# E-commerce in Fresh Food Supply Chain in China and its role on Quality performance

Mengyun Zhou[1] and Luisa Huaccho Huatuco[2]

[1]Leeds University Business School, University of Leeds, Leeds, LS2 9JT

[2]The York Management School, University of York, York, YO10 5GD

**Summary**

E-commerce companies have experienced a competitive environment in China, large companies benefit from more funding and talent, which puts a huge burden on small and medium size companies to find an effective way to manage quality with less investment. This paper gives a fresh food SC system's view and analysis of improving fresh food quality.

This paper focuses on small and medium-sized enterprises to analyse how companies can improve product quality through effective supply chain management, while ensuring the company's profitability. Using interviews with knowledgeable middle level managers in the SC, an analysis is carried out. The findings could help e-commerce companies in China strengthen their SC network and offer better quality standard of fresh food. Scarce literature discusses about fresh food e-commerce SCs in China, this research developed a basis background and knowledge. Nowadays, technology changes SC in various ways, this research explored how the advanced technology can be applied in fresh food SC. Some recommendations to companies that operate in this sector are provided. The limitations and future research directions of the fresh food supply chain are drawn.

**Track:** Performance Management.

**Paper type:** Full paper.

**Keywords:** supply chain, fresh food, quality, e-commerce, qualitative.

**Word count**: 7575 words (excluding Title/Summary, References, Figures and Tables).

## 1. Introduction

In recent years, e-commerce has gained wide popularity around the world, especially in China, the increasing number and popularity of online shopping has contributed to the reform of purchase methods. In 2016, China's total online sales were almost twice of that in the United States (Shi *et al*., 2019) and continue to grow at a rate of 30% (Yu, 2018). Fresh food as one of the popular types of online shopping also experienced explosive growth, the demand for fresh e-commerce currently the fourth largest among all e-commerce categories (Guo *et al*., 2017), from total sales of 0.55 billion in 2012 to 236.6 billion in 2018 (iresearch, 2019). E-commerce attract more customers with more convenience delivery and lower price, because in the context of China's imperfect supply chain (SC) infrastructure and decentralized smallholder production, e-commerce links producers and consumers through network technologies, which can reduce the intermediate circulation in the SC and maximize the profits of each node (Cong and Zheng, 2017). So, with the popularity of online stores of fresh products, the importance of the SC is gradually raised, gradually become the core competitiveness of the company's occupation of the market. Because of the short life cycle and high-quality processing requirements of fresh food, efficient SC is the key to reducing waste and maximizing profits. Recently, in China's advanced big cities, the government has invested heavily in SC infrastructure to encourage the development of the SC and even design the fresh product SC as the next five-year crucial plan (Wang *et al*., 2017). In this vein, the role of government is vital in this industry since it is about food supply, so having a good SC management for ensuring good quality of food supplies needs to be carefully considered.

Due to the seasonal, localized and perishable nature of fresh fruit, the quality control of the SC is more challenging than non-fresh food products. Consequences of quality problems are much serious which can lead to losing customer trust, increase total SC cost because of unnecessary return transportation (Ganeshkumar *et al*., 2017; Fan and Fan, 2018). When buying food online,

customers cannot check the food condition when pick it themselves. When the fresh food that does not meet the customer's quality requirements is delivered, this leads to produce returns, and transportation time and distance are extended by the return, which undoubtedly increases the waste of the food SC (Liu *et al.*, 2014). Besides, for customers, compared with the price and services, quality is a more important factor affecting their purchasing decisions (See ***Figure 1***).

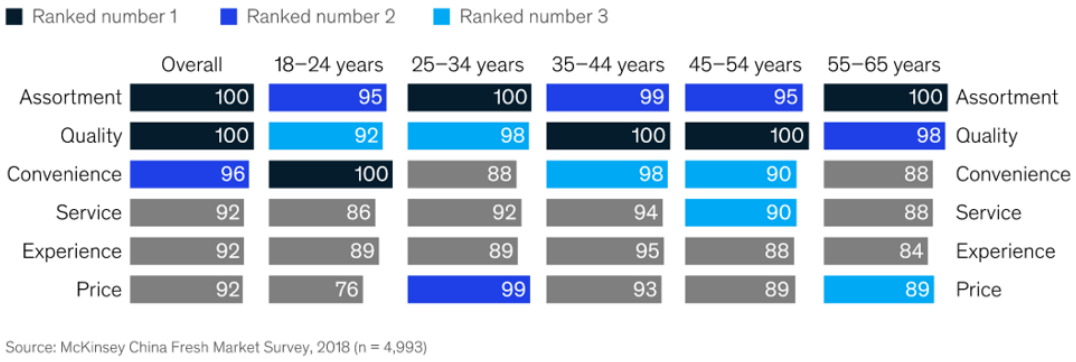


***Figure 1:*** *The importance of customer-satisfaction of fresh product*

So, improving the quality of the food SC has become an important issue. In recent years, quality problems have occurred in China's food SC many times, however, due to the complexity of the food SC, a fresh product from farm to customer's table experienced a lot of intermediate links and involved various participants, any negative impact will make the final food quality decline, so improving the quality management of the food SC also is a challenge (Liu *et al*., 2012). In fact, fresh quality is a kind of performance standard, and it is also related to safety and integrity. In some fresh SC, the use of quality to guide logistics is also a new concept, based on fresh products quality to select different logistics channels and different customers can save SC costs while ensuring that quality meets customer requirements (Van der Vorst *et al*., 2005).

This research focuses on the e-commerce fresh food SC, then select participants in different parts of the SC to obtain information to study quality management of fresh food SC. Investigate the management of e-commerce SC operators in China to ensure high-quality fresh food. The

fresh food studied in this paper mainly include fruit, vegetables, seafood, meat, dairy products and other fresh foods that need to be cold chain transported. There are three major types of fresh food e-commerce in China: B2C (business to customer), C2C (customer to customer), B2B (business to business) (Yang and Tang, 2019). In this paper, the fresh e-commerce mainly involved the transportation from the products to consumers through self-operated logistics or third-party logistics as B2C account for 40% (Statista, 2020) of sales among three type, while the business to business sales is not the focus of research. It is worth mentioning that although the context of this research is located in China, some implications of this study could be used to inform this topic globally.

This paper is structured as follows. Section 2 presents a literature review about fresh food quality, lead time and traceability. Section 3 provides the methodology which is qualitative interviews with key players in the SC. Section 4 presents the analysis and findings with a summary of the evidence from the results. Section 5 provides some discussion about this research based on the data and a comparison to relevant previous literature. Section 6 draws the conclusions as well as provides some limitations and avenues for future research.

