Research on the development of cold chain logistics of aquatic products in Zhoushan of China

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Abstract. Aquatic products are very ideal healthy food. Cold chain logistics is an effective way to ensure the quality of aquatic products in the circulation process. Zhoushan City (China) is situated in Zhoushan archipelago. Zhoushan fishing ground is the largest fishing ground in China, with abundant fishery resources. This paper expounds the theory of cold chain logistics, analyzes the present situation of cold chain logistics of Zhoushan aquatic products, points out the problems existing in cold chain logistics of Zhoushan aquatic products, and puts forward corresponding solutions, which has a positive role in promoting the development of cold chain logistics of Zhoushan aquatic products.

1. Introduction

Aquatic products are the general term of aquatic animal and plant products and their processed products produced by marine and freshwater fisheries. The per capita share of aquatic products in China is twice more than the world average level[1], while the per capita share of aquatic products in Zhejiang Province is 2.22 times more than the national per capita share[2]. Among all the cities in Zhejiang Province, Zhoushan City, located in Zhoushan archipelago, is a significant producing area of aquatic products in Zhejiang Province, and also the national core area of aquatic product catching and distribution. Consequently, it has the reputation of "Fish storehouse in the East China Sea" and "Fishery capital of China".

Aquatic products are nutritious and delicious. Aquatic products are prone to oxidation and bacterial contamination in logistics transportation[3], which will not only damage the taste of aquatic products, but also pose a serious threat to food safety. Cold chain logistics is the key to reducing deterioration of aquatic products in the circulation process. Solving the problems existing in cold chain logistics of Zhoushan aquatic products is not only conducive to the development of local aquatic products industry in Zhoushan, but also will set an example for the development of national aquatic products industry.

2. Summary of cold chain logistics theory

Cold chain logistics refers to the special supply chain system consisting of a series of procedures such as multi-level processing, transportation, storage, distribution and retail of products to maintain a low
temperature environment for various kinds of fresh agricultural products such as vegetables, fruits, meat, aquatic products and eggs, so as to ensure quality, reduce deterioration and avoid contamination [4]. Refrigeration technology and other related technologies are the bases of the development of cold chain logistics. With the advance of technology in the industry, cold chain logistics has made substantial progress.

Cold chain logistics of aquatic products is an essential classification of cold chain logistics. Cold chain logistics of aquatic products refers to the system engineering that the cold or frozen aquatic products are in the specified low temperature environment before production, storage, transportation, sales and consumption, to ensure quality and reduce deterioration[5]. The flow chart is shown in Figure 1. In aquatic products industry, it is critical to introduce the advanced idea and technology of cold chain logistics of aquatic products in time to gain the market advantage position.

3. Present situation of cold chain logistics of Zhoushan aquatic products
According to the 2008-2017 National Economy and Social Development Statistical Bulletin of Zhoushan City, the statistics of the total output of Zhoushan aquatic products, pelagic fishery and mariculture in these years are obtained, as shown in Figure 2. It can be seen from the figure that in recent years, the total output of Zhoushan aquatic products has maintained a growth trend, with a rapid growth rate. Except for a slight decline in 2008-2009, there is a great increasing range in the other

3.1. Present situation of cold chain logistics enterprises of Zhoushan aquatic products
There are two characteristics of cold chain logistics enterprises in Zhoushan: one is the rapid development in ladder form. Based on the scale of cold chain logistics enterprises in Zhoushan, they
can be divided into three types: small, medium and large. Among them, the small-scale cold chain logistics enterprises are mostly family enterprises, generally with several refrigerated transport vehicles; the medium-sized cold chain logistics enterprises consist of family enterprises and joint ventures, with relatively large scale and with a relatively large number of refrigerated transport vehicles; the large-scale cold chain logistics enterprises are mainly joint ventures, with a large scale and with refrigerated transport fleets. The second is that their distribution presents a concentration effect. In the early stage of cold chain logistics industry in Zhoushan, cold chain logistics enterprises are scattered throughout the archipelago. However, with the development of cold chain logistics in Zhoushan, at present, cold chain logistics enterprises are gradually transferring to important areas of aquatic products production and trade such as Shenjiamen fishing port and Zhoushan International Aquatic Products City[6].

3.2. Present situation of cold chain logistics mode of Zhoushan aquatic products

The cold chain logistics transportation mode of Zhoushan aquatic products can be summarized as follows: after being fished in the fishing ground, aquatic products are transported to ports by refrigerated transport ships, then in refrigerated warehouses. Finally, they are transported to aquatic product markets by refrigerated transport vehicles or flowing water transport vehicles. Ships, refrigerated transport vehicles and flowing water transport vehicles are the main cold chain logistics transport vehicles in Zhoushan.

