

# Digital Intelligence Analysis for the "First Mile" of Agricultural Product E-commerce Supply Chain

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**Abstract.** At present, with the continuous development of Internet technology, the development trend of "Internet plus agriculture" is increasingly obvious. With the increasing attention of the academic community to rural e-commerce, the supply chain management of agricultural product e-commerce has become one of the key research topics today. However, there is still a research gap on how to achieve efficient and precise integration of the "first mile" of agricultural product e-commerce supply chain, lacking a unified understanding and solution. Therefore, this article focuses on the digital intelligent countermeasures for the e-commerce supply chain of agricultural products in the "first mile". Firstly, analyze the current development status of agricultural product e-commerce and the specific reasons that affect the precise integration of smallholders and e-commerce enterprises, and then conduct strategic research to provide digital solutions for achieving the "first mile" e-commerce supply chain of agricultural products. The research results of this paper can provide decision-making guidance for the digital and intelligent development of agricultural product e-commerce supply chain, and promote the continuous development of "Internet plus agriculture".

**Keywords:** Agricultural Product, E-commerce Supply Chain, Smallholder, E-commerce Enterprises, Digital Intelligence.

## 1. Introduction

As a major agricultural country, selling agricultural products is the fundamental way for farmers to obtain income in China. For a long time, smallholders have struggled to meet the increasingly high requirements of e-commerce platform consumers for diversity and high-quality due to their small business scale and scattered living conditions. From the perspective of the supply chain, agricultural products still need to go through multiple intermediate stages such as intermediaries and retailers in order to reach consumers [1]. In recent years, with the continuous development of e-commerce, many rural areas have started to sell agricultural products through e-commerce platforms, thereby driving the economic development of rural areas. Due to the continuous development of internet technology and e-commerce platforms, it is possible for smallholders to connect to modern consumer markets. By utilizing information and communication technology and virtual platforms, e-commerce provides opportunities for smallholders to engage in direct transactions with consumers. Currently, there are two main ways for smallholders to participate in e-commerce sales of agricultural products, one is the "smallholders-consumers" model, and the other is the "smallholders-e-commerce enterprises-consumers model". But in fact, due to the inherent disadvantages of smallholders, they often find it difficult to sell their agricultural products directly to consumers through e-commerce [2]. In order to control and reduce transaction risks, smallholders are more inclined towards the second e-commerce model, which is the "smallholders-e-commerce enterprises-consumer model". Therefore, how to more efficiently and accurately connect with e-commerce enterprises has become a concern for smallholders.

There is still controversy in the academic community over whether smallholders can directly sell agricultural products to consumers through e-commerce entrepreneurship. Some scholars believe that smallholders can integrate into the development of e-commerce through independent entrepreneurship and achieve direct transactions with consumers. This "smallholder-consumer" agricultural product e-commerce supply chain model can reduce arbitrage space in the middle links of the supply chain, save transaction costs, and thus achieve income increase for smallholders [3].

However, there are also quite a few scholars who believe that smallholders do not have the ability to start an e-commerce business, and the "smallholders-consumers" agricultural product e-commerce supply chain model is difficult to achieve. The reasons are as follows: Firstly, although most rural residents have the basic conditions to access and use the Internet, the "secondary digital divide" caused by differences in information identification and utilization capabilities is gradually emerging [4]. Secondly, the increasing traffic gathered by online platforms and the increasing threshold for entrepreneurship generated by rules, capital, etc. have gradually excluded smallholders from the ranks of e-commerce entrepreneurship [5].

In order to share the dividends of the digital age and avoid the disconnect between smallholders and the digital age, some scholars have proposed a more comprehensive agricultural product e-commerce supply chain model, namely the "smallholders-e-commerce enterprises-consumers" model. This agricultural e-commerce supply chain model requires smallholders to first sell their agricultural products to e-commerce enterprises, and then e-commerce enterprises sell the product online [2]. However, from previous literature, it has been limited to the overall summary of the agricultural product e-commerce supply chain of "smallholders-e-commerce enterprises-consumers". Existing literature has not conducted in-depth research and theoretical explanations on how to achieve efficient docking between smallholders and e-commerce enterprises.

Therefore, there is still a lack of effective measures to achieve efficient and precise integration between smallholders and e-commerce enterprises.