## 2. Literature review

### *2.1 E-commerce in China*

E-commerce has four unique characteristics : (1) using network technologies and standards operate low-cost communication; (2) business and human resource management can be carried out through network facilities; (3) transactions occur on the Internet; (4) producers and intermediaries can provide electronic products and services to improve efficiency; (5) emerging laws and policies regulate online transactions (Geng *et al.*, 2007). The development of information technology has greatly promoted the growth of e-commerce. The main technology is the use of a visual online information transaction system, which has the characteristics of being traded at any time without being restricted by time and place (Hussain *et al*., 2015; Chen

*et al*., 2013). The 24-hour information interaction makes rapid SC response critical, and once the processing speed of orders is reduced, the circulation time of products in the supply will be raised. E-commerce brings new challenges to the traditional logistics model. The SC needs to repeatedly process many small and diverse orders, and the demand is full of high randomness (Xu *et al.*, 2019).

On the supply side, orders for food purchased by retail supermarkets are often large, and transaction costs of small quantities of products are large. Therefore, farmers are in a weak position in the fresh food SC with incapable of selling products independently, so they often choose to sell to suppliers at very low prices, finally suppliers gather products to offer to retailers. Process are differing in e-commerce fresh food SC, as orders are often small and scattered which can be direct delivered to customers, so there produces a possibility that small farmers enable to enter the market directly (Wiggins *et al*., 2010; Boyd *et al*., 2003). Moreover, by involving small farmers to the market, the negative impact of the profit and information asymmetry happened because of various middlemen in the SC can be reduced, so the terminal price of fresh food decline (Cong and Zheng, 2017; Cao and Mohiuddin, 2019). Vlachopolou and Matopolous (2010) state that the more complex of fresh food SC, the more members participate in the interaction, advantages are more significant of using E- fresh food SC. While Canavari *et al*. (2010) believe that not all E-commerce is adopting this approach, because suppliers always have advantages in information and resource integration, and it is impossible to completely disappear in the market. However, traditional suppliers have no longer in an irreplaceable position in the market. The direct participation of producers with price advantage will force traditional suppliers to adopt market by better service and quality.

On the demand side, the number of urban residents in China is gradually increasing, but the heavy workload and traffic congestion make residents reluctant to complete daily food purchases (Wang *et al*., 2015). E-commerce supply with home delivery services. Customers

can complete the selection at home with internet, so it gains popularity among public. On the other hand, for some residents in China remote areas, the lack of e-commerce means they are unable to access global fresh products because their demands for multinational products are small. The cost of retail SCs for large orders is high, while e-commerce meet the market demand for small orders (Gharehgozli *et al*., 2017). So, e-commerce completes the process of rural products to the city, and vice versa.

E-commerce has forced the reconfiguration of SC resources while fulfilling customers' needs. The focus of development is to manage the SC participants as a whole, and also reflects the importance of information transfer in the SC. The initial investment in e-commerce SC build is not large, and there is no need to set food shelves for consumers to choose in the downstream of the SC. Then quality becomes the only criterion for consumers to judge products when the products are delivered, which makes the importance of quality management in SC gradually increase.

*2.2 Fresh food quality*

The quality of fresh products mainly includes product quality and process quality（Luning *et al.*, 2002). Product quality refers to food safety, nutrition, freshness, value and function, low product quality food is mainly deteriorated, damaged or poisonous, most quality problems will be avoided in the primary selection, and customers can also identify according to their appearance (Sterns *et al*., 2001; Luning *et al*., 2002). The quality of the process mainly involves the production process, some of these can be harmful, such as: hand-dyed apples, processing sick pigs, pesticide residues, however, most problems are hidden from customers and cannot be easily identified. So, long-term consumption might threat public health (Luning *et al*., 2002). Frequent food quality issues make people to pay more attention to the quality of food rather than price. All fresh product quality can be regarded as a dynamic state, which decreases with time. The quality problem mainly occurs in three aspects: chemical residues exist in the

planting or breeding process, damage to the goods during transportation, and the producing process pollutes the environment and the food itself (Aramyan, 2007). Therefore, the main research direction is to avoid the problems of these three dimensions happened among SC. Although the problem of food quality is pointed out, the problem of establishing a complete quality standard still needs to be solved. The standard must meet two requirements. One is to meet the uniform standards for food production and inspection, and the second is to meet the quality standards required by customers, but each enterprise has different requirements on making standard and it is difficult to achieve uniformity, this is the main reason for the uneven quality of food in the market (Siddh, 2017; Sharma *et al*., 2017). Therefore, the establishment of a unified quality standard is a long-term process, and the current literature is more concerned about how to improve fresh food quality. The latest research to improve SC quality management mainly focus on two ways, reducing intermediate time (Sharma *et al.*, 2017), improving traceability system (Song *et al*., 2019). The length of the SC determines the time of transporting food, increasing transportation time makes fresh food deteriorate in transportation, in fact, the quality of fresh foods is essentially against time.

*2.3 Lead time*

The intermediate time can be reduced through streamlined SC participants and properly configured delivery. When participants increase, each participant has own standards and thinking, and the conflicting goal has a negative impact on the optimization of the entire SC (Aramyan, 2007). When the participants in the SC cannot quickly unify the decision, fresh products will be stranded at each node, so reducing intermediate processes means reducing SC participants or nodes that need to stay. In order to solve it, Yu *et al*. (2015) made a research on a framework for management quality and quantity of a four-echelon SC, proposed with a common commitment and contract to ensure that the entire SC maintained the same objectives (Yu *et al.*, 2015). In addition, the information shared among the participants is also very

important. When the external and internal SC has accessed to the information of food delivery, eliminating the difference in unequal information is conducive to establishing the same goal (Hu *et al*., 2019). on the other hand, a framework is studied by Besik and Nagurney (2017), which mentioned the fresh products are delivered directly to the local fresh market and then transport to the customer to ensure quality. Actually, it means to establish a short local SC, fresh products enter the market without going through the suppliers to save time, another benefit is that it can greatly encourages the development of local agriculture. In China's fresh retail industry, there is a very popular form to reduce intermediation, farmers and supermarkets are directly connected called "farmer-supermarket direct purchase" model (Wang *et al.*, 2015; Zhang, 2016). In fact, with the development of e-commerce, this model has also been applied to the e-commerce SC, which enable direct connecting between farmers and consumers. At the same time, setting the local SC can also reduce transportation distance food miles are presented by Shukla and Jharkharia (2013), which refers to the total distance from the produce of food to the customer. Globalization is the main reason for the growth of food mileage. Previously, the transportation of the food SC was based on roads and trains. With the development of the global SC, shipping and flights gradually joined the means of transportation. The environmental pressure caused by long-distance transportation has gradually become the focus of research, so Sim *et al.* (2006) state that when the long-distance transportation cost far exceeds the power consumption of storage and packaging, strengthening local farming and reducing global transportation should be considered. However, it is necessary to establish a global SC for imported food. For the inevitable long SC, food degrades with storage and shipping time, by establishing the best storage configuration and distribution model, putting high quality as orientation, using different distribution channels according to the type of food is a way to effectively reduce food cycle time and ensure quality (Rong *et al*., 2011). Besides, it can reduce, repeat and duplicate route by optimizing route planning. Yu *et al.* (2015) support this point by

using computer algorithms, which means to optimize warehousing and transportation to design a sustainable and efficient supplier network.

