

## THE ROLE OF AGRICULTURAL PRODUCT LOGISTICS SUPPLY CHAIN IN AGRICULTURAL ECONOMIC DEVELOPMENT IN THE CONTEXT OF BIG DATA AND IN-DEPTH LEARNING

XIANFENG ZHU

School of Economics and Management  
Jiaozuo University  
No. 3066, Renmin Road, Jiaozuo 454000, P. R. China  
zhu\_xianfeng@outlook.com

Received April 2023; revised August 2023

**ABSTRACT.** *This study introduces the application status of big data and deep learning in the agricultural product logistics supply chain and discusses their impact on the development of agricultural economy. In terms of the coupling and coordination analysis of agricultural product logistics supply chain and agricultural economic development, this article takes Chengdu as an example, constructs a coupling index system and a coupling and coordination degree model of Chengdu logistics supply chain and agricultural economy, and calculates and analyzes them. In terms of analyzing the influencing factors of the integrated development of Chengdu's agricultural product logistics supply chain and agricultural economy, the influencing factors are measured and analyzed from multiple perspectives. According to the results, the foundation of Chengdu's agricultural product logistics supply chain is relatively weak compared to the agricultural economy, and the development of the logistics supply chain cannot keep pace with the development of the agricultural economy. It is unable to fully utilize the advantages of agriculture to drive the development of the agricultural product logistics supply chain. At the same time, the integration potential of Chengdu's culture and agricultural product logistics supply chain is enormous. To effectively promote the high-quality development of agricultural product logistics supply chain, it is necessary to start from five aspects: policy, innovation, technology, talent, and business model. Finally, it is necessary to focus on promoting the transformation of modern science and technology in the logistics supply chain of agricultural products and promote the development of the logistics supply chain of agricultural products with scientific and technological progress, so as to promote the development of agricultural economy. This article aims to explore the role of agricultural product logistics supply chain in the development of agricultural economy in the context of big data and in-depth learning.*

**Keywords:** Big data, Deep learning, Agricultural product logistics supply chain, Agricultural economic development, Coupling and coordination theory

1. **Introduction.** As China's economic development enters the new normal, the proportion of agricultural economy in the national economy is becoming smaller and smaller. However, agriculture is still the basic industry in China and the main source of income for farmers. The logistics and transportation link in agricultural production is an important link from production to consumption of agricultural products, and also a key link that affects the quality and market value of agricultural products. Therefore, strengthening the management and optimization of agricultural product logistics supply chain is of great significance for improving the added value of agricultural products and promoting the development of agricultural economy [1].

With the rapid development and widespread application of big data and deep learning technologies, the agricultural field has gradually begun to pay attention to and apply these emerging technologies to improving the management efficiency and level of agricultural product logistics supply chain. At the same time, with the implementation of the national “the Belt and Road” strategy and the “rural revitalization” strategy, the logistics supply chain of agricultural products is also constantly optimized and upgraded, and the agricultural economic development also ushered in new opportunities and challenges [2,3].

In recent years, domestic scholars have increasingly deepened their research on the logistics supply chain of agricultural products. Some scholars have conducted research from multiple aspects such as supply chain management, logistics operations, and information technology to explore strategies and methods to improve the efficiency and reduce costs of agricultural product logistics supply chains. At the same time, some studies have also explored the role and mechanism of agricultural product logistics supply chains on agricultural economic development, such as enhancing the added value of agricultural products, and promoting agricultural industry upgrading [4,5].

Foreign scholars’ research on agricultural product logistics supply chain mainly focuses on supply chain management and information technology. The research content includes logistics operation efficiency, inventory management, logistics network optimization, etc. In addition, some studies have also explored the environmental impact and sustainable development of agricultural product logistics supply chains [6]. Domestic and foreign scholars’ research on agricultural product logistics supply chain mainly focuses on improving operational efficiency, optimizing supply chain structure, and reducing logistics costs. In addition, some studies have explored the impact and mechanism of agricultural product logistics supply chains on the agricultural economy [7,8]. In general, domestic and foreign studies believe that the optimization and development of the agricultural product logistics supply chain play an important role in promoting the development and modernization process of the agricultural economy. Although there is a certain research foundation at home and abroad, in the context of big data and deep learning, how to better apply these new technologies to promoting the upgrading and optimization of agricultural product logistics supply chains, as well as their specific mechanisms of action on agricultural economic development, still needs further exploration and research.

The research purpose of this article is to explore the role of agricultural product logistics supply chain in agricultural economic development in the context of big data and in-depth learning, including the following aspects.

- 1) Analyze the application status of big data and in-depth learning in the agricultural product logistics supply chain and understand the actual application of existing technologies in the agricultural field.

- 2) Explore the impact of agricultural product logistics supply chain on agricultural economic development in the context of big data and in-depth learning, including improving logistics operation efficiency, promoting agricultural product value-added enhancement, and agricultural industry upgrading.

- 3) This paper analyzes the current situation of the integration of agricultural product logistics supply chain and agricultural economy in China and discusses how to further play the role of logistics supply chain to promote the development of agricultural economy.

