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Research Article

Research on the Relationship of Coupling Coordination between Digitalization and Agricultural Sustainable Development

Xu Xiumei and Tian Xianghui

College of Economics and Management, Qingdao Agricultural University, Qingdao 266100, Shandong, China

Correspondence should be addressed to Tian Xianghui; xianghui@qau.edu.cn

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This paper constructs a coupling coordination degree model of digitization and agricultural sustainable development and tests coupling and coordination development levels by using the data from Shandong Province. Furthermore, the Tobit model is constructed to deeply analyze the influencing factors of its coordination development. The results show that the comprehensive development level of digitization and agricultural sustainable development in Shandong Province is generally on the rise; the degree of coupling coordination between digitization and agricultural sustainable development in Shandong Province has been steadily rising and entering into the stage of high-quality coordination in 2018; since 2016, digitization in Shandong Province has played the more important role in promoting agricultural sustainable development than economic development, opening-up degree, industrial structure, and talent reserve. Finally, based on the above research conclusions, relevant policy suggestions are put forward.

1. Introduction

With the continuous development of the internet and other advanced technologies, digitization has gradually become the new feature of the times. The Fifth Plenary Session of the 18th CPC Central Committee proposed to implement the big data strategy. The Fourth Plenary Session of the 19th CPC Central Committee added data as the seventh factor of production. It has been repeatedly proposed that agriculture should be combined with figures. Digital Agriculture and Rural Development Plan (2019–2025) has proposed to lead the development of agricultural and rural modernization with digitization. In 2021, the Central No. 1 Document has proposed to strengthen the digital construction of rural public services. China has always attached great importance to agricultural and rural issues and puts agricultural sustainable development and rural construction in a prominent position when planning national modernization [1], the coordinated development of digitization and agricultural sustainable development has become an important basis for the implementation of the rural revitalization strategy. Therefore, in order to realize agricultural sustainable development, we must give full attention to the role of big data resources [2], adhering to the deep combination of digital technology and agriculture and adding new impetus on agricultural and rural modernization [3]. Based on this, it is of great significance to explore the coupling and coordinated development level between digitization and agricultural sustainable development.

Digitalization is a remarkable feature of civilization in the 21st century and is the scientific basis of sustainable development strategy [4]. Yao [5] thought that it was the core computer technology and the process of comprehensive application of computer technology in the information field. In recent years, digitization has attracted extensive attention. Some scholars have conducted research on the digital transformation [6, 7] and also studied the construction of digital index systems [8, 9]. Other scholars have studied the degree of digitization [10, 11]. There are many studies on the coupling between agricultural sustainable development and other factors. Xu et al. [12] studied the coupling and coordination degree of industrialization, informatization,

urbanization, and agricultural sustainable development. Ma et al. [13] and Jiang and Hu [14] studied the coupling mechanism between urbanization and agricultural sustainable development. Liu and Yu [15] studied the coupling and coordinated development between agricultural socialized services and agricultural sustainable development. Chen et al. [16] discussed the coupling and coordinated development relationship between rural human capital and agricultural sustainable development. Chen et al. [17] studied the current situation of the coordinated development between agricultural sustainable development and informatization and pointed out that we should improve the informatization infrastructure. At present, there are few direct studies on the influencing factors of the coordinated development between digitization and agricultural sustainable development, but some scholars have explored the influencing factors of the coordinated development of agricultural sustainable development, informatization, and industrialization. Xu and Li [18] analyzed the influencing factors of the coordinated development between informatization and agricultural sustainable development in China. Chen et al. [17] analyzed the influencing factors of the coordinated development between agricultural sustainable development and informatization in Heilongjiang Province by constructing the Tobit model. Qian et al. [19] empirically analyzed the factors affecting the coordinated development of industrialization, urbanization, and agricultural sustainable development in China. For the relationship between digital investment and the sustainable development of agriculture, Fan [20] found that agricultural green development level steadily improved, presenting obvious space agglomeration characteristics, core growth power from social and economic benefits, digital level, and agricultural green development relationship between inverted *U* shape, and enhancing the level of digital helped to promote the development of agricultural green, but excessive digital investment did not continue to promote the development of agricultural green level.