*2.4 Traceability system*

Using traceability systems enables the entire SC information to be transparent from order placement to delivery to the customer. There are two types of traceability, traceback refers to the ability of food products to be traced from the retail end to the place of production, which can be used for further product improvement. Forward tracking mainly ensures the quality of products in the SC (Zhang and Li, 2012). Wu *et al.* (2015) believes that the root reason of food safety or quality problems is the asymmetry of information, SC lack enough information to properly evaluate the real-time quality of products. When the food produced is circulated in the SC, the producer, supplier, buyer and the customer can only know part of the information of the food, but establishing a traceability system provides each food item, the origin of the food, the method of processing and the mode of transport, which are all recorded in detail (Wu *et al.*, 2015; Cong and Zheng, 2017). It involves product traceability, process traceability, input traceability, disease and pest traceability which covered all information about whole supply and allowed track up and track down (Aung and Chang, 2014). Traceability shows benefit in three aspects: improving SC management, ensuring food quality and safety, figure out undetectable quality problems, all advantages can enhance SC competitiveness. Thereby when quality problems arise in the SC, managers can quickly identify where is the problems by using the traceability system, then it can be quickly resolved. From enterprises perspective, more funds should be invested in the establishment of traceability systems, the more sensitive of customers quality requirements are, the more profitable the traceability system can be, as it is a cost-effective quality management to build strong confidence for consumers (Song *et al.*, 2019). As people become more aware of quality awareness today, increasing the investment in traceability systems can lead to greater markets. The core technology of the traceability system

is the radio frequency identification (RFID), it at least contain two parts, one is a coded chip which combines with electronic product code to store information and mediate radio frequency signals, and the other is an antenna to transmit and receive signals (Zhang and Li, 2012). Using RFID technology means to attach a unique product identification of each product from farm, through scanning this code to find out how the product is circulating throughout the SC, for example, in the live fish SC, each fish is tagged with RFID and connected to the Internet (Pramatari *et al.*, 2010). Besides, the RFID tag also integrates temperature and humidity information to optimize cold chain transportation. Ruan and Shi (2016) designed a framework which can applied in the transportation process, a logistics distribution monitoring system that can be combined with the Internet of Things to monitor the freshness of fresh food in real time (Ruan and Shi, 2016). In fact, except for traceability, the use of RFID greatly reduces the time for products to enter and exit the warehouse. It eliminates the error and time waste of manual storage and is widely used in the storage system. The traceability system is an effective way to enhance quality, but it needs the cooperation of all SC participants to build a vertical system, the huge fund pressure makes difficult to complete for all enterprises.

## 3. Methodology

This research uses a qualitative research methodology based on interviews. An interview is a qualitative research method to acquires data through online, telephone or face-to-face. In the exploratory study, the interviews are more flexible and suitable as it allows creativity and innovation through responses from participants (Bryman and Bell, 2015). So, understanding the real development status of the SC from the perspective of practitioners through interviews may have an impact on the focus of research objectives which may influence findings. Interviews are semi-structured. Semi-structured interviews allow interviewers to flexibly change the order and form of questions in the process, as long as a specific topic is set (Rowley, 2012). As for the choosing of sample, there are seven interviewees who come from fresh e-

commerce business. As fresh food SC participants are complex, in order to have a more systematic understanding of the quality management of the whole SC, interviewees work in three different departments of the SC: purchasing department, logistics and storage department, and after-sales department. Due to geographical distance restrictions, interviews are conducted by telephone and online video. Each interview takes 30 minutes to an hour, and the data is recorded by computer. Access to respondents was gained through first author's contacts in China and the case selection was made to ensure an even representation of as many tiers of the fresh food SC.

***Table 1*** shows the general information of respondents, which includes their occupation, working experience, and responsible work, they come from two types E-commerce companies, one is mainly selling vegetables and fruit, the other focus on meats and seafood.

***Table 1:*** *General information for interviews*

| **Occupation** | **Interview duration** | **Main type of products** | **Main topic** |
|---|---|---|---|
| 2 Purchasers | 40 minutes | Vegetables and fruit | • Purchase method<br>• Suppliers choose and management |
| 2 Warehouse and logistics workers | 40 minutes | | • Warehouse management<br>• Logistic management<br>• Return policy |
| 1 Purchaser | 25 minutes | Seafood and meat | • The same as above themes for purchasers |
| 2 Warehouse and logistics workers | 40 minutes | | • The same as above themes for warehouse and logistic workers |

In terms of designing of interview questions (see Appendix 1 for details). At first, for some companies, the quality management of the SC is the key to increase market competitiveness. The design of interview questions should consider some interviewees may feel reluctant to

answer the questions, so more questions are designed to replace some sensitive questions when the interview gets blocked. Besides, the design of questions is related to the different work of interviewees. Based on the literature review, different topics are designed for different interviewees that they have a different understanding of the key points of SC quality management. For the participants engaged in procurement work, the main reason for the current unevenness in the market is the inconsistency of quality. Therefore, questions of the procurement participants will pay more attention to the quality control at the beginning of source and how to predict the demand of the customer. Second, for respondents from logistics and warehousing management, main topics are cold chain transportation and temperature-controlled warehousing. Significantly, all participants are from small and medium-sized e-commerce companies in China. For these enterprises, the characteristics of logistics is that the final transportation phase from warehousing to customers is often outsourced to third-party logistics. Then, ultimate responsibilities for these companies are to package the goods and then third parties will be picked up and delivery goods. Finally, for after-sales workers, the main purpose is to explore some feedback from customers on the quality of fresh produce. In addition, the return rate of fresh products is also an important topic. Once fresh products are returned due to quality problems, the delivery time and distance of fresh will be doubled. How to complete the return quickly and effectively to reduce losses is also a part of quality management.

## 4. Findings

### *4.1 Supply chain network*

E-commerce uses the network platform to attract customers, the more popular platform can bring more sales to the company. Recently, the most two popular online B2C and C2C business platform in China are Jingdong and Taobao, which can be found on customers response that they prefer big self-operated e-commerce. Although the demands of fresh food have been

growing, most customers still believe product quality of online business weaker than of physical stores. The competition is getting fiercer as more and more companies enter this market, only by creating core competitiveness can customer viscosity be enhanced. Moreover, the SC cost accounts for about 50% of total cost of fresh product, while the huge loss of returns makes the company's profits gradually lower. Moreover, two frequent quality problems are product itself does not meet the quality standards and deterioration caused by long lead time of transportation, which are mainly reflected in the procurement and warehousing logistics.

The structure of the fresh SC is universal (***Figure 2***), but there is a big difference in the management of intermediate links, which gains advantages in in service, response speed, quality and price.