In view of this, this article provides a solution to the problem of smallholders' agricultural products being unable to efficiently and accurately connect with e-commerce enterprises from a supply chain perspective. This article focuses on the current situation of digital management applications in the e-commerce supply chain of agricultural products, which is the "first mile" between smallholders and e-commerce enterprises. It provides digital solutions for efficient integration between smallholders and e-commerce enterprises, in order to achieve the dividend of digital development shared upstream in the agricultural product e-commerce supply chain.

## 2. Development Status of Agricultural Product E-commerce

The development of e-commerce has brought great convenience to consumers and businesses, making commodity transactions no longer limited by time and space, greatly improving transaction efficiency. With the implementation of the national rural revitalization strategy, major e-commerce platforms have realized the development potential of agricultural products and are vying to seize the rural market. With the continuous deepening of e-commerce platforms, rural e-commerce has ushered in broad development prospects.

According to data from the Ministry of Commerce, in 2019, the national rural online retail sales reached 1.7 trillion yuan, of which the online retail sales of rural physical goods reached 1.3 trillion yuan, accounting for 78% of the national rural online retail sales. This indicates that the development of rural e-commerce has become a trend [6]. As a major agricultural country in China, the fundamental source of income for farmers is through the sale of the agricultural products they produce. Moreover, China has a vast territory and abundant resources, and the types of products produced in different regions are not the same. The application of Internet technology can open up sales channels for high-quality agricultural products, unleash the speed and popularity of online dissemination, broaden the channels for agricultural product sales, and sell high-quality farm products to the whole country [7].

However, the current supply chain of agricultural products in China is still mainly based on traditional methods, relying on multi-level production and sales wholesale markets to achieve comprehensive distribution and circulation [8]. With the continuous development of internet technology, relying on digital intelligence has played a positive role in helping various industries improve efficiency. However, there is still a lack of effective integration in the upstream stage of the agricultural supply chain. In order to reduce transaction costs and control transaction risks,

smallholders often tend to choose traditional and conservative methods when selling agricultural products, that is, under the traditional agricultural supply chain, selling the agricultural products they produce through the primary wholesale market in exchange for labor remuneration. Obviously, this approach is not conducive to the modernization of the agricultural supply chain. Firstly, a multi-level and multi-link supply system with lengthy intermediate circulation links. Agricultural products generally need to go through four layers of circulation from producers to consumers. The agricultural products produced by scattered smallholders are purchased by the agricultural product brokers of the origin, transported to the primary wholesale market, and then distributed by the secondary wholesalers to the retail end of agricultural products such as the Farmers' market, and finally to the final consumers. Secondly, layer by layer price increases have led to low production revenue, thin retail profits, high consumer costs, and a cumbersome chain that weakens the profitability of practitioners.

E-commerce based on internet technology and online platform construction is expected to replace various intermediaries and become an effective way for smallholders to connect to modern markets [9]. E-commerce can utilize information and communication technology and virtual platforms to provide opportunities for smallholders to engage in direct transactions with consumers. Smallholders can complete activities such as information transmission, demand matching, and transaction payment online, thereby participating in the "smallholders-consumers" agricultural product e-commerce supply chain model. But in fact, very few smallholders can directly trade with consumers through e-commerce entrepreneurship [2]. Although there have been successful cases of this agricultural e-commerce supply chain model, it is extremely rare.

Due to the limited production capacity, weak operational and coordination capabilities of smallholders themselves, as well as the diversified and high-frequency transaction demands of online consumers, the "smallholders-consumers" model of agricultural product e-commerce supply chain is difficult to achieve. Smallholders have small production and operation scale, strong seasonality of production and planting, fewer varieties and quantities of agricultural products available for tea, and strong asset specificity of agricultural production investment. It is difficult for them to conduct direct transactions with numerous, dispersed and friendly online consumers with High-frequency trading needs.

Therefore, the more common and suitable agricultural product e-commerce supply chain model for smallholders is the "smallholders-e-commerce enterprises consumers" model, where smallholders first sell their agricultural products to e-commerce enterprises. Although this agricultural e-commerce supply chain model also involves the participation of intermediaries, compared to the traditional agricultural supply chain model, it greatly reduces the involvement of multi-level entities in the supply chain. However, between smallholders and e-commerce enterprises, there is still a solution where the agricultural products produced by smallholders cannot be efficiently and accurately integrated with e-commerce enterprises. Please refer to Chapter 3 for specific analysis.