To sum up, the current research on digitization mainly focuses on the aspects of digital transformation and digital measurement and there is less research on the interactive relationship between digitization and agricultural sustainable development and the influencing factors of coordinated development. In addition, the measurement of digitization level is mostly concentrated in enterprises and there is less research on the digitization degree of a certain region in China. Shandong Province has a good endowment of agricultural resources and has made some achievements in promoting agricultural sustainable development in the new era. However, the application level of digital technology in the agricultural field is significantly lower than that of the secondary industry and tertiary industry. The coupling and coordination relationship between digitization and agricultural sustainable development needs to be explored. Therefore, taking Shandong Province as an example, this study studies the coupling and coordination relationship between digitization and agricultural sustainable development under the background of digital transformation, deeply analyzes the influencing factors affecting the coordinated development, and puts forward countermeasures and suggestions. Related conclusions provide feasible references on increasing investment in digital infrastructure in rural areas, narrowing the gap between the level of the agricultural sustainable development, swallowing the rural digital facilities and services, ensuring rural residents access to digital information, improving the rural digital construction planning, and releasing digital dividend and promoting the efficient use of digital resources.

2. Coupling Mechanism of Digitalization and Agricultural Sustainable Development

2.1. Digitization Promotes Agricultural Sustainable Development. Digitalization promotes agricultural sustainable development to an advanced stage. First, the transformation of agricultural digitization has improved the rural network infrastructure and farmers' digital technology touching and digital application ability have continuously improved. The 4G coverage rate of poverty-stricken villages in Shandong Province has reached 99.9% and the broadband network coverage rate has reached 99.4% by 2020. The improvement of rural network infrastructure provides a basic guarantee for the further development of agricultural sustainable development. Second, digital technology is fully integrated with machinery manufacturing, water conservancy construction, and biotechnology in different stages of agricultural production and plays an active role in ensuring national food security, increasing farmers' income, saving production cost, and improving land productivity. The combination of digital technology and agriculture provides an important driving force for the development of agricultural sustainable development. Finally, digital transformation can reduce the damage of agricultural production to the ecological environment and accurately calculate the agricultural production process by using modern digital technology such as scientific fertilization and breeding, so as to ensure the production efficiency and protect the ecological environment. In summary, the application of digital technology provides strong support for agricultural sustainable development.

2.2. Agricultural Sustainable Development Creates Conditions for Agricultural Digital Transformation. Agricultural sustainable development is to develop agriculture with modern industry, science and technology, and management methods. It is a process of transformation from traditional agriculture to modern agriculture which is closely related to the technological progress. On the one hand, in the process of agricultural sustainable development with the improvement of farmers' skill level, farmers' acceptance and application level of digital technology continues to improve, creating convenient conditions for the promotion of digital technology in rural areas; on the other hand, the development of agricultural sustainable development promotes the application of digitization in agricultural production, operation, management, and

other fields. In agricultural sustainable production, the use of advanced technical means such as real-time monitoring of biological growth makes agricultural production more efficient, and efficient agricultural production needs the strong support of modern digital technology.

3. Research Design

3.1. Construction of Evaluation Index System. Based on the development status of Shandong Province and the research of Li and Mao [21], Xue and Hu [22], and Wang and Cheng [23], this study constructs the digital evaluation index system of Shandong Province, it includes four primary indicators: digital infrastructure, digital technology application, digital industry development, and digital talent reserve. Based on the research of Liu et al. [24] and Pan and Hu [25], an evaluation index system of agricultural sustainable development in Shandong Province is constructed, including five first-class indicators: agricultural production input, agricultural production output, agricultural science and technology development, rural social development and agricultural ecology. Finally, the evaluation index system of digitization and agricultural sustainable development in Shandong Province is constructed, as shown in Table 1. The index data of this study come from the statistical yearbook of Shandong Province from 2010 to 2019.

3.2. Calculating the Index Weight and the Comprehensive Score of Digitization and Agricultural Sustainable Development. The entropy method is an objective weighting method not affected by subjective factors [26], which is scientific. Entropy can measure the dispersion of an index. The smaller the entropy of the index, the greater the degree of dispersion and the greater the impact of the index on the comprehensive evaluation. Therefore, the entropy method is selected in this paper. According to the established index system, the index weight is measured and calculated by the entropy method. The results are shown in Table 1. The weighted evaluation method is used to calculate the comprehensive development level. The results are shown in Figure 1.