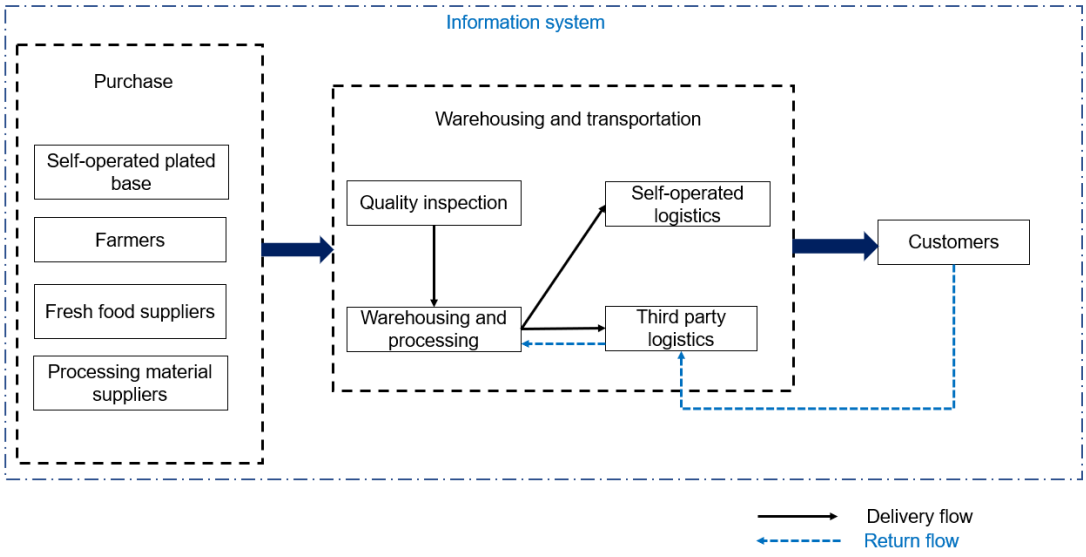


***Figure 2:*** *E-commerce fresh supply chain.*

### *4.2 Information system and traceability*

The traceability system throughout the SC is unrealistic, even this system can trace back to where the quality problem occurred. The biggest obstacle is that Chinese suppliers are not willing to cooperate with the establishment of traceability systems. For perishable products, the current responsibility distribution method is that once the products are signed and delivered,

the suppliers are no longer responsible for the quality of the products. Another factor is that RFID technology has not been applied in the entire SC. Warehouse managers believe that the role of RFID technology in warehouse is dispensable. It is difficult for fresh products to realize automatic replenishment, so the technology is only used for the design of the products location and the sequence of outbound. More important is that all products are sent directly to customers, but customers do not have the device to scan the code. Even so, 64% of consumers still think traceability systems are essential.

### *4.3 Purchasing*

Purchasing is the source for the company to improve product quality. Different forms of procurement affect the price and quality of fresh products. Qualified supplier management is the guarantee to continuously provide high-quality products. Last, the perfect quality inspection standards can eliminate low-quality products to ensure the satisfaction of products when they are delivered to customers.

### *4.4 Choice of procurement method*

The fresh procurement method is diversified. Firstly, purchasing from the original production area, which means procurement directly at the source of production through cooperation with farmers, generally using to purchase fresh which can be stored and transported for long time. Products are inspected, selected and pre-packaged at the local purchasing base, then shipping to different warehouses by refrigerated truck. The second method is purchasing from local areas, which is suitable for the procurement of fresh vegetables, seafood and local specialty products, especially for some fresh foods that cannot be transported for a long time, but this way has restriction on the category. The last way is to cooperate with some brand suppliers to purchase processed products, suppliers will take responsibility for transporting to warehouses. For e-commerce that mainly sells vegetables and fruit, the combination of the first method and the second method is mainly selected. Because the low profit of vegetables and fruit and short

transportation time makes the reduction of middlemen important, fewer intermediate links reduce the participants and complexity of the SC. Interviewers from fruit and vegetables e-commerce said that 50% of the company's products purchase from original places, compared with 20% cheaper from suppliers. Therefore, for fruit and vegetables that can withstand long-time transportation, such as potatoes, carrots, and oranges, priority will be given to the original place procurement mode. However, it is not easy to find qualified original region to purchase. Although it is not difficult to find the origin of each product, China's current agricultural characteristic is scattered, many products have different growth sites with different quality features, so the distance from planted places to the warehouse and the quality of the products should be considered. So, companies will send the procurement department team to destination for a period to judge the qualification before determining a procurement base. In terms of meat and seafood, it is impossible for an e-commerce company to avoid dealing middlemen. Most of the seafood and meat needs to be processed before they can be kept fresh or sold. Some seafood and meat processing require certain food processing knowledge and equipment. And the sources of seafood and meat are distributed throughout the country and needed be processed on-site, which means that e-commerce companies need to establish a huge number of professional processing bases nationwide. For small and medium-sized enterprises, lacking enough ability and money forces them buying fresh products from supplies, at the same time, they can strengthen the competitiveness by purchasing some imported products to enhance the variety from supplies.

Except to the choice of purchase method, the forecast of purchase orders is also an important factor to affect product quality. Predicting suitable purchase plan can reduce the backlog of inventory and the products circulation time in warehouses. For the most popular products, companies will set a safety inventory and check the quantity every day, when real time inventory is below safety inventory, purchasers should make new orders according to different

delivery time from purchase location. The best-selling product is not allowed to be out of stock, in order to predict customers purchasing behaviours, customer's data will be collected for forecasting demand.

However, the interviewees agreed that the e-commerce customer's purchase data experienced heavily fluctuation due to frequency of promotion activities. Most promotions are done by platform, for example, once some of interviewees' company held a kiwifruit promotion, in response to the sudden increase of demand for promotional activities, the company had purchased a large number of products, but due to the excessive number of competitors promoting the same products on the same platform, the sales volume was far less than the purchase volume. Besides, Summer temperature was very high, even there were constant temperature measures, huge number of unsalable products were rapidly deteriorating. In order to avoid similar situations, many e-commerce companies began to use pre-sales to carry out promotional activities. Pre-sale is a creative sales method that knows the customer's demands in advance. After the customer submits their orders, products will not be shipped immediately. Buyers and sellers will agree on an acceptable delivery time, generally ranging from two weeks to one month. The price of pre-sale is often lower than the market price, so it can attract potential customers who are willing to wait. Although the price of a single product is reduced, e-commerce companies can make a precise purchase plan according to the true customer's demands, so the demand-driven sales method to avoid the risk of product stagnation and deterioration, which can increase the profit rate. This model is very popular for fresh products in China as it accurately reflects customer's demand forecast.