- 4) Establish a coupling index system and a coupling coordination degree model between logistics supply chain and agricultural economy, measure the coupling coordination scheduling between logistics supply chain and agricultural economy, and analyze and evaluate it.

In summary, the significance of this study is to deeply explore the role of agricultural product logistics supply chain in agricultural economic development and receive

theoretical support and practical guidance to promote the sustainable development and modernization process of China's agricultural economy.

## 2. Relevant Concepts and Theories.

**2.1. Big data and deep learning.** With the rapid development of information technology, massive data is growing at an unprecedented speed. These data are commonly referred to as "big data" and include structured and unstructured data from various channels and sources. The rapid growth of big data has brought great challenges to data processing and analysis, and traditional data processing and analysis methods are already unable to handle the work of big data. Therefore, emerging technologies such as deep learning are widely used in big data analysis.

Deep learning is a machine learning technology based on neural networks, which can automatically learn to extract features from raw data, and can perform tasks such as classification, prediction, and decision-making on these features. Deep learning can analyze data through multi-level neural network structures to achieve highly accurate prediction and classification. This capability allows it to show great potential in dealing with big data issues in the agricultural logistics supply chain.

There are four main reasons for this. First, deep learning models are expressive and can adapt to high-dimensional, non-linear, and complex data patterns, which are difficult to achieve in many other machine learning methods. Second, deep learning is a way to make the most of big data, and unlike many traditional machine learning models, the performance of deep learning models improves as the amount of data increases. Moreover, deep learning has the ability of automatic feature learning, which can automatically extract useful features from raw data without tedious manual feature engineering. Finally, there are a number of mature deep learning open source tools and frameworks, such as TensorFlow and PyTorch, that offer easy-to-use and highly optimized features that make it easier to build and train deep learning models.

However, despite the above advantages of deep learning, we also need to realize that deep learning is not a cure-all for all problems. In some cases, such as tasks with less data, simple problem structure, or requiring strong interpretation, other machine learning methods may be a better choice.

In the agricultural field, the application of big data and deep learning technology is receiving increasing attention. For example, agricultural enterprises can use big data and deep learning technologies to monitor and analyze the growth and development of crops, thereby achieving accurate planting and fertilization, and improving the yield and quality of crops. In addition, big data and deep learning technology can also be applied to agricultural product logistics supply chain management, optimizing logistics transportation routes, improving logistics efficiency, and reducing logistics costs [9].

**2.2. Agricultural product logistics supply chain management.** Agricultural product logistics supply chain refers to the process of realizing the orderly circulation and coordinated management of logistics services, information flow services, and capital flow services through logistics technology and information means, relying on the organic integration of a series of organizations and resources in the production, processing, sales, and distribution of agricultural products. Agricultural product logistics supply chain management is a series of management activities that utilize logistics management and information technology to plan, organize, implement, and control the agricultural product logistics supply chain in this process, in order to achieve the goals of improving logistics efficiency, reducing costs, and enhancing competitiveness [10]. Agricultural product logistics supply chain management involves multiple links, including procurement, production,

warehousing, transportation, sales, etc. It is necessary to coordinate various resources and information in different links to achieve efficient logistics operation and timely information flow.

With the continuous development of logistics technology and information technology, agricultural product logistics supply chain management is also constantly updated and improved. Traditional agricultural product logistics supply chain management mainly uses a single management method, such as logistics operation planning, organization, and control, which is difficult to meet the growing logistics and information needs. Modern agricultural product logistics supply chain management pays more attention to integrating various resources and information, establishing efficient logistics networks and information platforms, improving the controllability and visibility of agricultural product logistics supply chain, making it better adapt to market demand, and promoting the development of agricultural economy [11].

**2.3. Coupling coordination theory.** The coupling coordination theory is a theory that analyzes the interaction of multiple factors. In the logistics supply chain of agricultural products and the development of agricultural economy, there are multiple factors that interact, such as the quality and output of agricultural products, the efficiency and cost of logistics transportation, and changes in market demand. The interaction and influence of these factors will have an important impact on the production, circulation, and sales of agricultural products. The coupling coordination theory can systematically analyze and study these factors, find the correlation and coordination degree between them, and provide scientific guidance and decision-making support for the sustainable development of agricultural economy [12].

However, coupling coordination theory is not the only method to analyze multi-factor interaction. For example, system dynamics focuses on studying the law of system behavior change from a global perspective, but mainly applies to systems with clear causal relationship and obvious feedback relationship between variables. Complex network theory is applicable to the analysis of complex interactions, but it requires a deep understanding of network structure and a lot of data support. Multivariate statistical analysis is applicable to the analysis of the relationship between multiple variables, but based on statistical assumptions, the normality and independence of the data are required.

In contrast, the coupled coordination theory focuses on analyzing the interrelation and function of the subsystems within the system, and describes this relationship by measuring the degree of coupling and coordination [13]. It focuses more on the stability and coordination of the overall system, and has great advantages for the analysis of multi-factor and multi-level complex systems, especially the complex problems of agricultural logistics supply chain and agricultural economic development.