3.3. Constructing the Coupling Coordination Degree Model between Digitization and Agricultural Sustainable Development

3.3.1. Coupling Degree. Coupling degree refers to the interaction between two or more systems and reflects the degree of interdependence and restriction between systems. Based on the capacity coupling coefficient model, this study constructs the coupling function of the development level between digitization and agricultural sustainable development in Shandong Province.

$$\frac{\sqrt[2]{(U_1 \times U_2)}}{(U_1 + U_2)}. \tag{1}$$

In equation (1), U_1 is the coupling degree of both and U_2 is the comprehensive score of both. The range of coupling degree C is 0~1. When $C = 1$, the coupling degree reaches benign resonance coupling and the system will develop order. When $C = 0$, the system will develop into disorder. When $0.8 < C \leq 1$, it indicates the high-level coupling stage. When $0.5 < C \leq 0.8$, it indicates the running in adaptation stage. When $0.3 < C \leq 0.5$, it indicates that it is in the antagonistic stage. When $0 < C \leq 0.3$, it indicates the low-level coupling stage.

3.3.2. Coupling Coordination Degree. The coupling degree C can measure the interaction degree between the two systems, but it cannot reflect the coordinated development level between the two systems. Therefore, the coupling coordination degree model is further constructed.

$$D = \sqrt[2]{C \times T}, \tag{2}$$

$$T = \alpha \times U_1 + \beta \times U_2. \tag{3}$$

In equations (2) and (3), D is the coupling coordination degree, C is the coupling degree, T represents the coordination index, and α and β are undetermined coefficients. In this study, digitization and agricultural sustainable development are regarded as equal importance, and $\alpha = \beta = 0.5$ is taken for reference. The value range of coupling coordination degree D is 0~1. According to different values of D, the coupling coordination degree is divided into 10 levels (Table 2).

4. Results and Analysis

4.1. Analysis on the Comprehensive Development Level of Digitization and Agricultural Sustainable Development. As can be seen from Figure 1, from 2010 to 2019, the comprehensive score of digitization and agricultural sustainable development in Shandong Province showed an overall upward trend. The comprehensive score of digitization increased significantly from the lowest 0.086 6 in 2010 to 0.953 3 and the comprehensive score of agricultural sustainable development increased from the lowest 0.0706 in 2010 to 0.8815. From 2011 to 2015, the comprehensive score of agricultural sustainable development has been higher than that of digitization and their development level was almost the same in 2016. However, after 2016, the digital development level showed a straight-line upward trend, gradually leading to agricultural sustainable development and significantly higher than that of agricultural sustainable development in 2019.

The comprehensive development level of digitization in Shandong Province shows an upward trend on the whole. From 2016 to 2019, the comprehensive score of digitization in Shandong Province increased from 0.4684 to 0.9533, with an obvious increase, with an average annual growth rate of 26.72%. Exploring the reasons may be related to The Action Platform for Promoting the Development of Big Data issued by the State Council in September 2015. The introduction of this action platform means that the development of big data

Table 1: Evaluation index system and weight of digitalization and agricultural sustainable development.