### *4.5 Suppliers management*

Supplier management ensures the purchase of fresh food quality. In the development stage, all production sites need to be inspected by investigators on the quality of the products, the amount of planting, the production facilities and processing equipment. After all performance is met,

e-commerce companies will sign a procurement contract with the local farmers or farmer cooperatives. However, the company and local farmers only work in a cooperative manner. But the company's management power of farmer suppliers is very limited, so the company does not participate in the quality management of the production process. Moreover, due to the lack of productivity of a single purchase site, multiple purchase sites are selected with different planting technology, production equipment and labour levels, which is easy to cause uneven quality of products from different regions and different batches. The worse phenomenon is that sometimes quality problems are hard to discern by naked eye, such as excessively high levels of pesticides and unsafe processing methods. Furthermore, cost of replacing the place of purchase is very high, not only establishing new local production base, but also taking a long time to visit another place. Therefore, some companies realized that it is necessary to participate in the management of the production process, then establishing a self-operated production base has become a new direction for enhancing company's products quality. Self-operated production base refers to the company's investment of funds and talents to establish planting or breeding bases to achieve full control of quantity and quality. Because of the large capital investment in the previous period, currently self-operated bases are only set for stable demand and high-end products.

The market forecast and quality of medium and high-end products are more important, these products are generally the most popular ones that can bring the most profit to the company. Once the company involved in the production process, product quality can be controlled, then the company takes a high quality as a selling point and occupies a certain market share. As middleman intervention is reduced, the profit margin and efficiency of SC have raised. In the future, companies are preparing to slowly extend self-operated bases to more products. For products procured by distributors and brand suppliers, the company uses a unified supplier management, which includes supplier qualification verification and periodic performance

evaluation. Supplier's performance is assessed in flexibility, quality, delivery time, quality complaint rates, and after-sales service levels. If the supplier's score continues to be below the pass line for one month, the company will look for alternative suppliers.

### *4.6 Double-layer quality inspection*

Two-tier quality inspection is also an important part of fresh product quality management (***Figure 3***).

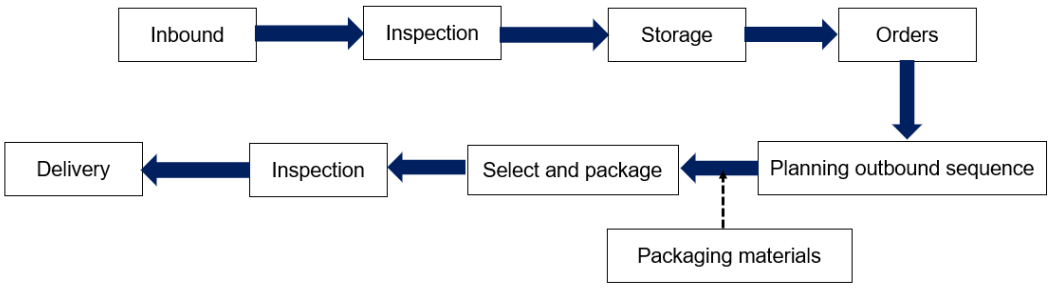


***Figure 3:*** *Warehouse-in and warehouse out inspection process*

Before goods are stored in the warehouse, the quality inspection department needs to ensure that the product meets the agreed quality standards. Full content of quality assurance includes appearance, taste, diameter, items temperature, shelf life and maturity, all information should be recorded in detail by labour. There is no professional technology and equipment to comprehensively measure all dimensions of quality. The manual inspection speed is relatively slow by workers, when many customers' demand needed to be met, quality inspection department force to sample parts instead of checking all batches, which led to some products with quality problems still being shipped into the warehouse. Once quality problems arise after storage, it is difficult to identify who needs to take responsibility. Before products are delivered to the customer, the quality department need conduct an inspection again to check whether the packaging is qualified. The standard of inspection is to ensure that the package remains intact

and has a fresh-keeping effect during long-term transportation, it turns out more than half of customers believe that the fresh-keeping package is still working when they get parcels.

However, the company still has difficulty in formulating uniform quality standards. Now employees of procurement department and quality assurance department are mostly from long-term practitioners of the fresh food industry. They rely on years of work experience to judge whether the product quality can meet customer needs, and they believe that the establishment of a unified quality standard requires grading the product by quality at first. However, this stage is completed by the picking centre or supplier before being shipped to the warehouse, e-commerce companies are hard to agree with a uniform quality standard with suppliers. So, as long as the product does not rot and deteriorate, the company is not willing to waste more manpower and time to re-qualify products after being shipped in warehouse. At the same time, respondents said that when the company has a great demand for a certain product, sometimes poor quality of this food will be delivered to the customer. The quick response to the customer's needs is considered the most important instead of high quality by the company, but this is contrary to the feedback from the customer' questionnaires, customers believe that once an e-commerce has experienced quality problems, 80% of the customers will not repurchase in the same companies.

### *4.7 Warehouse and Logistics*

After fresh food is delivered into the warehouse, it needs storage in different temperature zones according to different characteristics. Staff members record the temperature and humidity of each zones every day to check whether the equipment is running normally. There are three main temperatures zones (***Table 2***), and the maintenance of humidity relies on artificial spraying of water three times a day.

***Table 2**: Three temperature zones*

| Category | Temperature (℃) | Storage time（days） |
|---|---|---|
| Low temperature storage of fruit | 0-5 | 7-14 |
| Vegetables | 10 | 2-5 |
| Frozen seafood and meat | -18 | 90-180 |

In e-commerce companies, inbound and outbound warehouses are completed by manual operation with computer recording. The basic principle of entering and leaving the warehouse is first-in, first-out (FIFO), but it is also necessary to adjust the order of delivery according to the actual situation. The speciality of fresh products makes FIFO not the best way to ensure high quality, because the maturity of each batch is different. Even in the same storage environment, the speed of quality decline is different, therefore, the warehousing department set up an inspection team to check the actual situation of the products at the morning, at noon and at night to adjust the speed of outbound sequences.

When customer's orders transformed to warehouses, warehouses will reasonably design the packaging method according to products variety and quantity to ensure the freshness of the product. In order to ensure the best quality of delivery, fruit and vegetables mainly use foam buffer to maintain the appearance, while seafood needs to be frozen with ice packs or dry ice inside, and each box contains about 3-5 ice cubes depends on the length of transportation, plus a thermostatic protection box outside, and the expected preservation time is about 2-3 days. From the feedback of customers, this set of protective measures is very effective, and most of products still have fresh-keeping effects when they are delivery to customers.