### **3. Specific problems faced in achieving precise link**

#### **3.1. The Quantity Issue of Agricultural Products**

Generally speaking, a significant drawback for smallholders is their limited production capacity. In terms of production capacity, smallholders often have disadvantages such as small production scale, single planting structure, and strong seasonality of agricultural products [2]. Secondly, in agricultural production, there are characteristics such as strong periodicity, high risk coefficient, and low standardization, and smallholders need to face high production uncertainty. Obviously, there is a problem of smallholders being unable to stably supply large-scale quantities of agricultural products to e-commerce enterprises. Therefore, for e-commerce enterprises, how to achieve precise docking with smallholders from the perspective of the supply chain and stabilize the supply of agricultural products produced by smallholders is an unavoidable issue that must be considered.

### **3.2. The Quality Issue of Agricultural Products**

Quality is the core and soul of agricultural products, and for agricultural products, product quality is an important factor in obtaining market recognition [10]. As mentioned in section 3.1, smallholders have limited production capacity and cannot achieve large-scale mechanized and standardized production like specialized agricultural production bases. Therefore, in the traditional sales of smallholders, it is very common to mix high-quality and average quality products and sell them at low prices to buyers in the wholesale market. With the continuous development of social and economic conditions, the demand for a better life among the people has gradually increased, accompanied by an increasing demand for daily consumption of agricultural products. For e-commerce enterprises, facing the current high quality requirements of online consumers for agricultural products, it is urgent to stabilize the quality of their agricultural products. Otherwise, it will affect the satisfaction of online consumers with online consumption and even affect the company's reputation. Therefore, for e-commerce enterprises, it is necessary to find stable and high-quality agricultural product supply sources among smallholders, in order to achieve precise links with them.

### **3.3. The Logistics and Transportation Issue of Agricultural Products**

Agricultural products generally have the characteristics of being perishable and not easy to store, so there is an urgent need for efficient production and sales coordination, and high standards for transportation are required. However, in real life, due to the lack of concentration of rural residents, logistics supply is relatively dispersed. In some more remote rural areas, logistics enterprises are generally difficult to take into account, not only in the lack of service stations and outlets, but also in the lack of corresponding human resources responsible for transportation and distribution. In addition, the level of rural roads is relatively low, and transportation facilities are also poor [11]. These existing agricultural product logistics and transportation problems have led to numerous difficulties in the efficient operation of the agricultural product e-commerce supply chain, seriously affecting the efficient digital and intelligent link between smallholders and e-commerce enterprises. Therefore, it is inevitable to achieve efficient digital and intelligent integration between smallholders and e-commerce enterprises, and to solve the problem of smallholders' agricultural product transportation.

### **3.4. The Issue of Information Disconnection**

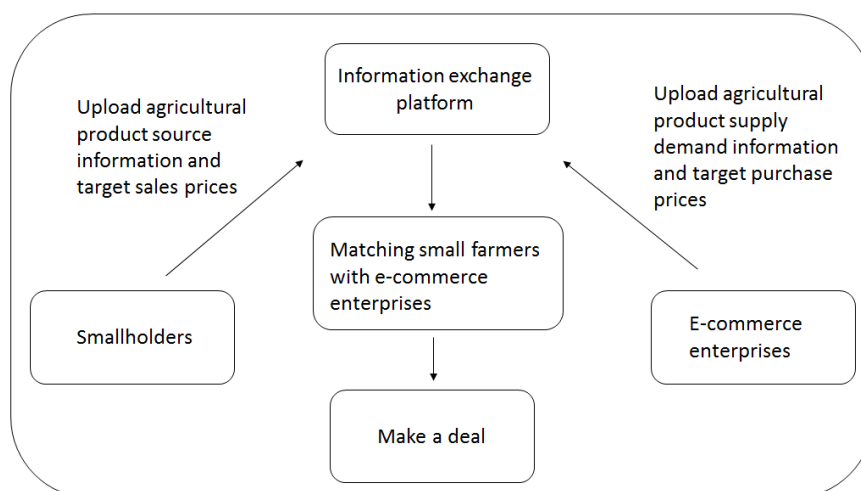
The circulation of information is a key link and fundamental factor in the development of e-commerce industries and the lack of smooth information transmission is one of the bottlenecks hindering the development of e-commerce. Due to the fact that smallholders are generally located in remote areas, the information generated during communication and transmission between the sales and production ends has a delayed nature, leading to a disconnect between supply and demand. Due to issues such as information asymmetry and disconnected information transmission, there is often a clear information gap between smallholders and e-commerce enterprises. E-commerce enterprises can predict the expected demand and quality requirements of agricultural products based on the consumer market, but often cannot accurately convey this information to smallholders in scattered rural areas. Smallholders are also unable to determine which e-commerce enterprise has the problem of lacking supply of agricultural products, and do not know which e-commerce enterprise should have higher economic returns for the agricultural products they produce. Therefore, solving the problem of information disconnection between smallholders and e-commerce enterprises is a problem that needs to be achieved through efficient digital intelligent links between smallholders and e-commerce enterprises.