	Primary index	Secondary index	Computing method	Attribute	Weight
Digitization	Digital infrastructure	Internet broadband access port (unit)	Direct access	+	0.068 0
		Length of long-distance optical cable line (km)	Direct access	+	0.091 4
		Number of websites per 100 enterprises (number)	Direct access	+	0.024 3
		Express business outlets (number)	Direct access	+	0.083 5
		Total telecom services (ten thousand yuan)	Direct access	+	0.144 2
	Application of digital technology	Household mobile phone ownership at year-end (10,000 households)	Direct access	+	0.039 4
		Number of mobile internet users (ten thousand)	Direct access	+	0.060 0
		Digital TV subscribers (10000 households)	Direct access	+	0.033 8
	Digital industry development	Electronic communication equipment manufacturing patent applications (Number)	Direct access	+	0.044 5
		Total exports of electronic information industry (ten thousand yuan)	Direct access	+	0.028 0
		Main business income of electronic information manufacturing industry (ten thousand yuan)	Direct access	+	0.128 7
		Express delivery volume (ten thousand pieces)	Direct access	+	0.106 1
	Digital talent reserve	Proportion of college graduates (%)	University graduates/Total population	+	0.072 9
		R&D expenditure (ten thousand yuan)	Direct access	+	0.040 1
		Per capita investment in education (yuan)	Total investment in education/Total population	+	0.035 1
Agricultural sustainable development	Agricultural production input	Growth rate of fixed asset investment (%)	Direct access	+	0.026 2
		Sown area of crops (Ha)	Direct access	+	0.063 7
		Proportion of agricultural employees (%)	Number of agricultural employees/Rural population	−	0.064 3
	Agricultural production output	Total import and export of agricultural products (10000 yuan)	Direct access	+	0.030 3
		Added value of primary industry (10000 yuan)	Direct access	+	0.029 8
		Quantity of three products and one standard product (number.)	Direct access	+	0.038 3
		Agricultural labor productivity (10000 yuan/person)	Added value of agriculture, forestry, animal husbandry, sideline fisheries/ Employees in the primary industry	+	0.041 8
	Agricultural science and technology development	Land output rate (10000 yuan/hm^2)	Total agricultural output value/ Cultivated land area	+	0.039 1
		Total power of agricultural machinery (10000 kw)	Direct access	+	0.050 6
		Effective irrigation rate (%)	Effective irrigation area/Cultivated land area	+	0.022 9
		Mechanization level of crop production (%)	Direct access	+	0.060 8
	Rural social development	Rural per capita net income (yuan)	Direct access	+	0.044 5
		Rural Engel's coefficient (%)	Per capita food expenditure/Total consumption expenditure	−	0.035 4
		Per capita living area of rural residents (m^2)	Rural residential area/Rural resident population	+	0.034 0
	Agroecology	Per capita public green space area (m^2)	Direct access	+	0.044 6
		Application amount of chemical fertilizer per unit cultivated land (kg/ km^2)	Total effective fertilizer application amount/Cultivated land area	−	0.091 1
		Pesticide use per unit cultivated land (kg/hm^2)	Total effective pesticide use/Cultivated land area	−	0.078 4
		Forest coverage (%)	Forest coverage/Total land area	+	0.204 4

has risen to a national strategy [27]. In this context, Shandong Province complies with the trend of social development and actively makes the digital investment. Since 2016, it has issued many policy documents to promote the development of big data, and the digital level has been continuously improved.

The comprehensive development level of agricultural sustainable development in Shandong Province generally shows an upward trend, but the comprehensive score increased from 0.415 6 to 0.4519 from 2014 to 2016, only by 0.0363, with a small increase. On the one hand, it may be related to more extreme weather in Shandong Province in 2014, such as wind and hail attacks. On the other hand, since 2014, the decline in the total import and export of agricultural products and the decline in the total power of agricultural machinery have hindered the development of agricultural sustainable development.

4.2. Analysis on the Coupling and Coordination Level of Digitization and Agricultural Sustainable Development. The comprehensive score index of digitization and agricultural sustainable development is analyzed by using the coupling coordination degree model to obtain the coupling degree and coupling coordination scheduling (Figure 2 and Table 3). As can be seen from Figure 2, the coupling degree of digitization and agricultural sustainable development in Shandong Province showed a high-level development trend as a whole from 2010 to 2019 and reached a benign resonance coupling in 2010 and 2019. In the five years from 2010 to 2015, the coupling degree of digitization and agricultural sustainable development in Shandong Province developed in waves, but the amplitude was relatively stable. From 2013 to 2015, it grew rapidly from 0.914 to 0.994. It has continued to develop steadily after 2015, and the coupling degree reached 0.999 from 2016 to 2018, which is close to benign resonance coupling.

Coupling degree can reflect the degree of interaction between the two, but it cannot obviously reflect the coordinated development level between the two. Generally speaking, when the comprehensive score index of digitization and agricultural sustainable development is very small, the coupling degree between them can reach a high state, that is, there is a low, low and high situation. When the comprehensive score index of digitization and agricultural sustainable development is very large, the coupling degree can also reach a high state, there is a high, high and high situation. Therefore, it needs to be further studied through the coupling coordination degree model.

