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## E-Commerce in Chinese Vegetable Markets

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### Abstract

China is both a major vegetable producer and consumer. Vegetables have many features such as regionality, seasonality, consumer ubiquity, and timeliness of sales. Vegetable prices in China fluctuate drastically, and there are many actors in the value chain, resulting in high consumer prices. In recent years, overproduction of many products has frequently occurred, resulting in the failure of many products to sell and products left to rot in the production place. The social problems of agriculture, rural areas and farmers, called the 'three rural problems', have become increasingly prominent. Enhancing the market competitiveness of agricultural production, and more effectively utilising agricultural resources, is the best way to develop agriculture. This paper suggests that one way of solving the problems of Chinese vegetable value chains is by expanding the use of e-commerce. E-commerce could greatly benefit farmers by reducing transaction costs and providing timely supply and demand information and feedback from consumers. This will help to reduce the negative effects of the three rural problems. To a certain extent, the e-commerce platform could solve the fluctuation of vegetable price because this mode is not affected by region and season. With vegetables moving faster and cumbersome spot trading procedures avoided, consumers could purchase vegetables from all over China over the Internet at any time. Therefore, in this paper, the current condition of Chinese vegetable e-commerce and the reasons that restrict its development are analysed, and measures for vegetable e-commerce development are proposed.

**Key words:** vegetable, e-commerce, value chain, consumers, logistics

### Introduction

The area planted to vegetables in China is extensive, second only to food crops. Moreover, vegetables are a kind of cash crop with strong development potential. Zhang (2018) explains that the vegetable industry has gradually developed into a critical pillar to achieve farmer employment, agricultural efficiency and rural economic development. Over the years, in order to ensure the smooth development of the vegetable industry, Dou and Shao (2018) noted that the central and local

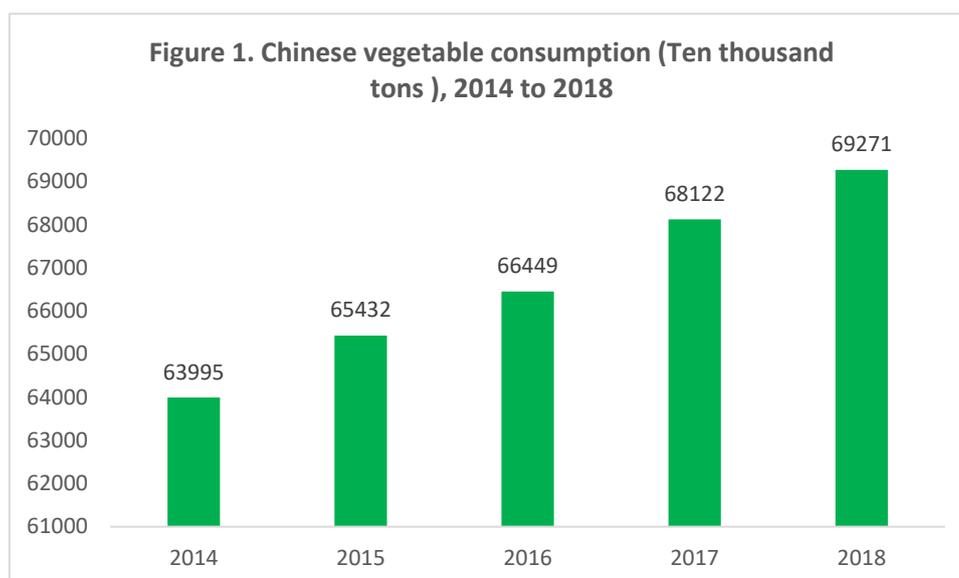
governments have successively issued national and provincial vegetable industry development plans and a guiding plan for the construction of “shopping basket program”. Planting subsidies and price insurance are available in local regions (National Development and Reform Commission, 2012). Since the implementation of the “shopping basket program” project in 1988, China's vegetable industry has made significant progress. According to Table 1, the National Bureau of Statistics of China (2019) state that, in 2017, the seeding area of Chinese vegetables was 66,500 thousand hectares, an increase of about 80 per cent over 1988 and an increase of more than 14 per cent over 2011. From 2009 to 2018, China's vegetable production achieved a major expansion, reaching 70,346,200 tons in 2018.

**Table 1. Changes in vegetable planting area and yield in China, 2009-2018**

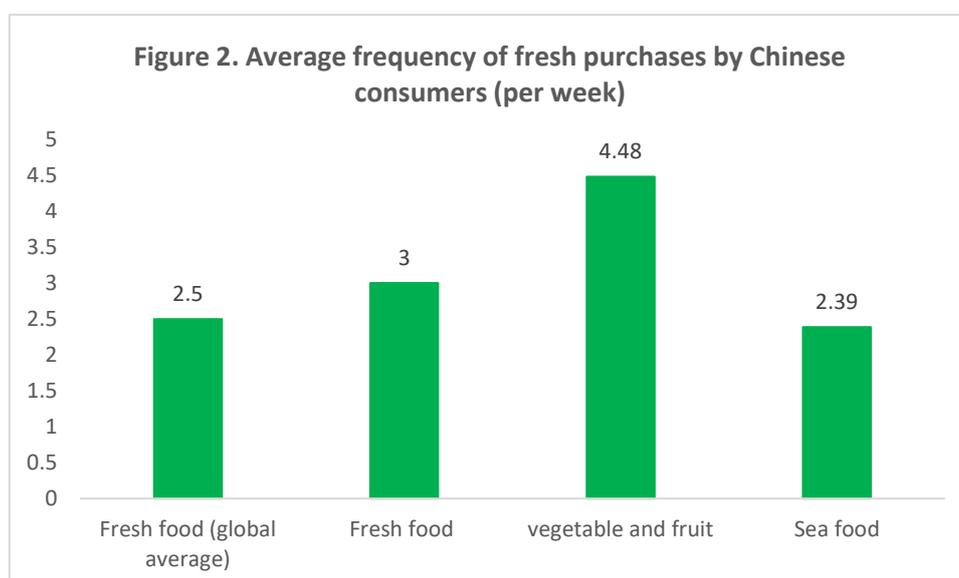
Year	Total output (thousand t)	Cultivated area (thousand ha)
2009	55,300.30	55,000
2010	53,030.86	57,000
2011	59,766.63	58,500
2012	61,624.46	60,000
2013	63,197.98	61,500
2014	64,948.65	63,200
2015	66,425.10	64,500
2016	67,434.16	66,000
2017	69,192.68	66,500
2018	70,346.72	

Source: National Bureau of Statistics of China (2019)

China's total vegetable production and planting area increased year by year, but the way of growing vegetables and the amount of demand has changed. On the one hand, urbanisation continues to expand. The area planted with vegetables is rapidly squeezed. Therefore, vegetable production begins to shift to the suburbs, and production is more dispersed (Dou and Shao, 2018). At the same time, the demand for vegetables by urban residents has continued to grow. People's living standard has been improved, and the demand for high quality and diversity of food has been increasing (Li, 2018). Many consumers no longer purchase vegetables that are only available locally. They prefer to buy fresh, less common, and more nutritious vegetables, such as organic or geographically grown vegetables. In addition, for those who like to pursue individuality, Li (2018) states that consumption of different products could also highlight individuality, which has also spawned a market for specialty agricultural products. Consumers are willing to spend money on these products. Figure 1 shows the rising trend of vegetable consumption in China from 2014 to 2018 (National Bureau of Statistic of China, 2019). However, comparing with Table 1 shows that the production of vegetables in China exceeds the consumption of vegetables. Many farmers do not have enough sales channels, and a large number of vegetables cannot be sold in time, so there is much waste. In addition, Figure 2 shows that in most daily foods, the frequency of fruits and vegetables purchased by consumers per week is the most, almost twice as many times as the global average fresh food (China Chain Operation Association, 2018). Vegetables, as a necessity of life, require a high degree of convenience in purchasing. It requires more vegetable sales methods to satisfy the demands of consumers in different regions.