## 4. Digital Intelligent Link Strategies between Smallholders and E-commerce Enterprises

In order to promote efficient and accurate digital intelligence links between smallholders and e-commerce enterprises, this article proposes an innovative solution. By utilizing the rapid development of internet information technology, we focus on the needs of both smallholders and e-commerce enterprises, in order to establish an integrated information exchange platform and achieve seamless interconnection and exchange of agricultural product information between the production and circulation ends.

### 4.1. Realize Information Sharing of Agricultural Product Supply Sources

As mentioned in section 3.4 earlier, there is an information gap between smallholders and e-commerce enterprises. With the rapid development of Internet technology and the advancement of Digital transformation, the information exchange platform has become an important tool to promote the information sharing of agricultural product supply. The information exchange platform plays a crucial role as a bridge connecting smallholders and e-commerce enterprises. On this platform, smallholders can easily publish information about their agricultural products, including variety, quantity, quality, and pricing data. At the same time, e-commerce enterprises can also obtain timely market supply information through this platform, understand the yield and quality of agricultural products in various regions, and provide scientific basis for procurement decisions. Figure 1 shows the flowchart of how smallholders and e-commerce enterprises can achieve efficient and accurate links through the agricultural product information exchange platform. Smallholders can upload the source information of agricultural products and the target sales prices of their produced agricultural products through the platform; E-commerce enterprises can upload demand information and estimated purchase prices of agricultural products through this platform; The agricultural product information exchange platform can compare the conditions and needs of both sides through Big data analysis technology and match them, so as to promote a faster and more efficient transaction between smallholders and e-commerce enterprises. This two-way information sharing model will greatly improve the transparency and efficiency of the agricultural product supply chain, help solve the problem of information asymmetry, and reduce resource waste and loss. Through efficient data exchange and sharing, smallholders can achieve precise market positioning and sales of their agricultural products to e-commerce enterprises. E-commerce enterprises can also optimize supply chain management and improve market competitiveness. This will provide strong support for the upgrading of the agricultural product e-commerce supply chain and the increase of farmers' income, achieve efficient and accurate links between smallholders and e-commerce enterprises, and promote the further development and application of digital agriculture in China.



**Fig. 1** Schematic diagram of agricultural product supply and source information sharing under the information exchange platform (Photo credit: Original)

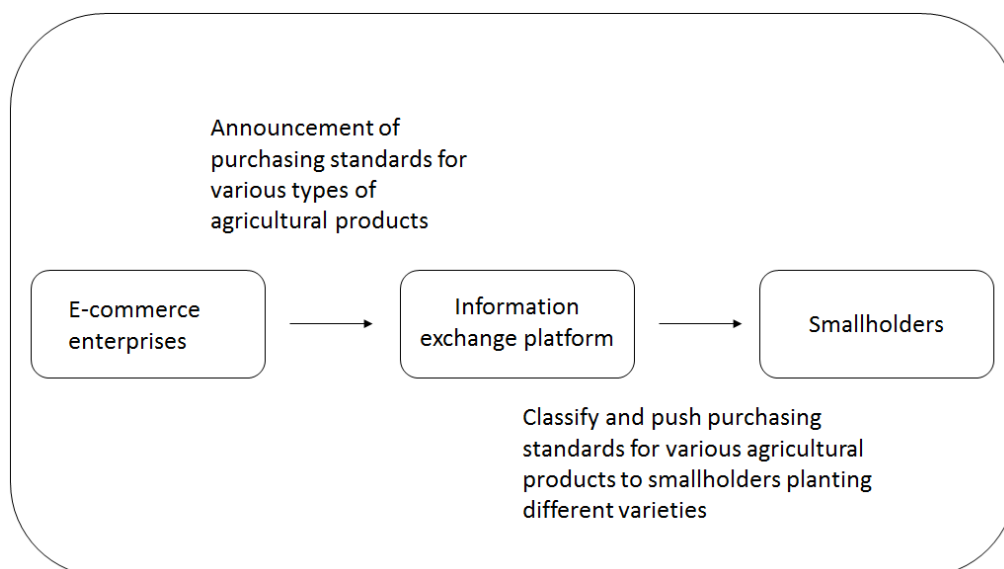
## 4.2. Unified Supply Standards for Agricultural Products