In practice, the coupling coordination theory can draw on and use many quantitative analysis methods, such as entropy method and grey correlation analysis method. These methods can measure and analyze multiple indicators in agricultural logistics supply chain and agricultural economic development, and reveal the degree of correlation and influence between them, so as to provide the basis for improvement and optimization of decision-making. Therefore, although there are other multi-factor interaction analysis methods, the coupling coordination theory is of significant significance for the practicability and practical guidance of this study.

### 3. The Impact of Big Data and Deep Learning on Agricultural Product Logistics Supply Chain and Agricultural Economy.

**3.1. Application of big data and deep learning in agricultural product logistics supply chain.** With the continuous development and popularization of big data and deep learning technologies, their application in the agricultural product logistics supply chain is becoming increasingly widespread. In the field of logistics, big data technology can be used for data collection, storage, processing, and analysis to improve the efficiency and quality of logistics transportation. Deep learning technology can be applied to forecasting and decision-making to improve the accuracy and intelligence of logistics and transportation [14].

Specifically, the application of big data and deep learning technology in the agricultural product logistics supply chain includes the following aspects.

1) Data collection and monitoring: Collect data during logistics and transportation through sensors, RFID, and other technologies, including temperature, humidity, location, transportation time, and other information, and monitor the logistics and transportation situation in real time.

2) Data processing and analysis: The collected data is processed and analyzed through big data technology to obtain the best transportation route and vehicle distribution plan, in order to improve transportation efficiency and reduce costs.

3) Prediction and decision-making: Analyze and model historical and real-time data through in-depth learning technology to predict future market demand, product prices, etc., so that decision-makers can make more accurate decisions.

4) Logistics and distribution: Through big data and deep learning technology, achieve intelligent and accurate logistics and distribution, and improve the efficiency and quality of logistics and distribution.

In summary, the application of big data and deep learning technology in the agricultural product logistics supply chain has initially taken shape, and their application will greatly improve the efficiency and quality of logistics transportation, promoting the sustainable development of the agricultural economy (see Figure 1).

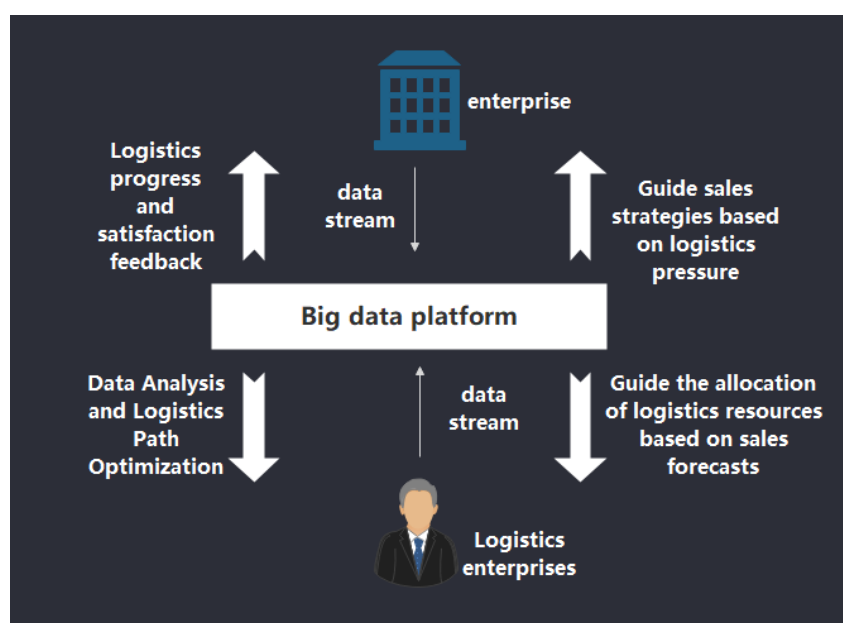


FIGURE 1. The impact of big data and deep learning on the logistics supply chain

**3.2. Impact of big data and deep learning on agricultural economic development.** With the rapid development of big data and deep learning technology, agricultural product logistics supply chain management has also ushered in new opportunities. Through the application of big data technology, the agricultural product logistics supply chain can more efficiently coordinate logistics information and resources at various stages, optimize logistics paths, reduce logistics costs, and improve logistics efficiency and service quality. At the same time, the application of deep learning technology can help agricultural product logistics supply chains achieve intelligent perception and control of logistics links, improve logistics safety and accuracy, and reduce logistics risks and losses [15,16]. On this basis, the agricultural product logistics supply chain can better meet consumer demand for logistics services and promote the prosperity and development of the agricultural product market.

However, it should not be ignored that these technologies also bring new challenges. The collection, storage and processing of data requires significant resources and technical support, which can be a challenge for many developing agricultural countries and regions. In addition, data security and privacy protection are also important issues we must face [17]. While making full use of big data and deep learning technologies, it is important to ensure that data security and privacy are adequately protected.

Specifically, the impact of agricultural product logistics supply chain on agricultural economic development in the context of big data and in-depth learning mainly includes the following aspects.

1) Reduce logistics costs of agricultural products. Through the application of big data technology, the agricultural product logistics supply chain can more efficiently coordinate logistics information and resources at various stages, optimize logistics paths, reduce repetitive transportation and waiting times, and thereby reduce logistics costs.