Source: National Bureau of Statistic of China (2019)



Source: China Chain Operation Association (2018)

In recent years, with the rapid development of the vegetable industry in China, vegetable output has greatly increased. However, Zhang, Tang and Zhang (2017) note that such a large supply is still not fully in line with the market demand, leading to market imbalances from time to time. This results in supply shortages and price fluctuations, which hinder the healthy development of the agricultural economy and affect farmers' income and agricultural stability. The problem of vegetables being difficult to sell is the contradiction between the decentralised operation of agricultural production in China and the requirements of the national market. The regional nature of agricultural products is a universal problem in the agricultural product market and a challenge for farmers. Many vegetables have typical regional consumption characteristics due to the limitation of their origin, which means that some vegetables are only produced and sold locally (China Vegetable Network, 2008). For example, in areas where lakes are more common, the production of aquatic vegetables is high. But this could lead to

regional waste if local vegetable supplies exceed market demand and are not delivered to other markets in time. Shen and Mu (2013) show that the structural adjustment of agricultural production to demand is not working, and the system of information flows is not perfect. Therefore, there is an urgent need for a modern vegetable distribution system that increases the availability of vegetables across the country.

Due to the revolution of information technology, e-commerce has been developing rapidly (Huo and Sun, 2015). The world has entered a new era of the network economy. As the popularity and commercialisation of the internet have grown, e-commerce has flourished in various fields (Li and Huang, 2018). The development of e-commerce has triggered changes in economic theory, economic structure and economic growth. At the same time, Li and Huang (2018) suggest that e-commerce has also triggered changes in business operations, organisational structure and government-enterprise relationships. It directly leads to changes in the definition and process of relationships and activities among consumers, farmers and investors on the economic front. Following the establishment of a vegetable electronic trading market, farmers could plan according to online trading orders. Through big data monitoring, farmers could obtain consumer demand and shopping preferences in advance, and then start planting. The original "led by the market" behaviour has changed to the current "lead the market" strategy, significantly reducing the market risk (Li and Yang, 2012). An increasing number of consumers accept buying vegetables through online stores because they have more choices and could save shopping time (Li and Yang, 2012). Many businesses conduct e-commerce, creating their own brands or online stores. Xu, Ning and Wang (2018) show that the market size and growth rate of fresh food e-commerce are increasing year by year. More farmers like to sell their products to consumers through e-commerce. At the same time, they could clearly understand the market and know more information about competitors, such as product price and product sales volume (Zhang, 2017). Therefore, the development of e-commerce is not only a technical challenge but also a significant issue related to national economic and social development. Qin (2016) pointed out that it is of considerable significance for improving the industrial structure and improving the quality of the entire national economy. After several years of practice, China's e-commerce has developed rapidly and become more pragmatic.

In recent years, the agricultural sector in China has been used to promote the development of the Internet. The Internet is used to improve agricultural production, operation and management, foster a number of refined modern ecological agriculture models to accelerate the improvement of new agricultural production and operation systems, and promote significant agricultural modernization (The State Council of China, 2015). The Chinese government has encouraged Internet companies to set up agricultural service platforms to support family farms, farmers' cooperatives, and leading enterprises in agricultural industrialization and other new agricultural production and operation entities. This has been done to transform agricultural production from production-oriented to consumption-oriented. By improving the technology of agricultural production and operation, promoting the reform of agricultural production circulation and sales mode, agricultural production efficiency and value-added can be improved. At the same time, the Internet provides more comprehensive and convenient information for farmers' production and planting, which converts network technology into greater farm productivity (Zhou and Wang, 2015). Through the Internet,

farmers could get more information to optimize planting technology and improve production efficiency. Then, through the calculation of big data, they could obtain the preferences of consumers to carry out planned planting, reducing waste. Zhang (2018) indicated that e-commerce has formed standardized management and control over vegetable supply and sales due to the participation of Internet Plus. This makes the e-commerce operation and development of vegetables transparent from circulation to sales. While the operating cost of green vegetables is reduced and the cost is minimized, the transparent regulatory system also guarantees the quality of vegetables. Both sides of the transaction benefit (Zhang, 2018). Therefore, the internet has a positive impact on the development of electronic commerce.

The application of e-commerce in information technology and network technology has injected new opportunities for the progress of Chinese agricultural products, bringing vitality to the development of agricultural economy (Qin, 2016). At present, consumers who buy fresh produce online are mainly office workers who have no time to shop and consumers who want to taste unusual food (Tang and Sun, 2018). As with the regional restrictions mentioned above, some vegetables are not common in many places, and this is when electronic platforms are in place, and consumers offer them cheaply. Yang and Gao (2013) indicated that consumers could "shop" at home by using e-commerce platforms, which saves both time and effort. This is because consumers do not have to spend the energy and time to go to the market or shopping mall to order, buy and ship home. In addition, they will have more choice. Under this situation, they could compare both price and quality to buy better and more suitable products. As a result, such consumers will be more inclined to buy online. Figure 3 shows that more and more consumers choose to purchase fresh food via e-commerce platforms (Ai, 2018).



Source: Ai (2018)

Fruits are the most popular category among fresh online shoppers. About 32 per cent of fresh online shopping users choose to purchase fruits. Dairy and vegetables are second and third, respectively. Among them, the probability of purchasing vegetables is one-third that of fruit. The transition from the traditional vegetable product model to modern e-commerce transactions, shows the development

of China's vegetable market. Enterprises and individual farmers use advanced and convenient network technology to build an agricultural information application platform. Then, they realize online vegetable transactions by integrating various resources. This improves the efficiency of agricultural production in China and increases the development of the agricultural economy. Li and Yang (2012) believe that e-commerce has played a significant role in promoting the improvement of vegetable competitiveness, which will have a profound impact on the revolution and progress of Chinese agricultural economy.

Due to the perishable nature of many vegetables, the critical link in the supply chain and the most prone to problems is logistics. Therefore, the development of vegetable e-commerce is closely related to logistics, especially cold chain transportation, which occupies a prominent position. Fu, Zhou and Zhong (2019) explain that cold chain logistics could reduce the loss of fresh products, improve the distribution capacity of fresh products, maintain the quality of fresh products and break down trade barriers of agricultural products in the transportation of fresh products. According to Sun (2013), the cold chain logistics system has more restrict requirements in a variety of aspects. For example, it needs high requirements on facilities, large investment, and more comprehensive management requirements for each link. Besides, compared with developed countries, the proportion of fresh agricultural products circulating through the cold chain in China is relatively low (Sun, 2013). Most of the fresh agricultural products are still circulating at room temperature (Hong, 2018). The support for fresh e-commerce in the cold chain is insufficient. In addition, the high cost and the loss rate of the cold chain are also one of the reasons for the unsustainable growth of many vegetable e-commerce enterprises (Zhang, 2017). Therefore, research and improvement of cold chain logistics technology is essential for the development of the vegetable e-commerce industry.