This section aims to explore the important role of information exchange platforms in promoting the standardization of agricultural product supply sources, in order to promote the upgrading and optimization of the agricultural product e-commerce supply chain.

As mentioned in section 4.1, the information exchange platform provides a platform for smallholders and e-commerce enterprises to share information, enabling both parties to transmit real-time information on agricultural product supply sources. On this platform, agricultural product information produced by different regions and farmers is centralized and aggregated, and e-commerce enterprises can obtain a large amount of agricultural product supply data through the platform. The characteristics of this centralized data provide valuable resources for developing unified standards for agricultural product supply sources.

As shown in Figure 2, through the use of information exchange platforms, e-commerce enterprises can provide a unified standard for purchasing agricultural product supply sources to smallholders responsible for agricultural product production. These standards can include the quality requirements, specifications, procurement and sales contract terms of agricultural products, ensuring that agricultural products meet the contractual standards in all stages of production, procurement, transportation, and sales, improving the market competitiveness of agricultural products and reducing transaction risks.

In addition, the information exchange platform can also incorporate data collection and analysis functions, which can help provide scientific basis for the formulation of agricultural product supply standards. Through Big data analysis and Market trend prediction, the platform can provide farmers and e-commerce enterprises with information on market demand, price fluctuations and other aspects, making the standards formulated more consistent with the actual situation and needs of the market.



**Fig. 2** Schematic diagram of information circulation for agricultural product procurement standards under the information exchange platform (Photo credit: Original)

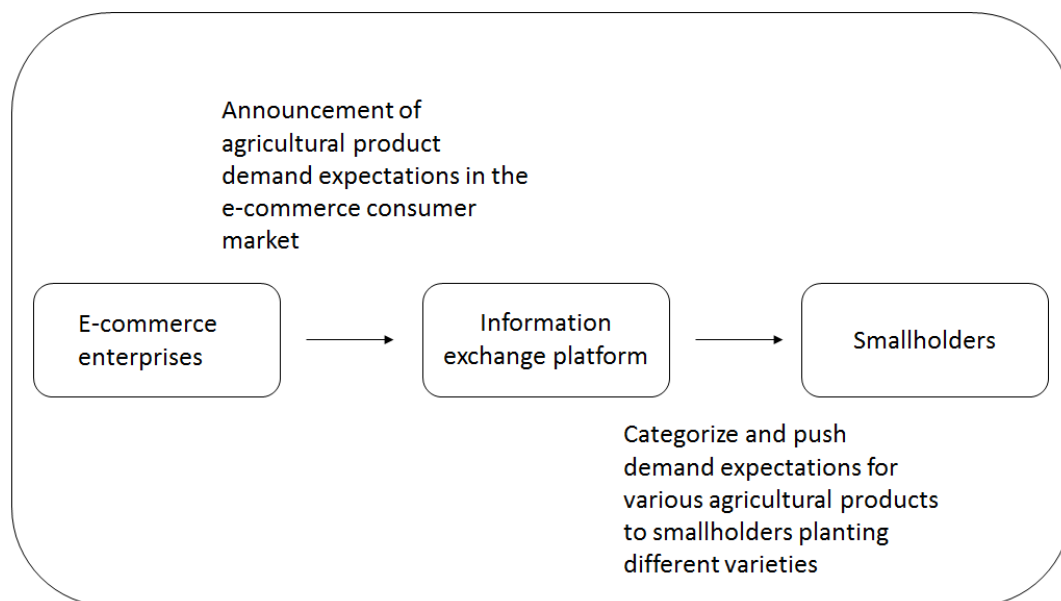
The information exchange platform provides strong support for formulating unified standards for agricultural product supply sources. By sharing data and information on the platform, smallholders and e-commerce enterprises can form unified standards, improve the market competitiveness of agricultural products, and optimize and enhance the supply chain of agricultural e-commerce.