2) Improve logistics efficiency and service quality. Big data technology can help agricultural product logistics supply chains achieve intelligent perception and control of logistics links, improve logistics safety and accuracy, thereby improving logistics efficiency and service quality, and meet consumer demand for logistics services.

3) Promote the prosperity and development of the agricultural product market. Through the application of big data and deep learning technology, the agricultural product logistics supply chain can better meet consumer demand for agricultural products, improve the sales volume and quality of agricultural products, and promote the prosperity and development of the agricultural product market (Figure 2).

In conclusion, the research needs to explore in depth how to give full play to the advantages of big data and deep learning technology, while solving the challenges it brings, in order to promote the healthy development of agricultural logistics supply chain management and agricultural economy.

**3.3. Development status of integration of agricultural product logistics supply chain and agricultural economy.** With the rapid development of China's agricultural economy, the role of agricultural product logistics supply chain in the agricultural economy has received increasing attention. The circulation efficiency of agricultural products has been greatly improved, further promoting the development of the agricultural economy. At the same time, the logistics supply chain has also provided strong support for the transformation and upgrading of the agricultural economy. Measures such as improving the service quality of the logistics supply chain and improving the logistics network have accelerated the process of agricultural modernization [18,19]. Currently, the development of China's agricultural product logistics supply chain presents the following characteristics.

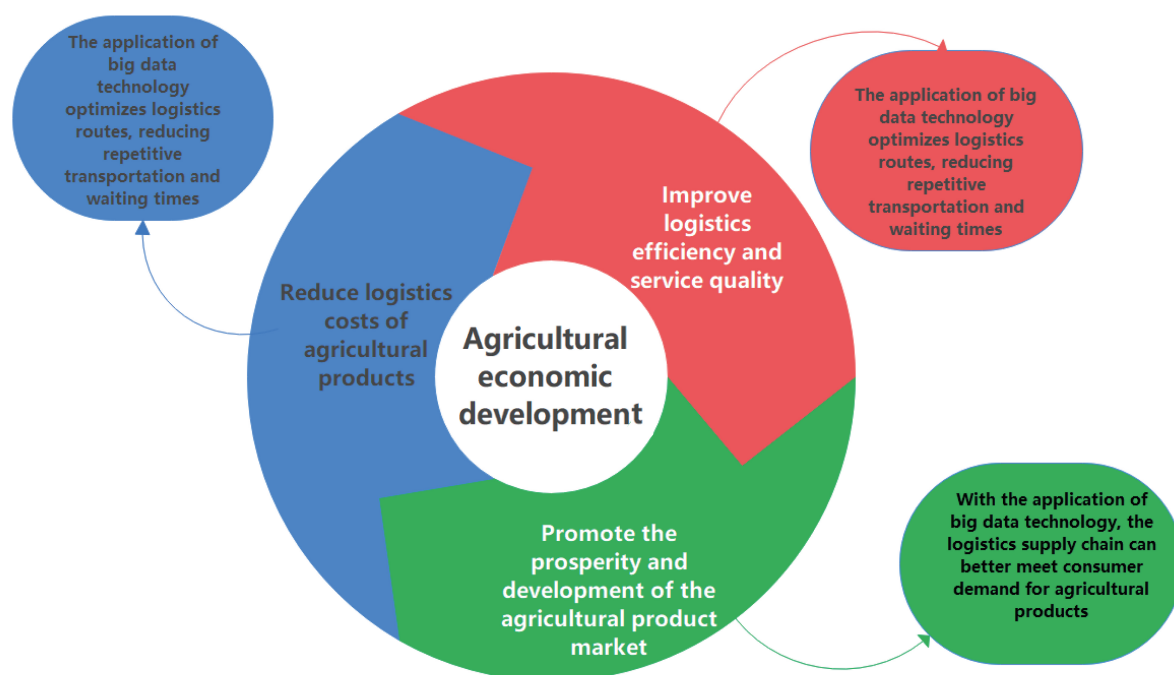


FIGURE 2. Impact of big data and deep learning on agricultural economic development

1) Continuous improvement in the application of logistics supply chain technology

With the rapid development of information technology, the application of logistics supply chain technology is also continuously improving. At present, China's logistics supply chain technology has become relatively mature, and China has made great progress in logistics informatization, logistics automation, and logistics intelligence.

2) Gradually improving the logistics supply chain network of agricultural products

In the development of agricultural economy, the construction of agricultural product logistics supply chain network is very important. Currently, China's logistics supply chain network has gradually improved, mainly including the development of logistics infrastructure, logistics enterprises, logistics services, and other aspects.

3) Continuously improving the quality of agricultural product logistics services

With the continuous development of logistics supply chain technology, the quality of agricultural product logistics services is also continuously improving. Currently, China's logistics service level has been greatly improved, providing a strong guarantee for the circulation of agricultural products.

4) Deep cooperation between agricultural product logistics supply chain and e-commerce platform

With the rapid rise of e-commerce platforms, the cooperative development of agricultural product logistics supply chain and e-commerce platforms has become a trend. Currently, some well-known e-commerce platforms in China have begun to engage in the field of agricultural products and have also begun to cooperate with logistics enterprises to achieve the circulation of agricultural products through the logistics supply chain (Figure 3).