The vegetable supply chain consists of producers, wholesale sales (primary and secondary markets), retail markets and consumers (Li and Yang, 2012). In some cases, there may be a tertiary wholesale market. Therefore, when vegetables reach the hands of consumers, the price may be much higher. Also, the seasonality of vegetable production is strong. There are two off seasons in the year. The variety and quantity of off-season vegetables are scarce, causing prices to soar. Li and Yang (2012) stated that the development of vegetable e-commerce could effectively solve this problem. For example, to establish a vegetable electronic trading market, growers can sell products based on online trading orders and then start planting. In addition, it can avoid cumbersome spot trading procedures and speed up vegetable circulation, thereby reducing circulation costs. Therefore, e-commerce can effectively solve the problem of high vegetable price fluctuations, high circulation costs, and low-season vegetables, bringing tangible benefits to the ordinary people and promoting the harmonious development of society (Xu, Ning and Wang, 2018). However, e-commerce is not an industry with only benefits. There are some problems that need to be improved. Li (2015) stated that the level of agricultural product standardization and branding is low, and the information flow between consumers and producers is not equal. Since China does not yet have sufficient regulatory measures and related laws to effectively monitor the online shopping process, making information asymmetry a prominent problem of online shopping. According to the monitoring data of the State Administration for Industry and Commerce of the People's Republic of China, in the second half of 2014, only 58.7 per cent of online trading products sampled were genuine (Zhang and Bao, 2017).

## **E-commerce Models**

Jiang, Zhang and Wang (2015) point out that the existing vegetable e-commerce models could be divided into three types: business-to-customer (B2C) e-commerce, vertical e-commerce and online-to-offline (O2O) e-commerce. Table 2 illustrates the essential information to explain these three different models (Xu, Ning and Wang, 2018).

### **Platform-type e-commerce**

The platform e-commerce defined here refers to an e-commerce website with a complete business category. Fresh vegetables are only part of the business categories such as Taobao fresh and Jingdong fresh.

#### ***B2C e-commerce example - Taobao eco-agriculture website***

This analysis uses Taobao as an example to illustrate the process and characteristics of the vegetable e-commerce platform. Taobao launched the Taobao Eco-Agriculture website in June 2012 to provide an absolute scale of the sales platform for farms, tea gardens and orchards. Jiang, Zhang and Wang (2015) show that Taobao Fresh website divides all products into five categories: organic food, green food, pollution-free food, ecological food and original agricultural products. There are corresponding product categories under each category (Yang and Gao, 2013). The site classifies vegetable products as fresh fruits and vegetables. The operating models of Taobao Ecological Agriculture Website and Taobao Network Operation Mode are all selling products in the form of stores. The merchant could determine the shipping method and scope of the goods.

The main types of vegetables sold on the eco-agriculture website are rhizomes, onions and ginger vegetables because such vegetables are frequently used and are not geographically restricted in taste (Jiang, Zhang and Wang, 2015). Therefore, it is less affected by external factors. During distribution, cooling is not required for transportation and storage, and long-term storage is more accessible to achieve (Zhang, 2017). Therefore, the losses suffered are relatively small. In addition, the sales performance of well-known farms or distributors is relatively high, whether it is the root or onion ginger vegetables mentioned above, or the vegetables with prominent regional characteristics (Yang and Gao, 2013). Vegetable products and brands have a particular reputation. Therefore, the online store has a relatively large number of customers, which can guarantee stable online store sales. At the same time, Yang and Gao (2013) state that the eco-agricultural website and Taobao do not provide a unified logistics system for merchants entering the platform. Some dealers have their own staff in the designated area to deliver online store orders. More online merchants will choose third-party logistics service to deliver goods (Jiang, Zhang and Wang, 2015).

### **Vertical e-commerce - the website of the company**

Vertical e-commerce refers to vertical websites that focus on food and fresh food, such as Zhongliang Womai, Orchard every day, Easy fruit fresh, Good fresh every day.

Table 2. Fresh e-commerce business model comparison

Model	Examples	Method	Category of products	Logistics	Advantages	Challenges
Platform-type e-commerce	Taobao fresh, Jingdong fresh, Suning fresh	Open fresh food channels, licenced third-party merchants are permitted to operate via the platform	The category, SKU* at the level of ten thousand	Coverage: > 10km, delivery time: 1-2 days, the product could be delivered in 2 hours.	1. Abundant flow of clients 2. Strong brand advantages 3. Early user habits 4. Enough integrity	1. Lack of quality standards 2. Difficult to control the quality of fresh products sold by individual merchants 3. Loss of commodities 4. Logistics problems
Vertical e-commerce	Zhongliang Womai, orchard every day, Easy fruit fresh, Good fresh every day	Vertically integrated supply chain	Multiple/full category, SKU in the order of thousands	Coverage: 3-5 km. Delivery time: generally, 1-2 hours.	1. Able to control the whole supply chain and gain price advantage 2. The deep subdivision is conducive to ensuring product quality and user experience	1. No early accumulation in food suppliers 2. The company's expansion speed is limited by the workforce and financial resources required by logistics distribution 3. High cost and difficulty in obtaining users' trust in the later stage 4. the strength is not strong, cold food storage difficult to meet the standard
O2O e-commerce	7Fresh, Super species, Hema fresh	The storefront model, stores are both warehouses and retailers, selling one-stop small package goods for family consumption, combining with catering	Fresh products, SKU is about 500-1000	Coverage: 3-5 km, delivery time: 1-2 hours; Some take 30 minutes	1. Quick response 2. More transparent 3. Enrich consumption scenarios and improve user experience	1. The construction cost of supply chain and logistics is relatively high, and the early-stage investment is relatively large, which requires a lot of resources to be integrated, making it difficult to standardise 2. Low gross profit and high loss 3. Users' consumption habits need to be cultivated

Source: Xu, Ning and Wang (2018)

SKU\*: stock keeping unit; It is defined as the minimum available unit in inventory management

Vertical e-commerce websites mainly provide one-step in-depth services for product types in specific industries (Wang and Zhao, 2016). In April 2010, Zhongliang Womai launched an online supermarket specialising in fresh food. The site divides vegetables into 13 categories, including specialty vegetables, herbs, organic vegetables, roots, tomatoes and leafy vegetables (Jiang, Zhang and Wang, 2015). Among them, specialty vegetables, organic vegetables and quick-frozen vegetables are produced by agricultural product distributors and workers. Other categories of vegetables that are co-supplied come from the company's farm. The operation of all farms is directly controlled and managed by the labour association. From breeding, fertilisation to pest control, there are strict standards in all aspects to ensure product quality (Wang and Zhao, 2016). The company has two distribution stations in Beijing and Shanghai. The distribution area of fresh products in Beijing is self-operated. Other regions are distributed by third-party logistics companies, Yuantong Express and SF Express. In addition to the Shanghai area, Shanghai's on-site distribution is through Shanghai's logistics and distribution, and other areas are provided by another logistics company, SF Express. Large e-commerce platforms such as Jingdong mall have self-operated logistics, while other small and medium-sized platforms rely more on the third-party logistics model. As shown in Table 3, although the self-operated logistics could respond to customer feedback in a timelier manner, small and medium-sized enterprises face higher costs (Liu, 2017). Therefore, the choice of third-party logistics is more in line with their development needs. Ge, Wang and Tang (2018) explain that after the consumer places an order, the e-commerce site decides which delivery method to use based on the location of the consumer.

**Table 3. The difference between self-operated logistics and third-party logistics**

	Model	Advantage	Challenge
Self-operated logistics	Industrial enterprises operate their own logistics Such as: Jingdong Express	1. All process are controlled by the platform, which is highly controllable and easy to manage. 2. Timeliness of delivery 3. Making adjustments according to customer feedback in time.	1. High cost, a lot of expenses, high labour cost, low constraint.
Third-party logistics	Enterprises specialize in logistics Such as: Yuantong Express and SF Express	1. Strong professionalism. The transfer of logistics risks can be achieved. 2. Save costs and labour. 3. Timeliness of delivery	1. Receipt of receipts are difficult to follow up and poor controllability. 2. Cannot communicate and maintain with customers.