The development type of coupling coordination degree of digitization and agricultural sustainable development in Shandong Province from 2010 to 2019 is determined through the coupling coordination degree classification table (Table 3). It can be seen from Table 3 that from 2010 to 2019, the coupling coordination degree of digitization and agricultural sustainable development in Shandong Province was between 0.1 and 0.995, which developed from a serious imbalance in 2010 to high-quality coordination in 2019, showing a steady upward trend. This shows that the influence between digitization and agricultural sustainable development in Shandong Province is gradually increasing and the degree of coupling and coordination tends to develop well. Specifically, the growth rate in 2015–2016 was the slowest, only 7% and gradually picked up in 2017. The growth rate of the comprehensive score of agricultural sustainable development gradually slowed down during 2015–2016, from 0.4303 to 0.4519, while the comprehensive score of digitization increased from 0.3925 to 0.4684, with a relatively rapid growth rate. Therefore, it can be inferred that the slowdown of the growth rate of coupling coordination degree in 2015–2016 was affected by agricultural sustainable development. From 2010 to 2013, the development of digitization and agricultural sustainable development in Shandong Province was in an unbalanced stage. At this time, the development level of agricultural sustainable development in Shandong Province was higher than that of digitization. The combination of agricultural sustainable development and digitization was not close enough, especially in the process of agricultural production, the application of digital technology was lacking, so that the two failed to produce a good synergistic effect. In 2014, the coupling coordination degree between the two exceeded 0.5, which developed from the verge of disorder to reluctantly coordinate. From 2014 to 2019, the development of digitization and agricultural sustainable development in Shandong Province was in the stage of coordinated development, from reluctantly coordinated to high-quality coordinated. From 2016 to 2017, from primary coordination to good coordination, the level of coupling coordination achieved a great leap during this period, which may be related to the rapid growth of the comprehensive level of digitization and agricultural sustainable development at the same time.

From 2010 to 2019, the comprehensive score index of digitization and agricultural sustainable development in Shandong Province showed an upward trend on the whole. In 2016, the comprehensive score index of digitization was significantly higher than that of agricultural sustainable development, and in 2019 was the most significant. At the same time, through Figure 2, it can be found that from 2016, the growth rate of the coordination index of digitization and agricultural sustainable development is significantly higher than that of the coupling coordination degree. Therefore, it can be inferred that the rise of the comprehensive score index of digitization promotes the coordination index of digitization and agricultural sustainable development, which indirectly shows that the promotion effect of digitization on agricultural sustainable development is greater than that of agricultural sustainable development on digitization.

5. Analysis on the Influencing Factors of the Coordinated Development between Digitization and Agricultural Sustainable Development

5.1. Selecting the Influencing Factors, Variables, and Constructing the Model. Based on the previous analysis of the coupling and coordination relationship between digitization

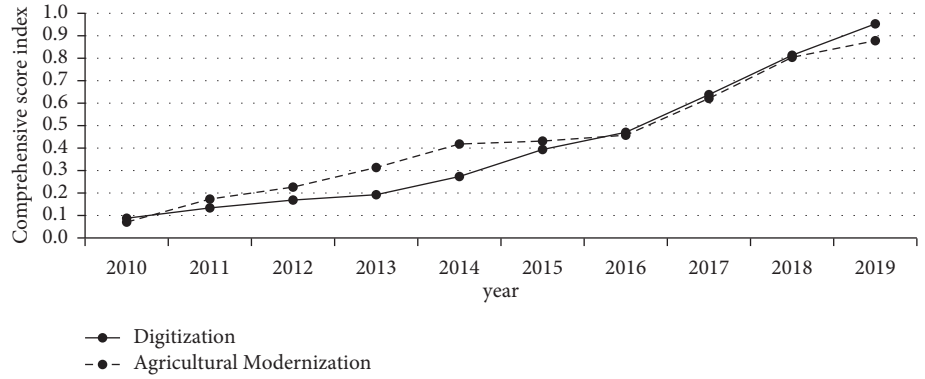

Figure 1: Comprehensive development level of digitization and agricultural sustainable development in Shandong province.

Table 2: Classification of coupling coordination degree.