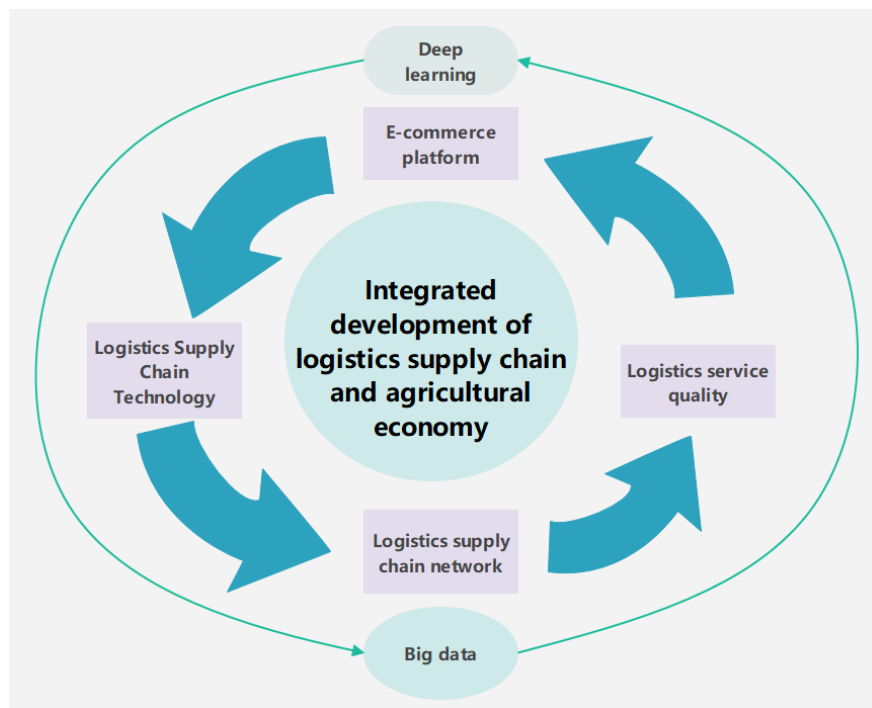


FIGURE 3. Integrated development of agricultural product logistics supply chain and agricultural economy

#### 4. Coupling and Coordination Analysis of Agricultural Product Logistics Supply Chain and Agricultural Economic Development.

**4.1. Construction of logistics supply chain and agricultural economy coupling index system.** In order to analyze the impact of agricultural product logistics supply chain on agricultural economic development, this study took Chengdu as an example and constructed a coupling index system. Use big data processing technologies to preprocess raw data, such as data cleaning, transformation, and integration, to improve the quality and applicability of data. Through deep learning models, important features are automatically extracted or feature dimension is reduced. The indicator system includes indicators for both logistics supply chain and agricultural economy, and quantitatively analyzes the degree of coupling between the two fields (Table 1).

##### 1) Logistics supply chain indicator system

The logistics supply chain indicator system consists of four levels of indicators, namely, infrastructure level, logistics transportation level, logistics enterprise level, and logistics service level. The specific indicators are shown in Table 2.

##### 2) Agricultural economic indicator system

The agricultural economic indicator system consists of three levels of indicators, namely, the production level, the circulation level, and the consumption level. The specific indicators are shown in Table 3.

##### 3) Coupling index system

After constructing the logistics supply chain and agricultural economic indicator system, this study uses fuzzy mathematics to couple the two indicator systems. The coupling indicator system includes two coupling indicators: logistics supply chain indicators and agricultural economic indicators. The specific indicators are shown in Table 4.

TABLE 1. Evaluation indicators for the impact of agricultural product logistics supply chain on agricultural economic development

Number	Index	Definition	Measurement method
1	Supply of agricultural products	Production volume of agricultural products within a certain period of time	Obtained through the survey and statistics of the agricultural department
2	Demand for agricultural products	Market demand for agricultural products within a certain period of time	Obtained through market research and other methods
3	Circulation of agricultural products	Circulation of agricultural products from the place of production to the place of consumption within a certain period of time	Obtained from monitoring data of agricultural product logistics system
4	Delayed sales of agricultural products	The amounts of agricultural products that cannot be sold for various reasons within a certain period of time	Obtained through market research and other methods
5	Loss rate of agricultural products	Loss ratio of agricultural products during logistics transportation and storage	Obtained from monitoring data of agricultural product logistics system
6	Transportation cost of agricultural products	Transportation costs of agricultural products from the place of production to the place of consumption	Obtained from monitoring data of agricultural product logistics system
7	Agricultural product prices	The selling price of agricultural products on the market	Obtained through market research and other methods
8	Quality of agricultural products	Quality characteristics of agricultural products, such as freshness, taste, and quality	Obtained through market research and other methods

TABLE 2. Logistics supply chain indicator system

Level	Indicators
Infrastructure	Transportation infrastructure, Information infrastructure, Logistics stations, Warehouse infrastructure
Logistics transportation	Transportation mode, Transportation distance, Transportation cost, Transportation speed, Transportation safety
Logistics enterprise	Enterprise scale, Enterprise efficiency, Enterprise growth
Logistics service	Supply chain visualization, Supply chain coordination

TABLE 3. Agricultural economic indicator system

Level/category	Indicators
Production level	Cultivated land area, Crop yield, Aquaculture output value
Circulation level	Logistics cost, Logistics efficiency, Logistics safety
Consumption level	Food safety, Consumption demand

TABLE 4. Coupling index system

Indicator type	Specific indicators
Logistics supply chain indicators	Logistics cost
	Logistics efficiency
	Logistics safety
Agricultural economic indicators	Agricultural product production
	Logistics and transportation
	Agricultural product sales

Through the construction of a coupling index system, this study can quantitatively assess the coupling degree between Chengdu's agricultural product logistics supply chain and agricultural economy, providing basic data support for subsequent research.