Source: Liu (2017); You (2013)

### **O2O e-commerce - Hema fresh, vegetable bag website**

The O2O fresh e-commerce defined here is a combination of online and offline approaches used by fresh sellers in sales, ordering, distribution, collection and promotion. This combination of online and offline e-commerce models can be combined in a variety of ways to flexibly select the appropriate O2O model based on the participants' existing resources and market needs (Ge, Wang and Tang, 2018). Zhu and Wang (2018) point out that there are two standard O2O models. One is the O2O membership order delivery service that large supermarket chains use based on their store sources and customer sources. Another is that consumers place orders on supermarket websites or mobile applications, such as Hema Fresh, Yonghui Supermarket, Sam Online Shopping and Fresh Marina. It is a combination of

store and self-service delivery initiated by e-commerce companies (Ge, Wang and Tang, 2018). It is currently the more popular vegetable e-commerce model.

The general O2O model website divides vegetables into four categories: green leafy vegetables, rhizome, pepper/bacteria and beans/onion ginger (Jiang, Zhang and Wang, 2015). The source of fresh vegetables in vegetable bags is from its production base and collaborative supply base, and processed vegetables come from suppliers such as Chaoda Modern Agriculture Group. Ge, Wang and Tang (2018) observe that customers could choose the vegetables they want on the platform, and the merchants will pack them and deliver them to the pick-up point. The pick-up point could be rented in certain community stores to cover a delivery area. Each pick-up point store has professional storing equipment and computer monitoring system that make it easy to order food for customers (Jiang, Zhang and Wang, 2015). Customers can also place orders on-site at the store's computer system. Zhu and Wang (2018) state that this kind of "store + self-delivery" combined with O2O e-commerce enables consumers to order online and deliver goods offline and choose delivery times that are more flexible. For operators, logistics costs can be reduced, as delivery can only be organised for designated locations, not door-to-door allocation.

According to the data in Figure 4, from 2013 to 2020, the market size of O2O has been increasing substantially (China Chain Operation Association, 2018). In 2015, the size of China's community O2O market was 51.8 billion yuan. In 2018, the market size will exceed 700 billion yuan, and by 2020, it is expected to reach 224.2 billion yuan.



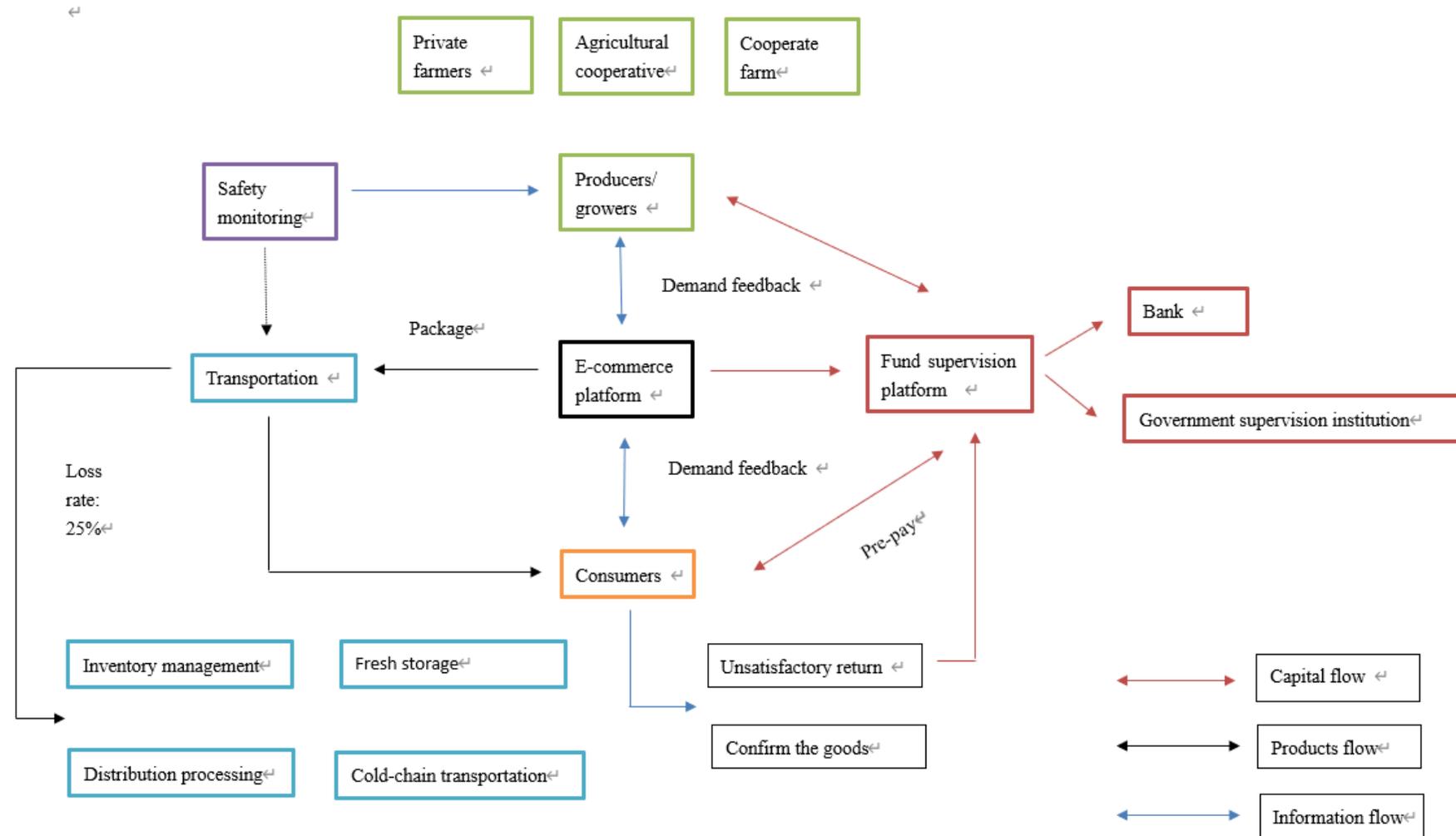
Source: China Chain Operation Association (2018)

## Value Chain

A representation of the current Chinese vegetable e-commerce value chain is shown in Figure 5. Its main features are:

1. The participating entities in the entire chain communicate through the network platform to realise the efficient flow of information. The e-commerce platform can provide a wide range of products for consumers to choose from without going out the door. In addition, producers could more accurately meet the needs and preferences of consumers and avoid waste in production. The new vegetable

Figure 5. Existing vegetable e-commerce value chain in China



Source: developed by the author

industry chain removes most of the intermediate links in the original traditional industrial chain, enabling producers and consumers to communicate directly through the online platform. The platform is unified for consumer sales, which reduces the cost of sales of products and achieves a win-win situation.

2. In this new vegetable industry chain, the first task is to find the market, and then to set production. This breaks the original traditional industrial chain model of production first and then sales. Consumer groups through the platform participant in pre-sale programs. The platform feeds back the demand to the producers. The producers adjust the planting output according to the demand. The chain is user-centred and market demand-oriented using internet-based thinking. This customer-oriented market can effectively reduce the risk of planting and better solve the sales problem for farmers. This is important information that helps some processing enterprises and farmers to dissolve production risks, increase production and income and increase efficiency.

3. The production, storage and transportation of products are all standardised and managed with safety standards set by the e-commerce platform centre. These detection and control systems also apply to individual producers. This is because both individual producers and enterprises need to attach to the e-commerce platform. The safety inspection centre commissioned by the e-commerce platform center conducts unified food safety testing to guarantee the quality of the productions.