Coordination level	Section D	Coordination type
1	[0, 0.1]	Extreme disorder
2	(0.1, 0.2]	Severe imbalance
3	(0.2, 0.3]	Moderate disorder
4	(0.3, 0.4]	Mild disorder
5	(0.4, 0.5]	Verge of disorder
6	(0.5, 0.6]	Reluctantly coordinate
7	(0.6, 0.7]	Primary coordination
8	(0.7, 0.8]	Moderate coordination
9	(0.8, 0.9]	Good coordination
10	(0.9, 1.0]	High-quality coordination

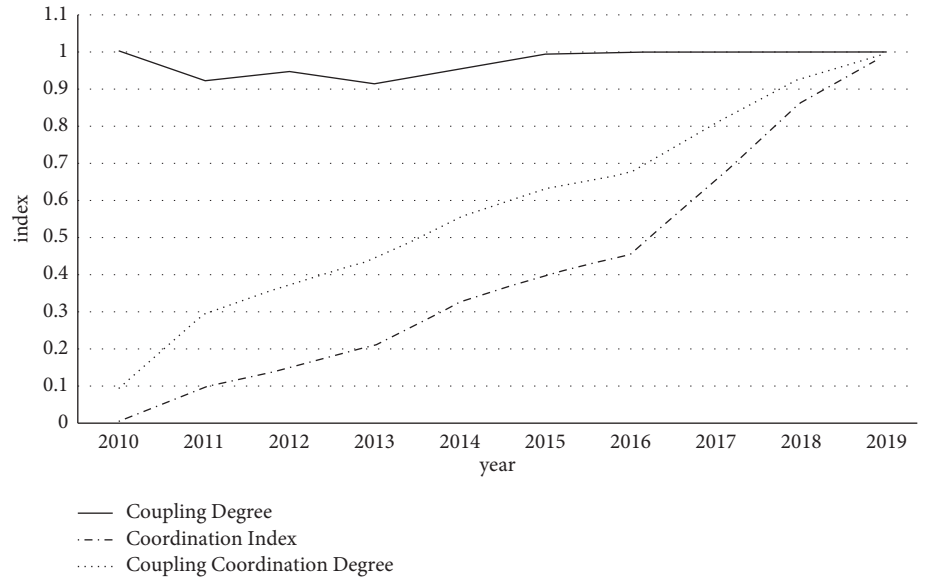

Figure 2: Evolution trend of coupling degree and coupling coordination degree.

and agricultural sustainable development, based on the existing research [28], combined with the development status of Shandong Province, the coupling coordination degree is selected as the explained variable, and the economic development level and industrial structure are selected as the explanatory variables (Table 4).

$$D_i = \alpha + \beta_1 \times GDP + \beta_2 \times Indu + \beta_3 \times \text{Open} + \beta_4 \times Agri + \beta_5 \times Gra + \mu. \quad (4)$$

Table 3: Coupling and coordination analysis of digitization and agricultural sustainable development in Shandong province.

Year	U_1	U_2	T	D	Type
2010	0.086 6	0.070 6	0.010 0	0.100 0	Severe imbalance
2011	0.130 1	0.172 4	0.096 0	0.298 0	Moderate disorder
2012	0.167 5	0.226 0	0.150 0	0.376 0	Mild disorder
2013	0.190 3	0.311 8	0.214 0	0.443 0	Verge of disorder
2014	0.274 7	0.415 6	0.325 0	0.555 0	Reluctantly coordinate
2015	0.392 5	0.430 3	0.400 0	0.631 0	Primary coordination
2016	0.468 4	0.451 9	0.456 0	0.675 0	Primary coordination
2017	0.638 1	0.621 7	0.655 0	0.809 0	Good coordination
2018	0.810 6	0.800 1	0.860 0	0.927 0	High-quality coordination
2019	0.953 3	0.881 5	0.990 0	0.995 0	High-quality coordination

The value range of the coupling coordination degree D between digitization and agricultural sustainable development is 0~1, so the explained variable has the characteristics of being cut, belongs to the limited dependent variable, and meets the setting conditions of the Tobit regression model [29]. Therefore, the Tobit model is selected to further analyze the influencing factors of the two and minimize the error. The model is as follows:

In formula (4), D_i represents the coupling and coordinated development degree of digitization and agricultural sustainable development in the i year, β_1–β_5 represents the regression coefficient of each variable, and μ represents the random error term.

5.2. Tobit Regression Analysis. Using stata15.0 software and doing Tobit regression analysis. The results show that (Table 5) the level of economic development (GDP), industrial structure (Indu), degree of openness (Open), and constant items are significant at the level of 1%, the talent reserve (Gra) is significant at the level of 5%, and the agricultural expenditure (Agri) is not significant.