**4.2. Construction of the coupling coordination model between logistics supply chain and agricultural economy.** The coupling coordination theory is a theory that analyzes the interaction of multiple factors. In the logistics supply chain of agricultural products and the development of agricultural economy, there are multiple factors that interact with each other. The interaction and influence of these factors will have an important impact on the production, circulation, and sales of agricultural products. The use of trained deep learning models for forecasting and decision-making, such as predicting the demand, price, logistics costs of agricultural products, to help optimize supply chain management. The coupling coordination theory can systematically analyze and study these factors, find the correlation and coordination degree between them, and provide scientific guidance and decision-making support for the sustainable development of agricultural economy.

In this paper, a coupled co-scheduling model is proposed to measure the coupled co-scheduling of China's agricultural logistics supply chain and agricultural economy. The model consists of the following five formulas.

The relationship between logistics supply chain and agricultural economy is calculated as shown in the following Formula (1).

$$C_{ij} = \frac{\sum_{k=1}^n \left( b \pm \frac{a_{ik}}{\max_{i=1}^m a_{ik}} + \frac{a_{jk}}{\max_{j=1}^m a_{jk}} \right)}{2n} \quad (1)$$

where  $C_{ij}$  represents the degree of connection between the logistics supply chain and the agricultural economy,  $a_{ik}$  and  $a_{jk}$  represent the scores of the logistics supply chain and the agricultural economy on the  $k$ th indicator, respectively,  $n$  represents the number of indicators, and  $m$  represents the number of logistics supply chains and agricultural economies participating in the evaluation.  $b$  represents an offset term or baseline. It is used to correct all logistics supply chain and agricultural economy degree of connection calculation, so that the results are more realistic. In practical applications, the value of this  $b$  can be estimated from empirical data, or based on expert judgment.

Calculate the impact of logistics supply chain on agricultural economy as shown in Formula (2).

$$P_i = \frac{\sum_{i=1}^n C_{ij}}{m} \quad (2)$$

where  $P_i$  represents the impact of the logistics supply chain on the agricultural economy,  $C_{ij}$  represents the connection between the logistics supply chain and the agricultural economy, and  $m$  represents the number of logistics supply chains participating in the evaluation.

Calculate the dependence of the agricultural economy on the logistics supply chain as shown in Formula (3).

$$Q_j = \frac{\sum_{i=1}^m C_{ij}}{n} \quad (3)$$

where  $Q_j$  represents the degree of dependence of the agricultural economy on the logistics supply chain,  $C_{ij}$  represents the degree of connection between the logistics supply chain and the agricultural economy, and  $n$  represents the number of agricultural economies participating in the evaluation.

The coupling degree between logistics supply chain and agricultural economy is calculated as shown in Formula (4).

$$H_i = \alpha P_i + (1 - \alpha) Q_j \quad (4)$$

where  $H_i$  represents the coupling degree between the logistics supply chain and the agricultural economy,  $\alpha$  represents the weight of the influencing factors,  $P_i$  represents the impact of the logistics supply chain on the agricultural economy, and  $Q_j$  represents the dependency of the agricultural economy on the logistics supply chain.

The coordination degree between logistics supply chain and agricultural economy is calculated as shown in Formula (5).

$$F_i = \sum_{j=1}^m w_j * A_{ij} \quad (5)$$

where  $F_i$  represents the evaluation score of the  $i$ th agricultural product logistics supply chain,  $w_j$  represents the weight of the  $j$ th evaluation index, and  $A_{ij}$  represents the score of the  $i$ th supply chain on the  $j$ th evaluation index.

In the model, the weight value is usually calculated by a certain method, rather than directly assigned. These methods may include statistical analysis of data, expert scoring, analytic hierarchy process, etc. In general, the determination of these weight values is one of the key steps in model construction and needs to be determined according to the specific research objectives and context. The correctness and rationality of these weights determine the accuracy and practicability of the model to a large extent.

In order to reflect the current situation of industry integration development more clearly, based on the results of empirical research and statistical analysis of existing data, this paper obtains the range of coupling cooperative scheduling corresponding to all levels of coordination. The level of refinement is then deduced theoretically, for example, if the theoretical range of coupled cooperative scheduling is 0 to 1, then each 0.1 can be set as a level. Finally, fine-tuning was made through the judgment of experts, and Table 5 was adopted as the evaluation standard of integration and coordination degree.