4. Compared with the traditional vegetable industry chain, there is one more participating party, namely the third-party fund supervision platform, in the new vegetable industry chain. This fund supervision platform manages the deposit paid by the consumer in advance. When the producer supplies the corresponding quality and quantity of products, the deposit and payment can be received. Therefore, to a certain extent, the third-party fund supervision platform has played a role of guaranteeing funds, ensuring the security of transactions between the two parties and reducing the occurrence of transaction disputes.

5. The new model increases product diversity and consumer willingness to pay (WTP). With vegetables sold in traditional markets, consumers are limited to a fixed area, such as in a city or on a street. However, e-commerce customers could be distributed throughout the country. For example, some vegetables grown in southern China are not available in northern China. E-commerce offers a platform for northerners to search for and buy these products. In addition, consumers in the north have higher WTP expectations for these products than local consumers, as consumers are more willing to buy unusual foods. To some extent, it could alleviate supply problems caused by vegetables which are only planted in particular regions. Consumers could purchase vegetables from many different areas to satisfy their demands.

This framework applies to the three circulation modes mentioned in Table2. Even though there are some differences in the specific operation process of these three modes, the basic framework is the same, which consists of the producer, consumer, transportation and fund supervision platforms around the e-commerce platform. These objects in the value chain are the basic and indispensable links required by e-commerce. This is because no matter whether the producer is a farmer or a company, in these three modes, it is necessary to communicate and trade with the consumers through the e-commerce platform. Whether the merchant adopts self-operated logistics or third-party logistics, the main logistics technology is still cold chain transportation. There is not much difference in transportation refrigeration technology and loss rates. In addition, the bank and the government as the supervision of financial institutions is also an inevitable important part of e-commerce. This ensures protection of personal interests in case of disputes.

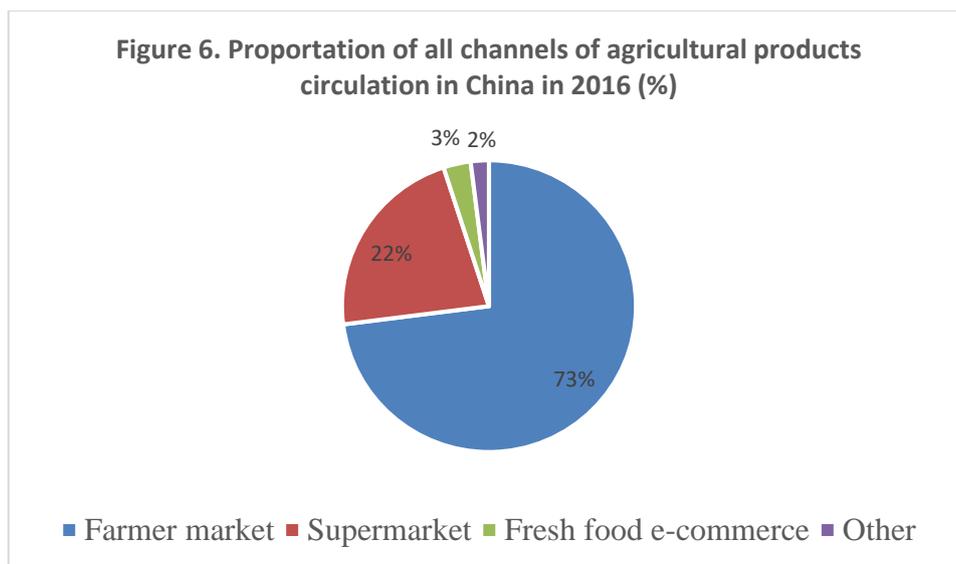
Table 4 contrasts the differences between various types of vegetable market models (Long and Wang, 2014). According to this table, the circulation model of e-commerce has many advantages. The most essential point is that circulation time and charges in the e-commerce model are lower than those in other models. Long and Wang (2014) note that the normal vegetable circulation model includes the links of farmers, markets or centralized vegetable sales points, secondary wholesale markets such as wholesale markets of producing areas and wholesale markets of selling areas, retail markets, logistics companies, and consumers. There is no direct connection between the producer and the consumer. However, the e-commerce mode of vegetable circulation is mainly based on the contractual relationship between sales and purchase. Whether the platform has a policy of making profits for suppliers is the key to attracting suppliers. However, the relationship is not very stable. Because of the increasing number of platforms, the right to choose suppliers also increases. Therefore, the number of goods on the e-commerce platform also fluctuates.

**Table 4. Compared with the characteristics of the vegetable circulation model**

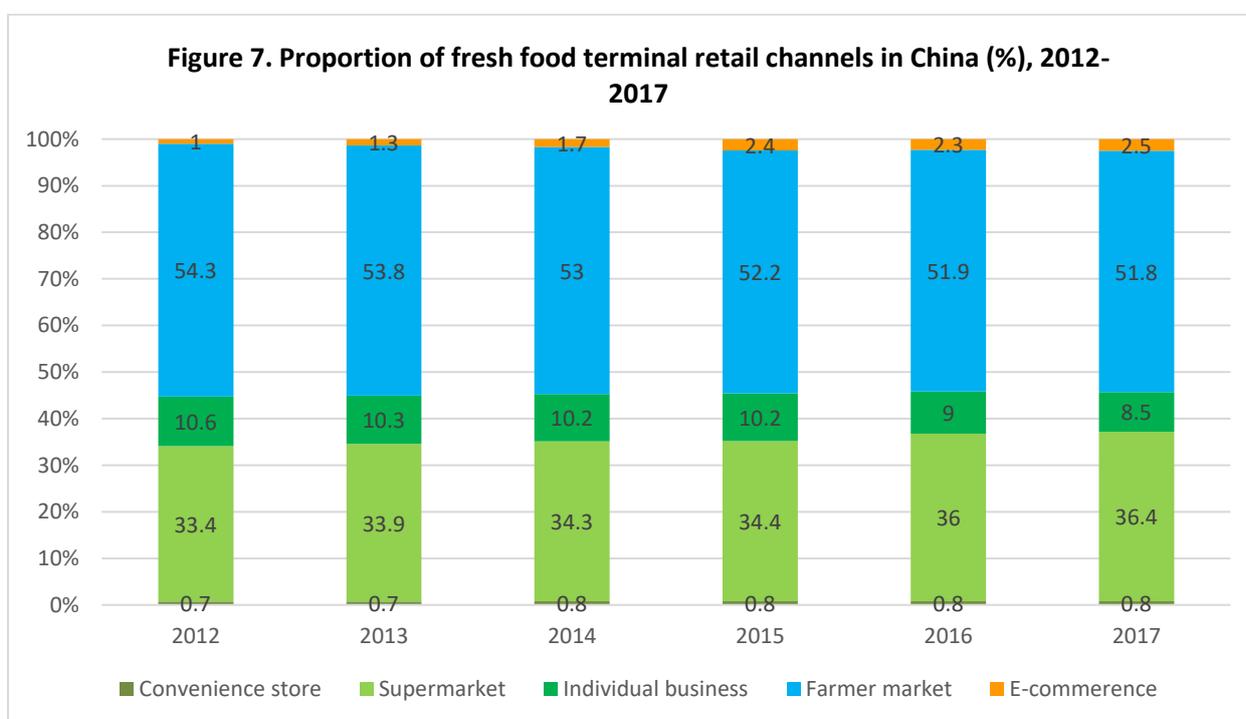
Model	Vegetable level	Inter- mediate links	Circulation time	Trade relationship	Transaction costs	Quality and safety
The wholesale market	Normal vegetable, an abundant variety	5-7	Relatively long	Business relationship, unstable	Relatively low	Limited control
Processing enterprises	Normal vegetable, special vegetable, high grade vegetable	3-5	Changeable	Contractual relationship, very stable	High	Very strict control
Logistics distribution center	Normal vegetable, high grade vegetable	3-5	Relatively short	Cooperative relations, relatively stable	Relatively high	Strict control
E-commerce	Special vegetable, high grade vegetable	3-4	Short	Contractual relationship, not very stable	Relatively low	Strict control

