

# Construction of Tropical Agricultural Products Emergency Logistics Coupling System: Take Hainan Free Trade Port as an Example

Liu Cuicui<sup>1</sup> and Wang Xiuqin<sup>2</sup>

<sup>1</sup>*Institute of Logistics Management and Engineering, Zhuhai College of Science and Technology, Zhuhai, Guangdong, China*

<sup>2</sup>*Zhuhai College of Science and Technology, Zhuhai, Guangdong, China*

**Keywords:** Emergency Logistics, Tropical Agricultural Products, System Dynamics, Hainan Free Trade Port.

**Abstract:** In order to better realize the value conversion of agricultural products through the emergency logistics of agricultural products, this paper analyzes the current situation of the emergency logistics of tropical agricultural products in Hainan. First of all, the characteristics of tropical agricultural emergency logistics are described, and the urgency of circulation and sales of agricultural products under the epidemic situation is integrated into the emergency logistics. Secondly, the coupling relationship between emergency logistics and tropical agricultural products is studied using the method of System Dynamics. Through the construction of the model and the behavior mode analysis of the coupling system, the paper put forward the following solution to use the emergency logistics to drive the sales of tropical agricultural products: the industrial Internet cloud warehouse mode is the breakthrough of emergency logistics development in tropical agricultural products; The refined management of standardized emergency logistics is the anchor of the value of emergency logistics in tropical agricultural products. The construction of emergency IT platform is the only way for emergency logistics to develop tropical agricultural products. This is of practical significance in increasing farmers' income and driving industrial economy.

## 1 INTRODUCTION

Since the 1960s, the rapid rise of new industrial forms such as the United States biological agriculture, digital agriculture, ecological agriculture and tourism agriculture has provided great impetus for the development of American agriculture. With regard to the study of agricultural logistics service industry in the transportation of agricultural products, Sloof et al pointed out that the quality of agricultural products may reduce the efficiency of its application, which depends on three factors: agricultural products themselves, consumer needs and objectives as well as the market conditions of agricultural products procurement. Long and Wood proposed that the only dominant factor determining the success or failure of crisis management is information management activities. Fritz Research Institute developed a software for supply chain management, which also could support emergency logistics information work. Tucker was the first to study the rise of specialized agricultural information service and how to transfer agricultural technical information to farmers. The relevant domestic policies include the 13th Five-Year Plan for The Construction of National Emergency

Response System: the No.2 document issued by the State Affairs Office (2017), which mentioned that the current public security situation is grim and complex and we should establish and improve the emergency logistics system, vigorously promote the development of integrated storage and transportation equipment for emergency supplies, and gradually realize the standardization, modularization and high efficiency of emergency logistics. The Research group of the Institute of Macroeconomics and the Department of Agricultural Economics of the National Development and Reform Commission pointed out strengthening the construction of rural infrastructure. In the No. 1 document of the Central Government "Several Opinions on Implementing the New Concept of Development, Speeding up agricultural modernization and Realizing the Goal of an all-round well-off life", the specific requirements of "promoting the close connection of agricultural production, addition and marketing, and cultivating the new mode of increasing farmers' income" were put forward. Domestic related researches include the construction of regional emergency logistics service mode (Wang Chenglin, Wu Xuelian, et al.), the construction of China's agricultural emergency