Zhoushan City is located in the Zhoushan archipelago, and its geographical position determines that ships are the primary mode of cold chain transportation of local aquatic products. According to the statistics of the 2018 National Economy and Social Development Statistical Bulletin of Zhoushan City, in 2018, there are 1600 marine transport ships in Zhoushan, with a transport capacity of 7.495 million deadweight tons, an increase of 23.2% over the end of last year. Among them, 174 ships have a tonnage of 10000 tons and above, an increase of 24 ships over the end of last year, with a capacity of 4.652 million deadweight, accounting for 62.1% of the total transport capacity of the city.

Refrigerated warehouse, refrigerated container, refrigerated transport ship and refrigerated transport vehicle are the main storage means of cold chain logistics of Zhoushan aquatic products. There are more than 110 refrigerated warehouses in operation in Zhoushan, with a total capacity of 350000 tons. There are 30 aquatic products processing enterprises in Putuo District, Zhoushan City, with an average capacity of 2360 tons for each enterprise, and 38 aquatic products processing enterprises in West Wharf, Zhoushan City. All these processing enterprises have a total capacity of 70000 tons, and 15000 tons for tax declaration [7].

4. Problems in cold chain logistics industry of Zhoushan aquatic products

4.1. Insufficient cold chain logistics equipment

According to the 2016 Distribution Map of National Cold Chain Logistics Enterprises, the refrigerated warehouse capacity of Zhejiang Province is about 1 million tons, ranking 13th in all provinces and autonomous regions in China, and the total number of refrigerated transport vehicles is about 1500, ranking 13th in the country. The per capita refrigerated warehouse capacity is about 200 tons / 10000 people, ranking 15th in the country, and the per capita number of refrigerated transport vehicles is less than 0.5/10000 people, ranking 17th in the country. By contrast, Shanghai's per capita refrigerated warehouse capacity is up to 1243 tons / 10000 people, and the per capita number of refrigerated transport vehicles is 7 / 10000 people, ranking the first in the country. In East China, the per capita refrigerated warehouse capacity is 310 tons / 10000 people, and the per capita number of refrigerated transport vehicles is 0.77/10000 people. It can be seen that each index of cold chain logistics equipment in Zhejiang Province belongs to the intermediate or low level among 32 provinces and autonomous regions in China, which is far behind the national top level and the average level of East China. However, the GDP and per capita GDP of Zhejiang Province have been in the forefront of China for a long time. Insufficient cold chain logistics equipment in Zhejiang Province is not
consistent with the situation that Zhejiang Province has a strong economy. Therefore, there is a lot of room for improvement. Zhoushan also faces the problem of insufficient cold chain logistics equipment: the number of refrigerated transport ship is not large, and the technology of refrigerated equipment applied to ships cannot reach the high level of the industry; the number of professional refrigerated transport vehicles is small, and the refrigerated transport vehicles of many small and medium-sized cold chain enterprises are transformed from general vehicles which present poor refrigeration effect; the capacity of refrigerated warehouses is low with old facilities, which cannot give full play to the role of refrigerated warehouse.

4.2. The backward development of third-party cold chain logistics
Third-party cold chain logistics (3PCCL) refers to an operation and management method that frozen and refrigerated food enterprises contract with professional cold chain logistics service providers to entrust them cold chain logistics business in order to concentrate on main businesses and bring down costs. Meanwhile, they keep close contact with cold chain logistics enterprises through information system, so as to achieve whole processing management and control[8]. For Zhoushan aquatic products enterprises, entrusting cold chain logistics business to professional cold chain logistics enterprises can not only help reduce the investment cost of cold chain logistics equipment, but also significantly facilitate the quality and efficiency of cold chain logistics of aquatic products, improve the quality of aquatic products and obtain more profits.

However, there are some problems existing in the development of third-party cold chain logistics of Zhoushan aquatic products: on the one hand, Zhoushan aquatic products enterprises do not pay enough attention to third-party cold chain logistics, and they are not aware of the benefits that third-party cold chain logistics brings to their aquatic product business. On the other hand, Zhoushan lacks sufficient third-party cold chain logistics services and professional third-party cold chain logistics enterprises. There are only 10 registered and existing cold chain logistics companies in Zhoushan, 28 registered and existing cold chain logistics companies in Ningbo, and 42 registered and existing cold chain logistics companies in Hangzhou. What's more, professional third-party cold chain logistics enterprises outside Zhoushan tend to pay more attention to carry out their business in Ningbo and less attention to the demands in Zhoushan. From the perspective of both supply and demand, there is a large gap of third-party cold chain logistics services in Zhoushan.