Source: Long and Wang (2014)

In the downstream circulation of agricultural production, the farmer's market still plays a leading role. According to the data in Figure 6, China Chain Operation Association (2018) present that in 2016, 73 per cent of agricultural products were distributed to the consumers' table through farmer's markets. The proportion of circulating goods to the end consumers through large supermarkets was 22 per cent, and the share of fresh e-commerce accounted for 3 per cent. As shown in Figure 7, fresh and healthy foods are undergoing significant and lengthy channel changes (China Chain Operation Association, 2018). The trend is that the farmer's market has further declined as a traditional distribution channel, and its market share has been replaced by more efficient and advanced modern circulation channels. The transformation of the farmer's market is imperative. As a result, the share of e-commerce is gradually increasing, from 1 per cent to 2.5 per cent.



Source: China Chain Operation Association (2018)



Source: China Chain Operation Association (2018)

### E-commerce in Vegetable Markets

Lu (2013) explains that the agricultural product supply chain is a network-chain system consisting of agricultural producers, agricultural product processing enterprises, distribution centres, wholesalers, retailers and consumers. Distribution services include raw material procurement, manufacturing, storage and transportation, distribution and sales. E-commerce and the supply chain are complementary. In the study of supply chain, by enhancing e-commerce capabilities and improving the level of collaborative operations, Li (2011) states that it could help improve supply chain performance. The operation of the supply chain allows enterprises to produce according to market demand. Effective information transmission lays a good foundation for the operation and logistics of

e-commerce (Ge, 2018). Internet and e-commerce could promote information sharing and optimise the vegetable supply chain from the beginning to the terminal (Lu, 2013).

### **Features of e-commerce**

1) In the current vegetable market, circulation patterns are influenced by participants and geographical location. This means that in addition to the diversity of circulation modes caused by different transaction arrangements and combinations among producers, middlemen, suppliers and consumers, the circulation modes will also be different due to regional differences (Wang and Zhao, 2016). For example, Shanghai Green (a type of vegetable in China) is mainly grown in east China, where the local people eat a lot, but consumers in the south also buy them. Therefore, Shanghai Green will be transported from east China to the south. At present, the vegetable source channels on the market are rich and varied. Some vegetables are purchased in the local market and others are purchased from other places. Wang and Zhao (2016) proposed that the proportion of the number of vegetables transported from other areas to the local market in the total circulation of the whole vegetable market shows an apparent rising trend. The increasing proportion is related to the rapid development of e-commerce.

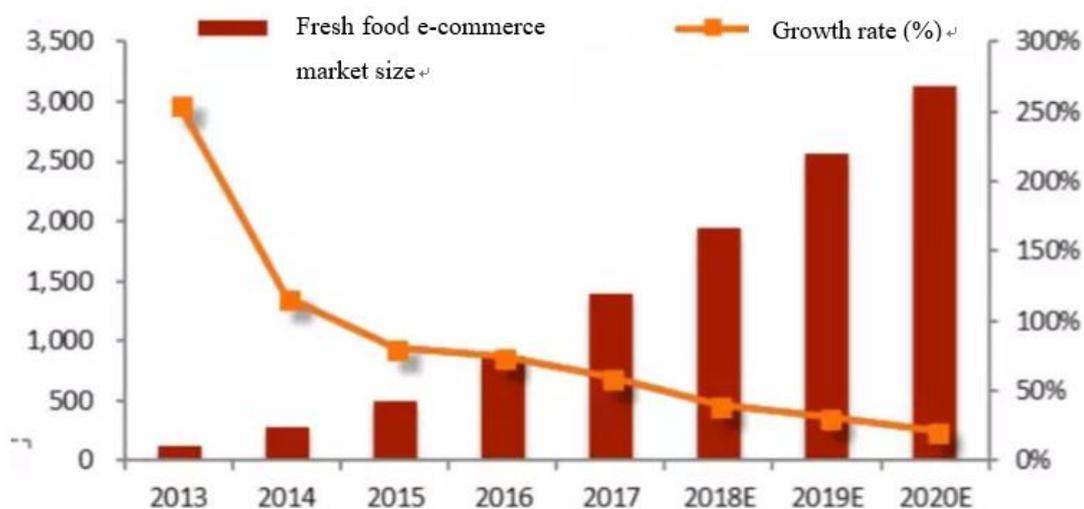
2) The number of direct stores in the e-commerce model has increased. In all small and medium-sized cities, people will see more and more vegetable-operated stores springing up (Tang and Sun, 2018). With the expansion of the scale of operations, the sales model of these directly operated stores is gradually expanding. Li and Yang (2012) show that these direct-sale stores sell fresh vegetables to consumers through various channels such as internet and telephone, and provide home delivery services to realise one-stop delivery of vegetables from farm to home. In addition, in order to better promote and sell products, farmers began to choose live streaming which is a new channel attached to the e-commerce platform such as Taobao and Douyin. In the studio, producers display their products, allowing consumers to see the quality and freshness of vegetables visually. Liang (2020) states that through this new mode of direct supply and online sales, more farmers have found new market space.

3) With the continuous growth in the number of internet users, the demand for online shopping has also increased. An increasing number of consumers are choosing to purchase fresh food on the e-commerce platform. At the same time, traditional fresh product marketing models are no longer able to meet growing demand and evolving markets. E-commerce is beginning to compete for the share of the traditional fresh food industry. As can be seen from Figure 8, Xu, Ning and Wang (2018) show that the e-commerce market for fresh foods is expanding. Comparing 2013 to 2019, the growth rate of the emerging e-commerce market has exceeded 200 per cent. It is estimated that by 2020, the number of emerging e-commerce platforms will exceed 3,000. Although the number of e-commerce platforms is growing steadily, the growth rate is gradually slowing down. It shows that the fresh e-commerce market is gradually being saturated, and competition is gradually increasing.

### **Advantages**

In general, e-commerce has the following advantages over traditional business methods in relation to vegetable markets in China:

1) It could help vegetable businesses to simplify and integrate various links in the supply chain into a whole, as well as speed up the flow of funds. In an e-commerce environment, companies can effectively integrate and utilise information from multiple sources and build their electronic networks through the network (Huo and Sun, 2015). E-commerce can promote business cooperation, establish

**Figure 8. Fresh food e-commerce market size and growth rate (%), 2013-2020**

Source: Xu, Ning and Wang (2018)

business and customer and internal business process reorganisation (Qin, 2018). It enables resource sharing and flat management, ultimately achieving the best combination of production, inventory, sales, finance and human resource management. Logistics, information flow and capital flows have maximised the effectiveness of ideal supply chain operations (Zhang, 2017). E-commerce also accelerates the flow of funds. Wang and Wang (2016) state that the turnover of funds in e-commerce does not need to be carried out between customers, wholesalers, shopping malls outside the bank, but directly through the network on the internal accounts of the bank. It dramatically speeds up the turnover of funds and reduces commercial disputes.

