tracking and tracing agricultural batch products along the food chain[J]. Food control, 2010, 21(2): 112-121.
6. Jang W, Klein C M. Supply chain models for small agricultural enterprises[J]. Annals of Operations Research, 2011, 190: 359-374.
7. Li Yanli.Exploration of the Development of Agricultural E-commerce under the Background of "Internet + Agriculture"[J].Agricultural Engineering Technology.2022(30)75-76,DOI:10.16815/j.cnki.11-5436/s.2022.30.031.
8. Kong Yan. Research on the Optimization of Rural E-commerce Development Path in the Process of Rural Revitalization at the County Level [D]. Northwest A&F University, 2023.
9. Zhang Wei, Jiang Yicen, Zhu Yanchun, Qin Chunlei, Li Jing. The Relationship between Rural E-commerce and Regional Coordinated Development under the Goal of Common Prosperity: An Empirical Analysis Based on Provincial Panel Data from 2018 to 2021 [A]. Proceedings of the 18th (2023) China Management Annual Conference and the 10th Anniversary Seminar on the Belt and Road Initiative. China Association for Management Modernization, 2023:14.
10. Hao Jinlei, Xing Xxiangyang.Study on the Influence Factors of Rural E-commerce Development in View of Farmers’ Participation[J].Journal of Xidian University(Social Science Edition).2016,26(05):14-20.DOI:10.16348/j.cnki.cn61-1336/c.2016.05.003.
11. Xu Xue, Wang Yongyu. Measurement,Regional Difference and Dynamic Evolution of Rural Revitalization Level in China[J].Journal of Quantitative & Technological Economics,2022,39(05):64-8.
12. Wang Zicheng, Yu Xiaobing, Wu Xuejing. Influence of Economic Development Level on the Coupling Coordination Degree Between Digital Economy and Rural Revitalization [J].Statistics &Decision,2023,39(14):27-32.DOI:10.13546/j.cnki.tjyjc.2023.14.005.
13. Zhao X, Ding X, Li L. Research on Environmental Regulation, Technological Innovation and Green Transformation of Manufacturing Industry in the Yangtze River Economic Belt[J]. Sustainability, 2021, 13.