There is a positive correlation between economic development and the coordination of digitization and agricultural sustainable development, which shows that the continuous improvement of regional GDP plays a significant positive role in promoting the coordinated development of the two. Higher GDP can promote the coordinated development of industries, which is consistent with the reality of Shandong Province.

The industrial structure is positively correlated with the coordinated development of digitization and agricultural sustainable development, which shows that the increasing proportion of the tertiary industry in GDP plays a significant positive role in promoting the coordinated development of the two. The continuous progress of the tertiary industry will promote the flow and transformation of production factors among industries. For the primary industry, the continuous development of the tertiary industry can effectively drive the integration of rural primary, secondary, and tertiary industries, which is conducive to the development of agricultural sustainable development, so as to promote the coordinated development between digitization and agricultural sustainable development.

The degree of openness is positively correlated with the coordinated development of digitization and agricultural sustainable development, which shows that the total amount of import and export has a significant positive effect on the coupling and coordinated development of digitization and agricultural sustainable development. Shandong Province is in a period of rapid development. Expanding its openness to the outside world can learn and introduce more advanced technologies, attract more talents and foreign capital to serve the economic development of Shandong Province, and promote the digital transformation and the development of agricultural sustainable development.

The impact of agricultural expenditure on the coupling and coordinated development between digitization and agricultural sustainable development is not significant, contrary to expectations. The possible reason for this phenomenon is that part of the agricultural financial expenditure is not directly related to agricultural sustainable development, such as rural relief fees, which has little impact on rural digital development, so it has little impact on the overall digital development of Shandong Province.

Talent reserve is positively correlated with the coordinated development of digitization and agricultural sustainable development, which shows that the increase in the number of graduates will have a significant positive effect on promoting the coordinated development of the two. The increasing number of graduates each year will play an important role in the R&D, promotion and application of digital technology, provide talent reserves for the development of digitization and agricultural sustainable development, and promote the coordinated development of the two.

6. Conclusions and Suggestions

6.1. Conclusions. First, this paper constructs the index system of digitization and agricultural sustainable development in Shandong Province and then analyzes the coupling coordination degree and influencing factors of digitization and agricultural sustainable development in Shandong Province from 2010 to 2019 by using the entropy method, coupling coordination degree model, and Tobit regression model. The conclusions are as follows: first, the comprehensive development level of digitization and agricultural sustainable development in Shandong Province is on the rise as a whole. In 2016, the level of digital development gradually exceeded that of agricultural sustainable

Table 4: Influencing factors of coupling coordination.

	Variable name	Variable symbol	Variable description	Unit
Explained variable	Coupling coordination degree	D	From the coupled co scheduling model	
Explanatory variable	Economic development level	GDP	Regional GDP	Ten thousand yuan
	Industrial structure	Indu	Proportion of tertiary industry in GDP	%
	Degree of openness	Open	Total imports and exports	Ten thousand dollars
	Agricultural expenditure	Agri	Proportion of agricultural expenditure in fiscal expenditure	%
	Talent reserve	Gra	Number of graduates in the current year	Person

Table 5: Regression results of influencing factors of coupled and coordinated development between digitization and agricultural sustainable development.

Variable	Coefficient	Standard deviation	T value	$P > \|t\|$	95% confidence interval	
GDP	0.088 9	0.015 1	5.90	0.002	0.050 1	0.127 7
Indu	0.155 5	0.017 6	8.81	0.001	0.110 1	0.200 8
Open	0.037 0	0.007 5	5.02	0.004	0.018 3	0.056 6
Agri	0.015 0	0.009 4	1.56	0.179	−0.009 4	0.038 8
Gra	0.028 0	0.011 9	2.37	0.064	−0.002 3	0.058 7
Constant	0.580 9	0.004 4	131.36	0.001	0.569 5	0.592 3

development; second, from 2010 to 2019, the coupling and coordination degree of digitization and agricultural sustainable development in Shandong Province showed a steady growth trend. In 2014, from the verge of disorder to Reluctantly coordinate, and in 2018, it entered the stage of high-quality coordination from good coordination; third, since 2016, the role of digitization in Shandong Province in promoting agricultural sustainable development has been greater than that of agricultural sustainable development; fourth, the improvement of economic development level and opening-up, the optimization of industrial structure and the increase of talent reserve have an obvious positive effect on the coupling and coordinated development of the two.