Fresh food is transported by different third-party logistic operators according to the storage location and shipping destination. There are currently two main warehouse location models: centralized warehousing and distributed warehousing. Centralized warehousing creates warehouses at the most user-intensive locations, the establishment cost is low, but it has long

inventory turnarounds and delivery time. Distributed warehousing is to establish scattered warehouses in different cities. The investment in early stage is large as a huge number of locations should be considered. The focus of the decentralized warehouse is to accurately predict the inventory of each warehouse. It has short delivery time and reduced SC delivery cost. Now, more and more companies are shifting from centralized to decentralized, based on previous customer purchase data to help with the selection of location and stock of storage. And when customer's order delivery destination is close to a certain procurement base, fresh food is packaged and processed from the local procurement centre and delivered directly to the customer to shorten circulation time. Therefore, how to design the shortest distribution network after the order is generated is the key for cost saving and high-quality products. There are third parties mainly used include Tmall/Jindong's self-operated logistics, SF (Shun Feng) Express and four most popular companies which included Shentong Express, Zhongtong Express, Yunda Express and Yuantong Express. See ***Table 3***.

***Table 3****: Distribution third parties*

| **Brand** | **Tmall/Jingdong (open to the medium and large companies in their platform)** | **SF Express** | **Ordinary third parties such as Shentong *et al.*** |
|---|---|---|---|
| **Delivery time** | The timeliness of the big cities is very good, some place can arrive in 1 day. | 2 days in large cities, 3 days in small and medium-sized cities and towns | Average 3-4 days |
| **Distribution areas** | Only the first tier and second-tier cities | Nationwide | Nationwide |

| | | | |
|---|---|---|---|
| **Features** | expensive, and only cooperate with medium and large business | average price with express specific product routes, such as hairy crab routes | Cheap |
| **Suitable products** | High-end and time-sensitive hot-selling products that need to be delivered to large cities such as cherries and beef | High-end products in large cities in small cities. | Low time-sensitive and low-priced products |
| **Daily picks frequency and times** | Once a day at 4:00pm | Three times a day at 12:00 am, 4:00pm and 7:00pm | Depending on demands for once or twice a day at 1:00 pm and 5:00 pm |

Third-party logistics has been improving in timeliness, but the inability to manage couriers and transportation process is a drawback of outsourcing logistics. At present, China's third-party logistics system omits the door-to-door service in the last mile of distribution but using public parcel cabinet in the community. The parcel cabinet is composed of multiple small lock boxes, after the courier delivers parcels to one box, the customer will receive a unique password to open the box. Fresh is a very time-sensitive product, but the time for the customer to take the courier is uncertain. Most of them will choose to pick parcels when they get off work, but some will pick up after one day. Moreover, the cabinet is sealed with higher temperature inside, which makes the fresh highly susceptible to deterioration. This new form of logistics brings uncertainty to the fresh SC, which makes more difficult to guarantee fresh quality. If the product deteriorates in the cabinet, it will be very difficult to determine the responsibility. Although the e-commerce company has negotiated with the courier several times, the product must be sent directly to the customer and signed after face-to-face inspection to confirm the

quality, due to the lack of management authority for third-party logistics, couriers still choose to use parcel cabinet to save time on delivery. There is almost no traceability for outsourcing delivery. When the product has a quality problem due to the damage of the transportation, it is difficult to trace back to the location where the problem occurred, unless consulting with third-party managers to gain data from their information system. Therefore, respondents' company is also thinking about how to establish self-operated logistics. Through preliminary calculations, the delivery cost of self-operated logistics is about half cheaper than that of third parties, but the investment in infrastructure and logistics network construction in the early stage cannot be ignored. A large-scale fresh procurement base has established a small self-operated logistics network as an experimental point, using the freezer truck to ensure cold chain transportation. The current operation is good, most customer believes that product quality has been improved, so self-operated logistics will gradually expand in the future. But self-logistics cannot completely replace the third-party logistics in the future, China's e-business customers has characteristics of wide distribution and small orders which regularly happened in some remote rural areas, utilizing self-logistics completely cover theses area should pay more money than with outsourcing to a third party (Liu *et al.*, 2019), designing a suitable mode combined with these two logistic method may be a better way to balance delivery quality and cost, gradually developing self-support logistics in urban areas at first is a more reliable.

In terms of return logistics, the return policy displayed on the platform is that once the quality problem occurs, company is responsible for all the expenses for return, but in fact e-commerce business prefers to pay the full compensation and is not willing to accept the decision to return. The return process requires an appointment for a third-party courier to pick up the goods, and then ship the product back to the warehouse, but almost all returned products are all spoiled and cannot be re-sold and e-commerce company still needs to pay for the return transportation. So, when a customer complains about a quality problem, the firm will determine the damage

and compensation according to the proportion of the product quality problem. Even if all the products are deteriorated, customers can get full compensation without returning the original product. This is a main reason for influencing customers return decisions and less people chose to return their products.

## 5. Discussion

### *5.1 The implication of technology in the supply chain*

Better temperature control technology and frozen trucks complete the development of the cold chain. Temperature management of warehousing and transportation is one of the important factors affecting product quality, the literature points out that excellent storage temperature is divided into four temperature zones: 18℃ and below, 0℃-1℃, 5℃, 10℃-15℃ (Aung and Chang, 2014). China's e-commerce has achieved in three temperature zones to protect quality. while in transport temperature control, the use of simple temperature packaging and third-party logistics transportation has been a risk to keep quality. Which makes e-commerce gradually developing self-operated logistics in the future to ensure the transportation of the entire cold chain from procurement to customers. Besides, the application of information system has indeed improved the effective management of information, especially in the processing of customer information and the processing of inventory information. E-commerce must deal with a lot of customer information every day, and the speed requirements are very high, the accurate information transmission shortens the circulation time of the product. However, the integration of information between buyers and suppliers is still limited. Although the sensitivity of competitive information hinders information sharing, if the two sides establish a cooperative relationship, information integration is a key approach to improve product quality (Chen *et al.*, 2013; Bai and Guo, 2017).

### *5.2 What factors in the supply chain will affect fresh quality?*

First, the accuracy of demands forecasts has an impact on the formulation of purchase orders. A reliable forecast is an effective way to reduce product storage time and increase shelf life (Dellino *et al*., 2018). Indeed, a lot of the quality loss of fresh product occurs when the sales volume has huge fluctuation.

The second is the quality of the product itself. The quality of the fresh product is affected by many uncontrollable factors, such as the difference in weather, origin and planting technology, all will affect the quality of the products in different batches.

Finally, the implementation of the automatic delivery station has potential influence on fresh quality. For small and medium-sized e-commerce, the last-mile delivery of third-party logistics does not achieve door-to-door delivery, which will pose the risk to fresh quality assurance. However, the flexibility, convenience and environmental protection of the automatic delivery station have gradually become mainstream in the city delivery (De Oliveira *et al.*, 2017), which forces fresh e-commerce to think about the solution.

### *5.3 Current approaches to improve quality control*

First, using pre-sales model to improve the accuracy of demands prediction. The customer's needs are always fluctuating. The way to formulate the purchase plan by collecting the customer's demand in advance is considered by fresh e-commerce to be the most effective way to guarantee the quality of products.