logistics system under emergencies (Fu Yu; Zhang Yi, Hou Hanping; Zhang Jingyu, Dai Anna et al.), the influencing factors of agricultural product management from multiple perspectives (Zeng Qianlin, Sun Qiubi; Lai Xiuyuan; Li Liu, Cai Jian, et al.), agricultural product logistics under the epidemic situation (Cui Mi; Wang Hainan, Ning Aizhao et al. Zhang Qinhong). The main representative researches are as follows: Wang Chenglin and Wu Xuelian put forward the operation mode of shared logistics center based on multi-agent coordination through in-depth analysis of the current situation of emergency logistics in China. Combining the current situation and existing problems of the development of food emergency logistics in Hainan, Fu Yu et al proposed strategies to strengthen emergency response and plan management and improve the level of early warning service. Zhang Yi and Hou Hanping analyzed the construction principles and common problems of agricultural emergency logistics system under emergencies, and put forward corresponding measures based on emergencies. Zhang Jingyu et al proposed that the government should strengthen logistics informatization and modernization. Li Liu et al believe that the involvement of e-commerce has a crucial impact on the operation of agricultural products, and the standardization of agricultural products and the construction of brand are the key to the quality of business. Cui Mi believed that affected by the epidemic, the supply chain of agricultural products should be built from six aspects, including optimization of upstream, innovation of downstream, development of cold chain and layout of emergency response system, to deal with the situation of "fire and ice" in fresh food industry. According to the impact of the epidemic on fresh agricultural products in China, Wang Hainan et al. proposed the development path and strategy of using digital supply chain to increase chain elasticity, improve fresh standardization and brand construction. Zhang Qinhong proposed that the huge impact of the epidemic on agricultural products should be addressed from three aspects, including strengthening cold chain logistics infrastructure.

The above shows that there are few studies on emergency logistics of tropical agricultural products. Tropical agricultural products in China are mainly concentrated in Hainan and other tropical regions. At the beginning of the epidemic, offline sales of agricultural products in Hainan were blocked. According to statistics, unsalable mangoes in Sanya, Hainan, reached 4,000 tons, which was only the tip of the iceberg in terms of delayed sales of tropical agricultural products. The emergency logistics and

tropical agricultural products can be combined to explore the coupling problems, and the value system can be built. The emergency logistics can be used to stimulate the local agricultural economy. This can not only solve the current problems during the epidemic emergency but also can lead the future agriculture economy and explore the road of the sustainable development.

## 2 THE STATUS QUO

Since the COVID-19 pandemic, the impact of this social unrest extends to the special period after the present pandemic, where the function of the market economy is weakened or was even completely ineffective at the beginning of the pandemic. The government needs to work with farmers to keep the society running smoothly. In tropical agricultural products emergency logistics, Hainan government has become the provider of emergency logistics, so it is necessary to build a set of optimal system planning and countermeasures. For the emergency logistics of tropical agricultural products, in addition to the characteristics of emergency logistics mentioned above, it also combines the characteristics of tropical agricultural products themselves: the scattered and disorderly phenomena arising from the more concentrated harvest of tropical agricultural products need urgent agricultural products circulation and the restrictions of their shelf life need efficient sale. This paper focuses on the research of circulation of tropical agricultural products and the emergency logistics.

Hainan agricultural emergency logistics can be mainly reflected in the following aspects:

First, the offline marketing of agricultural products has been impacted. Due to the impact of the epidemic, it is difficult to sell melons and vegetables in winter. Hainan is the largest winter melon and vegetable production base in China. Different from other production bases, its sales place is mainly outside the province. Due to this, merchants, logistics, sales market all affect Hainan agricultural products. Farmers are in a more passive part of the supply chain, and the phenomenon of "dilemma between buying and selling" appears. Combined with the traditional festival of "public season" with Hainan characteristics, the poultry raised by farmers has reached the sales standard but there is nowhere to sell, and the income of farmers is severely hit. As an export market, the agricultural products can not be consumed by the local market. Moreover, since closed-off management is implemented in villages and towns around the

country, most agricultural activities are forced to stop working, and farmers have a low degree of integration with the logistics system.

Second, logistics infrastructure construction lags behind, and emergency storage and security is not perfect. The circulation efficiency of fresh agricultural products is low, which affects the sales radius. The information technology of emergency logistics lags behind and emergency logistics lack standardized operation standards. The participation of farmers in Hainan is not high, most of them only focus on planting. When emergencies similar to the epidemic come, they do not know how to sell their own products. The transportation facilities of the source area of agricultural products are backward. Although the state has stressed the new rural construction to solve the "last kilometer" problem of rural logistics, the transportation facilities in Hainan are still backward because it is mountainous.