2) It is possible to reduce intermediate links and obtain higher profits. Vegetable supply is characterized by a long production cycle and a short market life cycle. The vegetable supply chain must shorten the chain and avoid waste. E-commerce does not require wholesalers, specialty stores and shopping centres to reduce product cycles. Customers can order the products they need directly from the manufacturer via the web (Wang and Wang, 2016). E-commerce can broaden sales channels and markets for enterprises and maximise the supply and demand information on vegetables. Therefore, enterprises or farmers can organise production and processing according to actual conditions, thus avoiding risks. Hu (2017) states that by redesigning the distribution process and reducing the circulation middle layer, price differences could be avoided. Restructuring the supply chain and supply chain network strategies can improve supply chain efficiency and supply capacity, and achieve higher profits (Lu, 2013).

3) Zhang's (2017) research shows that companies can learn about competitors' information, such as performance, product prices, and product sales. It can help companies promote transformational technology and improve product competitiveness.

4) Customer choice can be increased, enhancing customer and vendor communication. E-commerce provides a wide range of choices for consumers' needs through the internet, allowing them to choose and buy satisfactory products without leaving their homes (Li and Yang, 2012). Customers could also make their own needs through e-commerce and order their favourite products. Manufacturers could spend less time on understanding the demands of users, thus avoiding waste in production.

## Major Challenges

### Vegetable cold-chain logistics facilities are inadequate and costly

In recent years, more and more e-commerce companies are operating in the fresh fruits and vegetables market. There are nearly 4,000 fresh electronics businesses in China, of which 7 per cent are making huge losses, 88 per cent are making small losses, 4 per cent are stable, and only 1 per cent are profitable (Zhang, 2017). The biggest problem is cold chain logistics. Fruit and vegetable products are different from other products. Fresh products have the characteristics of perishable, short shelf life and natural deterioration so that the requirements for cold chain logistics facilities and logistics distribution are high. Therefore, it is essential to ensure that the product has sufficient freshness during the transportation process for vegetable e-commerce. Hu (2017) believes that in the process of warehousing, transportation and distribution, it is easy to cause product loss. Some measures and methods must be taken to solve this problem. Zhang's (2017) research shows that the cost of fresh cold chain logistics is 1-2 times that of ordinary commodities, and the cost of cold chain generally accounts for 25 - 40 per cent of the total cost. Therefore, for e-commerce of vegetable agricultural products, cold chain logistics construction costs and expenditures are higher, and the recycling cycle is longer. In addition to this, the loss rate is another barrier to the development of Chinese cold chain technology. As can be seen from Figure 9, due to the lack of strong technical support and mature market experience, China is relatively backward in controlling fresh loss rate compared with developed countries, such as Europe and America (Xu, Ning and Wang, 2018). Through the improvement of cold chain logistics technology and cold chain distribution technology, European and American countries can control the loss rate of fresh products to a stable level of 5 per cent. The loss rate of other foods also fell below 1 per cent. However, the average loss rate of fresh Chinese produce is close to 25 per cent, which dramatically increases the cost of the fresh market. In addition, due to the low usage rate of China's cold chain logistics in the transportation of fresh food, the loss rate of food in circulation is high. In Figure 10, Xu, Ning, Wang (2018) pointed out that the utilisation rate of fruits and vegetables in cold chain logistics is only 5 per cent, resulting in the loss rate of fruits and vegetables in circulation is much higher than that of meat and aquatic products, up to 25 per cent. Most vegetable product manufacturers and e-commerce platforms cannot afford such costs.

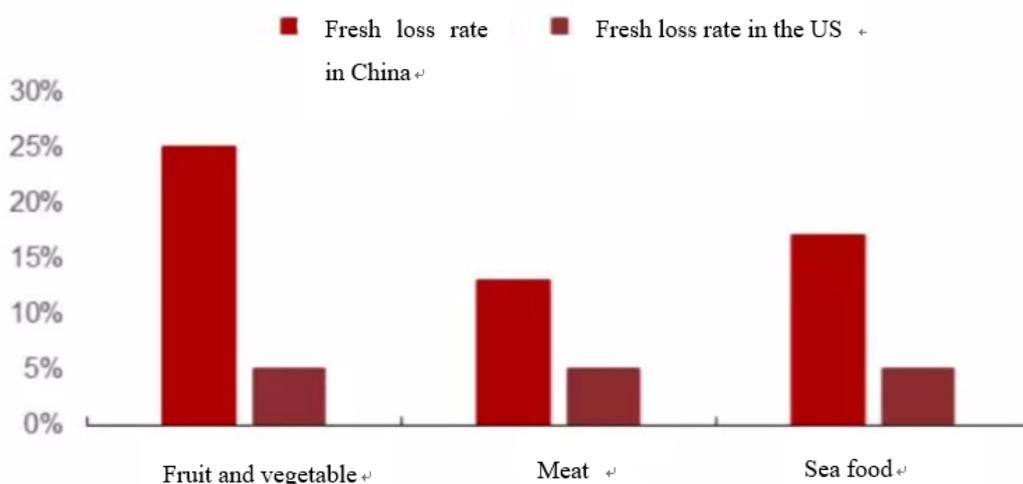
### Consumers' e-commerce consumption habits for fruit and vegetable agricultural products

While e-commerce in vegetables has a promising future, the online consumption habits of agricultural vegetable products have not been fully cultivated. Table 5 shows that most consumers prefer to purchase vegetables from supermarkets and farmer markets (Meng, 2016). Only 21.67 per cent of people would like to try to purchase vegetables through the e-commerce platform.

Figure 11 shows that there are many reasons led to this situation (Meng, 2016). The main element for not choosing an e-commerce platform as the channel to purchase vegetables is that consumers are most concerned that they cannot guarantee the quality of vegetables without choosing them in person. Besides, consumers purchase vegetables online for convenience, but long-distance delivery could lead to a decrease in the quality and freshness of vegetables. This will make consumers hesitate to buy vegetables through e-commerce. In addition, the consumption of vegetable agricultural products started by e-commerce is mainly targeted at young people (Jinzhun data, 2019). However, according to the survey, the majority of people who buy vegetables are Chinese middle-aged and elderly people, accounting for 44.72 per cent, and the proportion of young people is about 20 per cent (Meng, 2016). For the elderly who are not familiar with the Internet, it is challenging for them to purchase vegetables or agricultural products through mobile phones or computers. Therefore, the e-commerce consumer

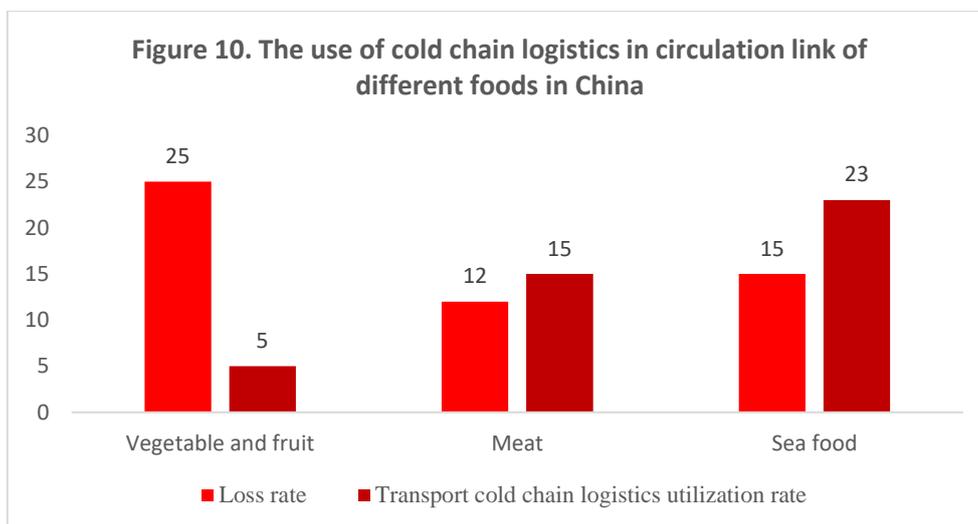
market of agricultural vegetable products still needs a long-term cultivation process.