Second, comprehensive supplier management and self-purchase bases ensure the high-quality source of fresh food. Except effective supplier's performance evaluation, regular field visits are necessary for suppliers' selection and managing to ensure product quality and process quality. Establishing a good SC relationship through supplier management is the key to ensuring product quality, especially for purchasing directly from farmers, which destroying the weak position of farmers in the SC and mitigating SC conflicts (Liu, 2018). And self-purchase

bases enable total quality management from planting or breeding. Another benefit is that intermediary agent can be reduced to save time by building self-purchase bases.

Third, strict quality inspection ensures product quality before inbounding and after outbound. Warehouse-in inspection can ensure that the supplier's products meet the quality standards, inspecting will pay more attention to whether the product's size, taste, and appearance meet the contractual standards. Outbound inspections pay more attention to product maturity, deterioration and packaging. Double-checks confirm that the product is delivered to the customer in the best condition.

Finally, designing of logistics also play a vital role in quality control. Warehousing location selecting based on data collected from customers can reduce delivery distance, then shorted delivery routes can be designed according to the location of warehouse or purchase bases and the destination of delivery to reduce repeated and unnecessary transportation. A literature supports this method by proposing that shortest delivery route is an effective way to improve product quality and customer satisfaction (Chen *et al*., 2014).

## 6. Conclusions

The following recommendations for fresh food SC organizations is given as follows:

- Procurement cost is the key for the organizations since that determines their profit. Research says that 50% of total cost is spent for managing SC effectively. It indicates that remaining 50% is the procurement cost. Organizations need to work closely with SCM companies to reduce this cost. Companies could try to minimize the procurement cost as well through certain strategies like bulk-buying, contract-based buying, ensuring future and forward contracts.

- Apart of cost and profit, relationship management, contracting with vendors, effective procurement, handling customer complaints are some of the areas that must be looked into to construct an effective SC management.

There are some limitations in this research as follows. First, a common limitation with case base research is the lack of generalization of results, so they only apply to the companies that have taken part in this research. However, some of the insights can be taken forward to inform the sector and wider global market. Second, the participants were employees at medium level management in their companies, so it is difficult for them to answer the questions related to strategy at company' level.

Further research could follow two aspects. First, collect some opinions from e-commerce top management executives and analyze how to ensure product quality from the perspective of the company's operations of entire SC. Second, to extend the study to large fresh food e-commerce companies, because they have obvious advantages in the use of advanced technology, and the competition in the SC is becoming increasingly more intelligent.

**References**

Aramyan, L. H. Alfons, G.J.M. Oude, L, Vorst, J. and Kooten, O. (2007). Performance measurement in agri-food supply chains: a case study, *Supply Chain Management: An International Journal*, 12, 304-315.

Aung, M. M. and Chang, Y. S. (2014). Traceability in a food supply chain: Safety and quality perspectives. *Food Control*, 39, 172-184.

Bai, H. and Guo, Q. (2017). Analysis on the Influencing Factors of the Development of Chinese Fresh Cold Chain Logistics under E-Commerce Background. *Journal of Management and Strategy*, 8(1), 55-60.

Besik, D. and Nagurney, A. (2017). Quality in competitive fresh produce supply chains with application to farmers' markets. *Socio-Economic Planning Sciences*, 60, 62-76.

Boyd, S., Hobbs, J. and Kerr, W. (2003). The impact of customs procedures on business to consumer e-commerce in food products. *Supply Chain Management: An International Journal*, 8(3), 195-200.

Bryman, A. and Bell, E. (2015). *Business research methods*. Oxford: Oxford University Press.

Canavari, M., Fritz, M., Hofstede, G., Matopoulos, A. and Vlachopoulou, M. (2010). The role of trust in the transition from traditional to electronic B2B relationships in agri-food chains. *Computers and Electronics in Agriculture*, 70(2), 321-327.

Cao, Y. and Mohiuddin, M. (2019). Sustainable Emerging Country Agro-Food Supply Chains: Fresh Vegetable Price Formation Mechanisms in Rural China. *Sustainability*, 11(10), 2814, 1-14.

Chen, J. V., Chen, Y. and Capistrano, E. P. S. (2013). Process quality and collaboration quality on B2B e-commerce. *Industrial Management & Data Systems*, 113(6), 908-926.

Chen, M. C., Hsu, C. L., Hsu, C. M. and Lee, Y. Y. (2014). Ensuring the quality of e-shopping specialty foods through efficient logistics service. *Trends in Food Science and Technology*, 35(1), 69-82.

Cong, Y. and Zheng, Y. (2017). Study on operation mode of agricultural supply chain in WeChat business environment. *Journal of Service Science and Management*, 10(3), 330-337.

De Oliveira, L. K., Morganti, E., Dablanc, L. and de Oliveira, R. L. M. (2017). Analysis of the potential demand of automated delivery stations for e-commerce deliveries in Belo Horizonte, Brazil. *Research in Transportation Economics*, 65, 34-43.

Dellino, G., Laudadio, T., Mari, R., Mastronardi, N. and Meloni, C. (2018). A reliable decision support system for fresh food supply chain management. *International Journal of Production Research*, 56(4), 1458-1485.

Fan, Z. and Fan, Y. (2018). Fresh Products Supply Chain Coordination Model under the

Background of E-commerce Considering Freshness Affecting Demand [Online]. *Proceedings of the International Conference on Economics, Finance, Business and Development.* Francis Academic Press UK. Available at: https://webofproceedings.org/proceedings_series/ECOM/ICEFBD%202018/ICEFBD090.pdf [Accessed 24 June 2020].

Ganeshkumar, C., Pachayappan, M. and Madanmohan, G. (2017). Agri-food supply chain management: literature review. *Intelligent Information Management*, 9, 68-96.

Geng, S., Ren, T. and Wang, M. (2007). Technology and Infrastructure Considerations for E-Commerce in Chinese Agriculture. *Agricultural Sciences in China*, 6(1), 1-10.

Gharehgozli, A., Iakovou, E., Chang, Y. and Swaney, R. (2017). Trends in global E-food supply chain and implications for transport: literature review and research directions. *Research in Transportation Business & Management*, 25, 2-14.

Guo, J., Wang, X., Fan, S. and Gen, M. (2017). Forward and reverse logistics network and route planning under the environment of low-carbon emissions: A case study of Shanghai fresh food E-commerce enterprises. *Computers and Industrial Engineering*, 106, 351-360.

Hu, J., Zhang, J., Mei, M., Yang, W. and Shen, Q. (2019). Quality control of a four-echelon agri-food supply chain with multiple strategies. *Information Processing in Agriculture*, 6(4), 425-437.

Hussain, S., Ahmed, W., Rabnawaz, A., Sohail Jafar, R., Akhtar, H. and JianZhou, Y. (2015). Supply Chain Management of Agricultural Technology Innovation: Study of Fujian and Taiwan. *Industrial Engineering Letters*, 5(12), 22-30.

iresearch (2019). 2019 China's internet industry report. Available online: http://www.iresearchchina.com/content/details8_51471.html. [Accessed on 24 June 2020].