**4.3. Calculation and analysis of the coordination degree between logistics supply chain and agricultural economy.** Based on the formula calculation and statistics,

TABLE 5. Fusion coordination level table

Classification of fusion types	Index	Coupled co-scheduling	Coordination level
Lose balance	1	0.0000-0.0999	Extreme disorders
	2	0.1000-0.1999	Serious disorders
	3	0.2000-0.2999	Moderate imbalance
	4	0.3000-0.3999	Mild disorders
	5	0.4000-0.4999	Borderline disorder
Coordinate	6	0.5000-0.5999	Grudging coordination
	7	0.6000-0.6999	Primary coordination
	8	0.7000-0.7999	Intermediate coordination
	9	0.8000-0.8999	Good coordination
	10	0.9000-1.0000	Quality coordination

TABLE 6. Coordination levels of logistics supply chain and agricultural economy coupling in Chengdu (1)

Indicator	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Logistics supply chain development level function	0.30	0.32	0.50	0.44	0.51	0.64	0.55	0.70	0.50	0.70
Function of agricultural economic development level	0.31	0.44	0.39	0.41	0.44	0.51	0.55	0.71	0.40	0.50
Comprehensive evaluation indicators	0.3122	0.3995	0.4489	0.4226	0.4762	0.5761	0.5544	0.7116	0.4405	0.5880
Coupling degree	0.9978	0.9970	0.9932	0.9992	0.9965	0.9935	0.9999	0.9999	0.9908	0.9711
Coupled co-scheduling	0.56	0.63	0.67	0.65	0.69	0.76	0.75	0.84	0.66	0.75

we can obtain the coupling coordination scheduling, coupling coordination degree level, and coordination type of Chengdu logistics supply chain and agricultural economic industry from 2013 to 2022. The details are shown in Table 6, Table 7 and Figure 4.

**4.4. Result analysis.** In the research on the integration and development of agricultural economy and agricultural product logistics supply chain in Chengdu, an important analysis was conducted on the development level of agricultural economy, the development level of agricultural product logistics supply chain, and the degree of integration. The following conclusions are drawn.

Firstly, through the study of the overall development level function of Chengdu's agricultural economy and agricultural product logistics supply chain, it is found that the development level of the agricultural economy in 2013 and 2014 lagged behind the agricultural product logistics supply chain. From 2015 to 2018, 2021, and 2022, the development level of agricultural product logistics supply chain lagged behind the agricultural economy.

TABLE 7. Coordination levels of logistics supply chain and agricultural economy coupling in Chengdu (2)

Time	Coupling coordination level	Coordination type
2013	Grudging coordination	Agricultural economy lags behind
2014	Preliminary coordination	Agricultural economy lags behind
2015	Preliminary coordination	Logistics supply chain lags behind
2016	Preliminary coordination	Logistics supply chain lags behind
2017	Preliminary coordination	Logistics supply chain lags behind
2018	Intermediate coordination	Logistics supply chain lags behind
2019	Intermediate coordination	Synchronous development
2020	Good coordination	Synchronous development
2021	Preliminary coordination	Logistics supply chain lags behind
2022	Intermediate coordination	Logistics supply chain lags behind

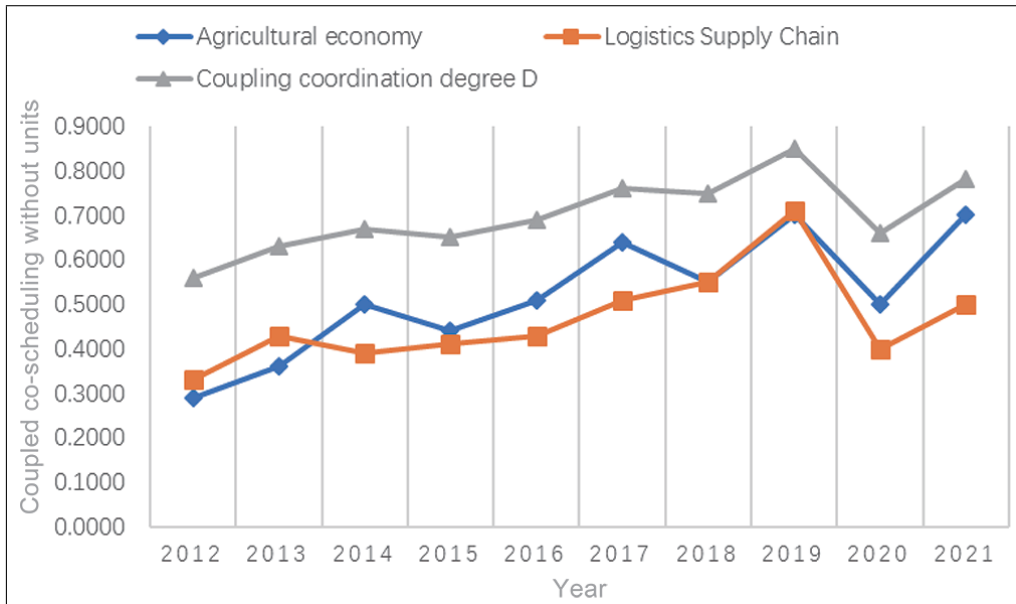


FIGURE 4. Trends in the coupled development level of logistics supply chain and agricultural economy in Chengdu

In 2019 and 2020, the cultural and agricultural product logistics supply chain was in a synchronous development state. The overall development level of the agricultural economy and agricultural product logistics supply chain has continuously improved, showing a good development trend and strong momentum, and is a new driving force for high-quality economic development. However, the development level of agricultural product logistics supply chain is still mainly lower than the development level of agricultural economy, indicating that the development of logistics supply chain and related fields is in an incomplete state. The foundation of the agricultural product logistics supply chain is relatively weak compared to the agricultural economy, and the development of the logistics supply chain cannot keep pace with the development of the agricultural economy. It is unable to fully utilize the advantages of agriculture to drive the development of the agricultural product logistics supply chain.