4.3. Lack of professional cold chain logistics talents
At present, China's cold chain logistics has entered a high-speed development period, the number of cold chain facilities and equipment has risen significantly, and the quality of cold chain logistics has been considerably improved. However, due to the special requirements for cold chain logistics talents, the number of cold chain logistics talents cannot meet the society’s needs[9]. According to the Medium- and Long-term Plan for Development of the Logistics Industry (2014-2020), logistics practitioners in China grow at an average annual rate of 6.2%, creating about 1.8 million logistics job vacancies every year. However, there are only 150000 logistics talents from logistics major in colleges and universities every year, which is far from satisfying the society’s demand for logistics talents.

Compared with Shanghai, Hangzhou, Ningbo and other developed cities in China, Zhoushan's economic development is obviously not enough, and its attraction to logistics talents is not strong, thus it is difficult to retain cold chain logistics professionals who are originally scarce in China. At present, most of the practitioners of cold chain logistics of aquatic products in Zhoushan have not received professional training, or rarely learned professional knowledge of cold chain logistics. They lack of theoretical consciousness and professional operation skills, which is a restrictive factor that cannot be ignored for the development of aquatic products industry relying on cold chain logistics.

4.4. Poor informatization of cold chain logistics
Logistics informatization refers to a series of processes such as collecting, classifying, transferring, aggregating, identifying, tracking and querying all or part of the information generated in the logistics
process by using modern information technology, so as to achieve control of the goods circulation process, thus reducing costs and improving efficiency[10]. Modern logistics cannot be separated from processing information flow. Without information flow, logistics will no longer be smooth[11]. At present, the informatization level of cold chain logistics of aquatic products in Zhoushan is improving, but on the whole, there are still some problems such as backward technology, poor information circulation and inaccurate information transmission, and a lack of widely used logistics information platform. Most of the world's advanced port cities have developed logistics information platforms. For example, in the last century, Singapore has established a comprehensive logistics information conversion platform, TradePalette, which helped Singapore save about $1 billion in logistics. DTTN, the digital trade transport network and data exchange system established in Hong Kong, can be applied to more than 80 trade and logistics services, including aquatic products logistics.

5. Countermeasures for the problems in cold chain logistics of Zhoushan aquatic products

5.1. Increasing investment in cold chain logistics equipment

Logistics equipment is an important tool for the development of modern logistics. The development of cold chain logistics of aquatic products in Zhoushan requires sufficient refrigerated warehouses, and they should be built reasonably and utilized properly. Since 2011, Zhejiang Province has concentrated on building medium and low temperature refrigerated warehouses for aquatic products in important port cities to relieve urgent needs. However, after 2013, due to the soaring costs of pelagic fishery, the prices of aquatic products in international market fell sharply. Many fishery companies' profits fell seriously, and even could not bear the storage costs. In some cities of Zhejiang Province, refrigerated warehouse providers even subsidized the storage costs for fishery companies[12]. The government should draw lessons from above cases. It should review and approve the construction of refrigerated warehouses according to the fishing situation of Zhoushan aquatic products, in order to rationally meet the quantity gap of Zhoushan refrigerated warehouses and ensure the improvement of quality of refrigerated warehouses in Zhoushan at the same time. For the already existing refrigerated warehouses, the proportion of low-level refrigerated warehouses should be minimized. The best refrigerated warehouses with standardized construction and proper operation will be rewarded.

For professional refrigerated transport ships and vehicles, first of all, we should try to reduce the use of ordinary ships and vehicles as refrigerated transport ships and vehicles after a little modification. For this, relevant departments can issue standards to prevent a large number of unqualified modified refrigerated transport ships and vehicles from running. Secondly, we should encourage enterprises to upgrade their equipment and facilities in refrigerated warehouses and try to ensure that the loading and unloading process is completed within the refrigerated warehouses, so as to maintain a whole course cold chain. Finally, Kaili and Dalengwang, located in East China, are the two major manufacturers of refrigeration equipment for refrigerated transport vehicles in China, and the largest suppliers of condensing units for middle and high-end refrigerated transport vehicles. Zhoushan should take advantage of this location advantage to establish its extensive business with such refrigerated transport vehicles and refrigeration equipment giants.