Liu, G. (2018). The Impact of Supply Chain Relationship on Food Quality. Procedia computer science, 131, 860-865.

Liu, G., Li, G. and Feng, Q. (2019). Research on the Optimization of Instant Delivery Model for Fresh E-commerce. [Online]. *Proceedings of the 3rd International Conference on Architectural Engineering and New Materials (ICAEN)*, pp. 505-509. Available at: http://www.dpi-proceedings.com/index.php/dtetr/article/view/29053/28067 [Accessed on 24 June 2020].

Liu, Y. S., Yu, R. and Lin, X. X. (2012). Food Supply Chain Safety Risk Prevention and Control: Based on the Behavioral Perspective. *Journal of Service Science and Management*, 5(3), 263-268.

Liu, Y., Zhang, Q. and Li, Q. (2014). A Research on mechanisms and countermeasures of the food safety incidents occurring on food supply chain. *Journal of Service Science and Management*, 7(4), 337-345.

Luning, P. A., Marcelis, W. J. and Jongen, W. M. (2002). *Food quality management: a techno-managerial approach*. Wageningen Press.

Pramatari, K., Karagiannaki, A. and Bardaki, C. (2010). Chapter 21: Radio frequency identification (RFID) as a catalyst for improvements in food supply chain operations. In: Mena, C. and Stevens, G. (Eds.) (2010). *Delivering Performance in Food Supply Chains*, Woodhead Publishing, pp. 432-455.

Rong, A., Akkerman, R. and Grunow, M. (2011). An optimization approach for managing fresh food quality throughout the supply chain. *International Journal of Production Economics*, 131(1), 421-429.

Rowley, J. (2012). Conducting research interviews. *Management Research Review*, 35(3/4), 260-271.

Ruan, J. and Shi, Y. (2016). Monitoring and assessing fruit freshness in IOT-based e-commerce delivery using scenario analysis and interval number approaches. *Information Sciences*, 373, 557-570.

Sharma S., Anil C., Bhavana M. and Deepak G. (2017). A literature review on investigation of supply chain quality issues/constructs in agri-fresh supply chain. *International Journal of Advance Research in Science and Engineering*, 6(2), 706-710.

Shi, K., De Vos, J., Yang, Y. and Witlox, F. (2019). Does e-shopping replace shopping trips? Empirical evidence from Chengdu, China. *Transportation Research Part A: Policy and Practice*, 122, 21-33.

Shukla, M. and Jharkharia, S. (2013). Agri-fresh produce supply chain management: a state-of-the-art literature review. *International Journal of Operations and Production Management*, 33(2), 114-158.

Siddh, M. M., Soni, G., Jain, R., Sharma, M. K. and Yadav, V. (2017). Agri-fresh food supply chain quality (AFSCQ): a literature review. *Industrial Management and Data Systems*, 117(9), 2015-2044.

Sim, S., Barry, M., Clift, R. and Cowell, S. (2006). The relative importance of transport in determining an appropriate sustainability strategy for food sourcing. *The International Journal of Life Cycle Assessment*, 12(6), 422-431.

Song, Z., He, S. and Xu, G. (2019). Decision and Coordination of Fresh Produce Three-Layer E-Commerce Supply Chain: A New Framework. *IEEE Access*, 7, 30465-30486.

Statista (2020). Available online at: https://www.statista.com/ [Accessed on 24 June 2020].

Sterns, P. A., Codron, J. M. and Reardon, T. (2001). Quality and quality assurance in the fresh produce sector: a case study of European retailers. *Proceedings of the 2001 Annual meeting, August 5-8, Chicago, IL, American Agricultural Economics Association* (New Name 2008: Agricultural and Applied Economics Association).

Van der Vorst, J. G., Tromp, S. and van der Zee, D. J. (2005). A simulation environment for the redesign of food supply chain networks: modeling quality-controlled logistics. *Proceedings of the Winter Simulation Conference*, 10 pp. IEEE.

Vlachopolou, M. and Matopolous, A. (2010). Chapter 20: Adoption of e-business solutions in food supply chains. In: Mena, C. and Stevens, G. (Eds.) (2010). *Delivering Performance in Food Supply Chains*, Woodhead Publishing, pp.416-431.

Wang, Z., Yao, D. and Yue, X. (2015). E-business system investment for fresh agricultural food industry in China. *Annals of Operations Research*, 257(1-2), 379-394.

Wiggins, S., J. Kirsten and L. Llambí. (2010). The future of small farms. *World Development*, 38, 1341-1348.

Wu, L., Wang, S., Zhu, D., Hu, W. and Wang, H. (2015). Chinese consumers' preferences and willingness to pay for traceable food quality and safety attributes: The case of pork. *China Economic Review*, 35, 121-136.

Xu, G., Qiu, X., Fang, M., Kou, X. and Yu, Y. (2019). Data-driven operational risk analysis in E-Commerce Logistics. *Advanced Engineering Informatics*, 40, 29-35.

Yang, L. and Tang, R. (2019). Comparisons of sales modes for a fresh product supply chain with freshness-keeping effort. *Transportation Research Part E: Logistics and Transportation Review*, 125, 425-448.

Yu, J., Gan, M., Ni, S. and Chen, D. (2015). Multi-objective models and real case study for dual-channel FAP supply chain network design with fuzzy information. *Journal of Intelligent Manufacturing*, 29(2), 389-403.

Yu, Z. (2018). Research on the Optimization of After-Sales Parts Supply Chain Management Based on Supplier Management—Taking SAIC General Motors After-Sales Parts as an Example. *Open Access Library Journal*, 5(11), 1-24.

Zhang, M. and Li, P. (2012). RFID Application Strategy in Agri-Food Supply Chain Based on Safety and Benefit Analysis. *Physics Procedia*, 25, 636-642.

Zhang, Q. (2016). Research on the Quality and Safety Management of Food Supply Chain. *Open Journal of Social Sciences*, 4(7), 70-75.

**Appendix 1: Interview questions**

1. General information

- Occupation
- Responsibility
- Employed years

2. Key questions

2.1 For purchase system

- What are the sources of fresh sourcing? How to make choice?
- Is there a uniform procurement standard for purchasing?
- How to manage suppliers to improve quality performance?
- How to make procurement plan?

2.2 For warehouse and logistic system

- How to choose logistics, why?
- How to ensure the quality of fresh food from warehouse to customer?
- How to ensure the quality of fresh food from suppliers to warehouses?
- How to evaluate the current cold storage system for storage and transportation?
- What factors affect quality in the warehousing system and distribution system?
- What factors affect the location of the warehouse?

2.3 For marketing system

- What is the quality problem with the product when it shipped to the customer? What is the frequency? Can it be traced back to the responsible person?
- What kind of return policy does the company have?
- Will customer data be collected for analysis? What is the main purpose?