## 4.3. Match Supply and Demand between Sales and Production Ends

The establishment of an information exchange platform provides a unique opportunity for effective cooperation between sales and production ends, achieving precise matching of agricultural product supply and demand. The information exchange platform, as a hub for gathering information on the

supply and demand of agricultural products, greatly simplifies the process of information transmission and builds an efficient and convenient bridge for cooperation between the sales and production ends. Through this platform, smallholders in the production end can timely understand the market demand situation, including information on variety, quantity, quality, and other aspects, by directly facing e-commerce enterprises in the consumer market. Through this market information, smallholders can produce the agricultural products that are truly needed in the market, thereby achieving supply side structural reforms in agriculture. This information sharing mechanism can help various market entities on the sales and production sides to more accurately grasp market dynamics, effectively bridging the gap between supply and demand.

Figure 3 is a schematic diagram of the expected demand information flow for agricultural products by e-commerce enterprises. As shown in the figure, e-commerce enterprises timely transmit market demand information on the quality, quality, and quantity of agricultural products to the production end, namely smallholders, by predicting the future of the agricultural product consumption market. After receiving the market forecast information, smallholders adjust their production plans to produce agricultural products more in line with market demand. The information exchange platform provides a new way for collaborative cooperation between sales and production ends, achieving precise matching between agricultural product supply and demand. Through information sharing on the platform, the sales and production ends can better understand each other and efficiently connect, thereby achieving complementary advantages between smallholders and e-commerce enterprises, and promoting modernization and intelligence of agricultural production and sales.



**Fig. 3** Information Flow Chart of Expected Demand for Agricultural Products under the Information Exchange Platform (Photo credit: Original)

#### 4.4. Disclose Transportation Order Request Information to Solve the Problem of Difficult and Expensive Transportation of Agricultural Products

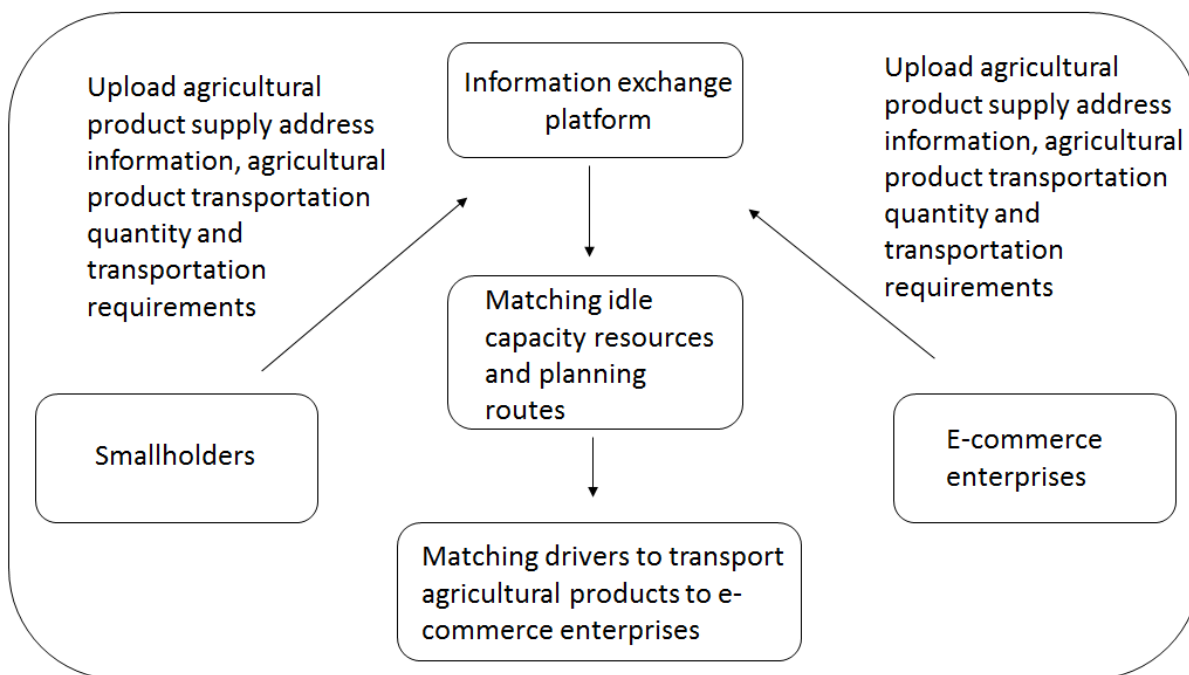
In the current process of rural e-commerce supply chain development, the key to ensuring its stable and high-speed sustainable development is to fully integrate and utilize all useful resources available for the agricultural product supply chain through information exchange platforms. Especially in vast rural areas, there are a large number of idle transportation resources, such as shuttle bus drivers. Building an efficient information exchange platform in the information exchange platform can maximize the potential of these idle transportation resources. By giving full play to the functions of the information exchange platform, the intelligent matching and efficient scheduling of transport capacity resources will effectively solve the transportation problems of agricultural products produced by smallholders and the high transportation costs, thus solving the transportation difficult