6.2. Suggestions

6.2.1. Give Priority to the Development of Agriculture and Rural Areas. While promoting digital transformation and strengthening digital investment, Shandong Province should adhere to the principle of giving priority to the development of agriculture and rural areas, constantly strengthen the basic position of agriculture, formulate policies and measures in line with the actual situation of Shandong Province, promote the deep integration of digital technologies such as big data with agriculture and rural areas, expand the coverage of digitization, better apply digital technologies to the primary industry, and let digitization continue to contribute to the development of agricultural sustainable development. At the same time, we should strengthen the construction of digital infrastructure and the improvement of farmers' cultural quality in rural areas, gradually narrow the digital divide between urban and rural areas, and provide necessary conditions for the coordinated development of digitization and agricultural sustainable development.

6.2.2. Increasing Investment in Digital Infrastructure and Reduce the Gap of Agricultural Development Level between Regions. Continue to vigorously promote the broadband medium Country, achieve rural communication network coverage upgrade, complement rural and poverty regional digital facilities and services shortcomings to ensure that the number of access to rural residents equal opportunity of the numerical information. Distinguish rural digital infrastructure construction, and choose the best fit rather than the state-of-the-art infrastructure. Rural digital infrastructure construction should be mainly concentrated on peasant livelihood resources and services provided, artificial intelligence, big data, and other advanced technologies applications can be submitted to the relevant industry associations and enterprises for semi-market organizations to ensure the efficiency of resource utilization.

6.2.3. Improve Digital Construction Planning to Ensure That Combined Resource Input Texture. To grasp the new opportunities for agricultural development in the digital age and unleash shared numbers dividend, we need to pay attention to prevent source input insufficient and excessive and other problems in different digital investment directions to ensure the digital input is rational and effective. Increase the integration and optimization of digital platform upgrading, break down information barriers on different platforms, and establish the data common to multiple departments to realize the maximum use of resources. Besides, make full use of big data to create new production mode to

improve the level of green agricultural development ranging from resource utilization, ecological conservation, and product quality.

6.2.4. Optimize the Industrial Structure. The tertiary industry has the characteristics of strong employ ability and low resource consumption, which plays a great role in promoting the development of primary and secondary industries. Therefore, while ensuring the healthy and stable economic development of the primary and secondary industries, we should constantly improve the competitiveness of the tertiary industry, break through the current situation of traditional industries, and continuously develop emerging producer services. Especially in the era of the digital economy, we should attach great importance to the development of communication and information services, consolidate the basic part of the digital economy, increase investment in technology, talents, and funds, and encourage scientific and technological innovation, comprehensively improve the quality and competitiveness of the tertiary industry in Shandong Province.

6.2.5. Improve the Level of Opening to the outside World. As a coastal province, Shandong Province should take the opening to the outside world as the top priority and give full play to its regional advantages. On the one hand, we should actively introduce foreign capital and advanced management methods and technologies; on the other hand, we should constantly improve the level of foreign trade, continuously optimize the export products and industrial structure, and enhance the competitiveness of products. The improvement of the level of opening to the outside world can provide more opportunities for the development of Shandong Province, promote the healthy and efficient development of the economy, and provide power for the coordinated development of digitization and agricultural sustainable development.

6.2.6. Attach Importance to Talent Cultivation. The development of digitization and agricultural sustainable development requires a large number of professional and technical talents. Shandong Province should increase education investment and policy support, pay attention to the cultivation of digital and agricultural talents, and increase the reserve of professional and technical talents. On the one hand, continuously improve the professional skills of digital talents, improve their independent innovation and R&D ability, guide digital professionals to the grass-roots level, better serve farmers with digital technology and improve farmers' digital contact and digital ability. On the other hand, the government should introduce and implement relevant incentive policies to encourage more agricultural college graduates to actively participate in grass-roots work, so as to contribute to the implementation of rural revitalization strategy and the development of agricultural sustainable development.

During the research process, limited by time and energy, this paper still has the following deficiencies to be improved: (1) this paper only considers the whole sample and ignores the difference of coupling coordination between different cities; (2) ignores the spatial difference between digital investment and agricultural sustainable development; (3) only measures the coupling coordination degree and lacks in-depth study on its influencing mechanism. The above deficiencies are reserved to further discussion later.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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