**Figure 9. The comparison of fresh food loss between China and the US**



Source: Xu, Ning and Wang (2018)

**Figure 10. The use of cold chain logistics in circulation link of different foods in China**



Source: Xu, Ning and Wang (2018)

**Table 5. Consumers' awareness and attitude towards vegetables purchased online**

Classification indicator	Statistical characteristic	Number (people)	Proportion (%)
Whether heard of buying vegetables online	Yes	97	27.00
	No	263	73.00
Whether tried buying vegetables online	Yes	78	21.67
	No	282	78.33

Source: Meng (2016)



Source: Meng (2016)

### **Market homogeneity is serious, and competition is fierce**

Most of the fresh agricultural product e-commerce companies are concentrated in developed cities such as Beijing, Shanghai and Shenzhen. Most of the companies in other regions rely on e-commerce platforms such as Taobao to conduct transactions (Zhang, 2017). The products are mainly root vegetables such as onions and ginger. Product homogenization is very serious, which makes the same type of e-commerce enterprises form a fierce competition. Zhu and Wang (2018) point out that coupled with the high cost and low unit price of the e-commerce industry, although the emerging e-commerce companies may have strong capabilities, they will ultimately have the challenge of reducing overall profitability.

### **The part of supply chain in vegetable is still unclear, and the distribution efficiency still needs to be improved**

In the Internet age, everything from organization, warehousing, transportation, distribution to direct customer is closely connected. However, according to the current development scale of fresh vegetables in China, the degree of coordination of circulation channels of most fresh vegetables is not high enough (Zheng, 2017). There are still problems in the connection between each link, which will also affect the efficiency of fresh vegetable circulation. Zhang (2017) said that although some e-commerce platforms could provide some support, there are still many manual methods and manual judgments throughout the circulation process and the distribution efficiency needs to be improved.

### **Product standardisations are difficult to unify**

There are many varieties of agricultural vegetables, so there is no uniform standard or technology to measure the quality of products. Even for the same vegetables, it is difficult to uniformly measure them due to their different sources and origins (Zhang, 2017). For example, the cabbage in the south and the north will not have the same taste and shape because of the different geographical locations. Therefore, it is difficult to form standardized operations, nor can it improve operational efficiency and management quality. At the same time, it also makes it difficult for consumers to make horizontal comparisons and judge pros and cons (Wang and Zhao, 2016). In addition, it may even mislead consumers, which affects the positive formation of consumer experience and consumer reputation

(Wang and Zhao, 2016). Electronic platforms need to develop separate standards based on different products (Wang and Zhao, 2016).

### **Farmers' use of electronic products is still in its infancy**

Due to limited education, the cultural quality of farmers is generally low so that they do not have the capacity to receive new technologies and new information (Li and Huang, 2018). In a systematic network trading platform, Wang and Zhao (2016) point out that the e-commerce platform needs specialised technical personnel to build the platform from the construction of the network to the warehousing and logistics of the products. The daily maintenance and repair of electronic products also require specialised technicians. Li and Huang (2018) note that skilled people who understand e-commerce technology are reluctant to serve in rural areas. This has caused a severe shortage of rural e-commerce application technicians, which has seriously hindered the development of rural e-commerce platforms.

### **Suggested Improvements**

#### **Establish an efficient vegetable supply chain to control circulation costs**

Advanced information technology and preservation technology should be widely used to ensure the freshness of vegetables and control the circulation cost of vegetables. Vegetable e-commerce companies can use supply chain management with information technology to achieve integration of production and sales. Xu, Lin, and Luo (2014) explained that while vigorously developing vegetable cold chain logistics technology, recyclable packaging materials can be used to reduce packaging costs. In the supply chain, vegetable e-commerce companies use e-commerce to effectively integrate upstream and downstream links and reach solutions to optimise logistics and distribution (Lu, 2013). By reducing intermediate links in circulation, companies or individual producers can be helped to reduce the cost of vegetable losses. After reorganising the supply chain and unifying the upstream and downstream of the supply chain, vegetables can be delivered to consumers at the most affordable price (Zhu and Wang, 2018). At the same time, the participants in each link of fresh vegetables should experience the importance of mutual cooperation, so as to further improve the flow efficiency of fresh vegetables (Zheng, 2017).

#### **Establish a vegetable quality and safety system**

Vegetable e-commerce enterprises should establish large-scale standardised production, improved inspection and testing standards and systems, and a complete quality traceability system (Xu, Lin and Luo, 2014). First of all, Zhu and Wang (2018) point out that vegetable e-commerce enterprises should strive to promote the standardised production of vegetables and promote brand building. This would be by encouraging growers to develop pollution-free, green and organic vegetables and actively promoting scientific vegetable cultivation methods. The second step is to improve the vegetable inspection and testing system. Li and Huang (2018) indicated that they should set up an inspection department within the vegetable e-commerce enterprise to strengthen the supervision and management of the quality and safety of vegetables on this website. The government encourages vegetable growers to strengthen self-examination and use third-party testing agencies to speed up the formation, testing and testing of vegetable quality and safety. The third step is to improve the quality traceability system. In this case, the effective connection of vegetable production, processing and distribution, and the clarification of the quality and safety responsibilities, can be achieved (National Development and Reform Commission, 2012).

### **Market segmentation, aiming at high-end consumption**

Vegetable e-commerce should target the middle class as a target customer base. The middle class has a high level of education, good economic foundation, ability to pursue a higher quality lifestyle, and focus on health (Xu, Lin and Luo, 2014). For low-income families, they think online shopping is expensive. Therefore, they will not regard vegetable e-commerce as the leading way to buy vegetables. However, for the rich, they want to enjoy high-quality special food. In this respect, they are more interested in vegetable e-commerce. Therefore, the growth and development of the middle class will promote the development of vegetable e-commerce (Zhu and Wang, 2018). The vegetable industry e-commerce positioning provides consumers with high-end safe and quality vegetables. Compared with the traditional meat market and other farmers' markets, vegetable e-commerce companies are more likely to control the quality of vegetables from the source (Li and Yang, 2012). Strict inspection standards and access conditions improve the quality of vegetables, thus ensuring the safety of vegetable consumption.

### **Vigorously cultivate rural e-commerce talent**

Li and Huang (2018) explain that with the "Talent Introduction Program" and "College Student Village Program", which are vigorously promoted by the state, more high-quality and high-tech skilled technicians can be attracted to the countryside. It will speed up the solution to the shortage of rural talent and the backwardness of technology. Farmers can truly feel the changes brought by the internet to people and understand the future development trends of rural e-commerce platforms (Li and Huang, 2018).

### **Conclusion**

Although China's vegetable e-commerce application has achieved good progress, there are still some problems in the actual operation process. This model could save transaction costs, shorten distribution channels, and reduce circulation costs. However, due to the characteristics of vegetables, the requirements for the environment and offline distribution are very high. If one of the links is flawed, it may lead to poor customer experience, which will reduce consumer trust in online agricultural products. Therefore, local governments need to strengthen the construction of cold chain transportation, promote the industrialization of vegetable and agricultural products, and promote the stable development of the agricultural economy. Moreover, from a holistic point of view, although the time for the internet to join the agricultural industry is relatively recent, participation is still rising, which has prompted the continuous development of agricultural e-commerce. This shows that the future development prospects of the vegetable e-commerce marketing model are positive. In this process, e-commerce marketing of vegetables needs to continue to improve the entire standardization system. For contemporary society, e-commerce will provide more opportunities and guarantees for Chinese farmers to increase their income.

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