problem of consciousness in the efficient link of agricultural products between smallholders and e-commerce enterprises.

Figure 4 is a schematic diagram of the transportation order request information function in the agricultural product information exchange platform. Through this transportation order request information disclosure function, on the information exchange platform, drivers with idle transportation capacity can find routes suitable for their planned journey through the logistics transportation assistance interface, effectively converting idle transportation capacity into resource advantages. The platform provides a convenient channel for information dissemination and acquisition, allowing drivers to timely understand the current market demand for agricultural product transportation, select suitable transportation tasks, and fully utilize their transportation resources.

At the same time, the information exchange platform can also utilize advanced distance algorithms and intelligent scheduling systems to reasonably allocate agricultural product transportation tasks to drivers who adapt to the route, maximizing the efficiency of transportation capacity utilization. By optimizing transportation routes, and reducing empty and redundant transportation, not only transportation costs are reduced, but also the transportation time from the production end to the sales end of agricultural products is shortened, improving the timeliness and quality maintenance of agricultural products, and providing consumers with higher quality products.

The transportation order disclosure function of the agricultural product information exchange platform plays an important role in promoting the development of rural e-commerce supply chain. It improves the transportation efficiency of agricultural products, promotes the rapid circulation of agricultural products from production to sales, breaks geographical restrictions, expands the market scope of agricultural products, and improves market competitiveness. By fully integrating and utilizing available resources, especially idle capacity resources, the platform promotes the efficient utilization of capacity in the agricultural product supply chain, thereby achieving the matching of supply and demand of capacity resources, and contributing an important force to the upgrading and optimization of rural e-commerce supply chains. Meanwhile, smallholders, through the use of information exchange platforms, can organize agricultural product transportation more flexibly, minimizing the waiting time for agricultural product logistics transportation, reducing transportation costs, and making it more convenient for agricultural product transportation.



**Fig. 4** Schematic diagram of idle capacity information flow under the information exchange platform (Photo credit: Original)

## 5. Conclusion

With the continuous development of China's online agricultural product consumption market, the issue of the "first mile" e-commerce supply chain for agricultural products is becoming increasingly severe. How to solve the problem of efficient and precise docking between smallholders and e-commerce enterprises, and promote the intelligent development of the "first mile" e-commerce supply chain of agricultural products, has become an inevitable problem in today's agricultural modernization. The analysis results of this article indicate that the quantity, quality, logistics and transportation of agricultural products produced by smallholders, as well as the information disconnection between the production and sales ends, are all factors that affect the stable and high-quality development of the "first mile" e-commerce supply chain for agricultural products. Furthermore, this article proposes corresponding solutions, including building an agricultural product information exchange platform, sharing agricultural product supply information between smallholders and e-commerce enterprises through the information exchange platform, unifying agricultural product supply standards, matching supply and demand between sales and production ends, and disclosing transportation order request information, to solve the problems of difficult and expensive agricultural product transportation. However, there are still shortcomings in this article, and specific case studies have not been analyzed. The implementation effect of the proposed plan needs to be further tested. Future research will explore more digital intelligent solutions to achieve the "first mile" e-commerce supply chain of agricultural products based on specific cases, in order to promote the stable and orderly development of China's agricultural modernization.

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