Secondly, from the perspective of the integration and coordination of Chengdu’s agricultural product supply chain and agricultural economy, it can be seen that with the

development of policy support and cultural tourism, the integration between Chengdu's agricultural economy and agricultural product logistics supply chain has gradually improved. However, the COVID-19 has affected the development of agricultural products logistics supply chain and agricultural economy to a certain extent, reducing the degree of integration and coordination between them. With the support of government policies, the situation will gradually improve in 2022, but further support from local government departments and improved utilization of logistics supply chains are still needed to promote the development of the agricultural economy, achieve a high degree of integration, and achieve common development. The integration potential of Chengdu's cultural and agricultural product logistics supply chain is enormous, and it can be started from five aspects: policy, innovation, technology, talent, and business model to more effectively promote the high-quality development of the agricultural product logistics supply chain. Specifically, the government can introduce relevant policies to support the development of logistics supply chains; enterprises can strengthen innovation and improve logistics efficiency and quality; in terms of technology, technologies such as big data and deep learning can be applied to improving the intelligence of the logistics supply chain; introduce talents to improve the management level of logistics supply chain; in terms of business models, new business models can be explored to improve the profitability of the logistics supply chain.

Thirdly, in the quantitative survey of the degree of coupling and coordination between cultural tourism and the four main influencing factors in Chengdu, it can be seen that the correlation degree of the four influencing factors is above 0.6, which means that they all have a positive promoting effect on the integration of the agricultural product logistics supply chain and the development of the agricultural economy. Consumption demand factors and human capital factors have the greatest impact on the development of Chengdu's agricultural economy, with their grey correlation degrees exceeding 0.8, 0.850, and 0.814, respectively.

In summary, the integration and coordination of Chengdu's agricultural product logistics supply chain and agricultural economy play a crucial role in the development of agricultural economy. The government and enterprises should promote high-quality development of the logistics supply chain from multiple aspects to achieve better integration of the agricultural economy and agricultural product logistics supply chain. With the vigorous development of modern information technologies such as deep learning and big data analysis, science and technology have become a new driving force for industrial integration and innovative development. Although Chengdu is one of the regions with the most active high-tech activities in China, it is significantly deficient in agricultural economic development. Therefore, it is necessary to focus on promoting the transformation of modern science and technology in the agricultural product logistics supply chain and promote the development of agricultural product logistics supply chain with scientific and technological progress, so as to promote the development of agricultural economy.

**5. Conclusion.** This article discusses the role of agricultural product logistics supply chain in agricultural economic development in the context of big data and deep learning. Firstly, relevant concepts and theories such as big data and deep learning, agricultural product logistics supply chain management, and coupling coordination theory are elaborated. Then, it analyzed the impact of big data and deep learning on the agricultural product logistics supply chain and agricultural economy and discussed the current development situation of the integration of agricultural product logistics supply chain and agricultural economy. Finally, based on the coupling and coordination theory of logistics supply chain and agricultural economy, the coupling index system and coordination degree

model of logistics supply chain and agricultural economy are constructed, and empirical analysis and interpretation of the results are conducted.

Through the research in this article, we can draw the following conclusions: Big data and deep learning technology can optimize the agricultural product logistics supply chain, improve logistics efficiency and reduce costs, while also improving agricultural production efficiency and quality, and promoting agricultural economic development. The integration and development trend of agricultural product logistics supply chain and agricultural economy is obvious. The development of logistics supply chain can promote the circulation and marketization of agricultural products, increase farmers' income and national economic growth. The index system and coordination degree model constructed based on the coupling coordination theory can comprehensively evaluate the coupling degree and coordination degree of logistics supply chain and agricultural economy, providing scientific basis and decision-making support for the sustainable development of agricultural economy.

Future research can further explore the application of big data and deep learning in agricultural economic development, optimize logistics supply chain management, and improve agricultural production efficiency and quality. At the same time, it is possible to explore the integrated development of agricultural product logistics supply chain and other related fields, providing broader development space for the agricultural economy.

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## Author Biography



**Xianfeng Zhu** received B.S. degree in School of Economics and Trade from Henan Agricultural University in 2002. She received M.S. degree in School of Economics and Management from Henan Polytechnic University in 2010.

Ms. Zhu is currently a full-time teacher at the School of Economics and Management, Jiaozuo University, China. Her main research interests include logistics management and agricultural economics. She has published over 10 papers on well-known journals.