5.2. Developing third-party cold chain logistics actively

On the one hand, Zhoushan's aquatic products producers and sellers should actively cooperate with third-party cold chain logistics enterprises in Shanghai, Hangzhou, Ningbo and other places, release bidding information of third-party cold chain logistics of aquatic products, and attract third-party cold chain logistics enterprises to pay attention to business in Zhoushan. On the other hand, local government of Zhoushan should issue preferential policies for third-party cold chain logistics enterprises, attract third-party cold chain logistics companies in other cities or overseas to carry out businesses in Zhoushan, and promote the development of local third-party cold chain logistics enterprises.
At the end of 2017, Putuo District issued a document named as “Some opinions on accelerating the development of e-commerce”, encouraging e-commerce enterprises to actively apply cold chain logistics technologies and schemes of third-party logistics, and providing financial subsidies for e-commerce enterprises that use third-party cold chain logistics. Similar policies can be applied to Zhoushan aquatic products enterprises to promote cooperation between Zhoushan aquatic products enterprises and third-party cold chain logistics companies, so as to achieve win-win results for Zhoushan municipal government, Zhoushan aquatic products enterprises and third-party cold chain logistics companies.

5.3. Optimizing the introduction and training system of cold chain logistics talents
The government and enterprises should establish a reward system for cold chain logistics talents to attract high-quality talents to work in Zhoushan. The organs or organizations where cold chain logistics talents work should carry out safeguard measures and conditions, and establish a reward mechanism for achievements. The high-end management and technical posts related to cold chain logistics will be included in the demand posts for the introduction of high-end talents in Zhoushan Archipelago New Area to attract high-quality cold chain logistics talents to work in Zhoushan.

We need to make good use of local educational resources in Zhoushan, pay attention to the cultivation of cold chain logistics talents in colleges and universities, and establish a vocational education system for cold chain logistics of aquatic products. The government should actively guide Zhejiang Ocean University and Zhejiang International Maritime College to carry out cooperation between school and enterprise. Colleges and universities train professional cold chain logistics talents for enterprises, and enterprises provide practice bases for colleges and universities[13]. At the same time, Zhoushan can attract logistics related students of Zhejiang University to practice in Zhoushan through the medium of the Ocean College of Zhejiang University. In addition, Zhoushan can establish third-party training institutions and public training bases for cold chain logistics, utilizing teaching resources from Zhejiang Ocean University and Ningbo University to train logistics industry employees, unemployed people and job seekers who want to engage in logistics, and to increase the number of middle- and low- end practitioners engaging in cold chain logistics in Zhoushan.

5.4. Enhancing informatization of cold chain logistics
The government should issue relevant logistics information platform construction plans, learn from the logistics information platforms that has been built and operated in advanced port cities such as Hong Kong, Singapore and Shanghai, integrate Zhoushan International Aquatic Products city, major fishing grounds and aquatic products enterprises into a common platform, establish a complete cold chain logistics information platform, and enhance informatization of cold chain logistics.

We should encourage the main information owners of cold chain logistics, such as logistics parks, large- and medium-sized aquatic products enterprises, to extensively apply professional softwares and equipment to cold chain logistics informatization, strengthen the sharing of information with each other, and ensure smooth information flow in the process of cold chain logistics as well as the accuracy and betimes of information transmission. For the small-scale, family township aquatic products producers located in the islands, the relevant departments of the local township government should instruct them to use information softwares and equipment, in order to establish a comprehensive cold chain logistics information platform covering the whole industry of Zhoushan aquatic products.

6. Conclusion
According to the Outline of the 12th Five-Year Plan for Economic and Social Development, which was deliberated and adopted at the Fourth Session of the Eleventh National People's Congress in 2011, it clearly put forward that we should focus on promoting the development of Zhoushan Archipelago New Area in Zhejiang Province. In 2016, Zhejiang Province issued the 13th Five-Year Plan for Open Economic Development in Zhejiang Province, which also pointed out that it is necessary to "further
promote the substantial integration of Ningbo and Zhoushan port, as well as the construction of port economy circle and Zhoushan Archipelago New Area. It can be seen that the State and Zhejiang provincial government are vigorously promoting the construction of Zhoushan Archipelago New Area. Under this favorable environment, we should strive for more beneficial national policy support [14] to promote the development of cold chain logistics of Zhoushan aquatic products.

Aquatic products industry is the characteristic industry of Zhoushan. To solve various problems in aquatic products industry is the key measure for developing Zhoushan's economy. Cold chain logistics is the lifeblood of aquatic products. To improve cold chain logistics of Zhoushan's products, we should take measures based on people, equipment and system, and chase the best in the industry continuously. This is to consolidate the status of Zhoushan as "Fishery capital of China". It is also of great significance to build Zhoushan into a world-class fishing ground, which is also a critical step for Zhoushan to develop its archipelago new area and implement the national maritime economic strategy.

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