Third, agricultural logistics companies are not professional and the value-added logistics services such as circulation and processing of agricultural products are of low level. As an economic and social service industry, logistics industry plays an irreplaceable role in the development of other industries. Since there are too multifarious kinds of agricultural products, the requirements are also different as to storage and transportation. Warehousing and transportation of agricultural products at this stage is still in its quantity meet stage and it is not realistic to equip all the agricultural products with corresponding facilities. As a result, the degree of specialization is naturally generally low. Logistics development planning lags behind.

In short, the epidemic has highlighted the inconveniences of transportation in rural areas, the relatively backward third-party logistics, the scarcity of storage logistics and the poor professional circulation and processing of agricultural products, resulting in the phenomenon of "rich harvest but poor interest" in rural areas.

### 3 SYSTEM DYNAMICS MODEL CONSTRUCTION

#### 3.1 Analysis of the Construction of the Basic Model Structure

In this model construction, system dynamics is mainly used to study the emergency logistics of agricultural products in the circulation link under the epidemic situation. Tropical fruits and vegetables

were in the peak season of demand and there were booking agreements or trading cooperation signed by wholesalers or commercial enterprises in advance, so the sales volume was good at the beginning. When fruits and vegetables and other agricultural products come on the market in winter, the positive feedback loop plays a leading role in this period. The epidemic struck an inhibition of the adjustment of the agricultural products sales loop. This in turn leads to the cancellation of the orders of agricultural products. Even the order agreements signed with wholesalers are also largely affected. Large amounts of agricultural products could not be sold out. The epidemic lowered the demand for agricultural products sales investment, which further restricted the agricultural products sales promotion. It also lowered the logistics service performance criteria of export market, restricting the performance improvement of emergency logistics service, so as to make the emergency logistics supply negative feedback circuit plays a leading role. This aggravated the sales dilemma of agricultural products, so that agricultural products could not be sold. In order to solve this situation urgently, to trigger the demand for emergency logistics investment, to improve the existing service level, to improve the service performance of emergency logistics, and to solve the loss caused by unsalable agricultural products, another negative feedback loop plays a role in the performance of emergency logistics service, and the "negation of negation" rule of double negation can in turn promote the sales of agricultural products. The causal loop diagram and stock flow diagram of the fundamental model of insufficient investment in agricultural products sales and logistics are shown in Figure 1 (a) and (b).

The example equation is as follows:

The initial value of emergency logistics service performance = 100

Emergency logistics service performance = IF THEN ELSE (induced emergency logistics service demand <= existing logistics service level, 1, ZIDZ (existing emergency logistics service level, induced emergency logistics service demand)) \* 100

Marketing promotion rate = induced demand for emergency logistics service \* 0.5 \* (emergency logistics service performance - 90) / 100

Logistics investment demand = MAX (Required service - existing service level, 0)

Service of demand = induced emergency logistics service demand

Sales volume of agricultural products = INTEG (marketing promotion rate, 80)

Existing service level =INTEG (Service growth rate, 100)

Service growth rate =DELAY31 (logistics service investment, time required for service formation, 0)

Induced emergency logistics service demand =INTEG (demand change rate, 80)

Demand change rate = sales volume of agricultural products \*0.5\* (emergency logistics service performance -90)/100

Logistics service investment =DELAY31 (Logistics investment demand, delay time of service investment, 0).

The final sentence of a caption must end with a period.

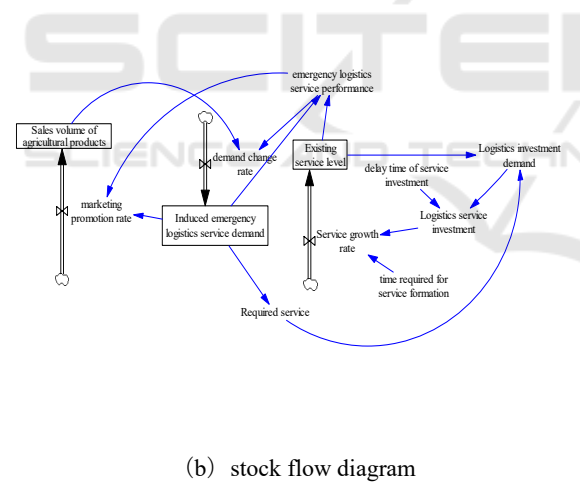
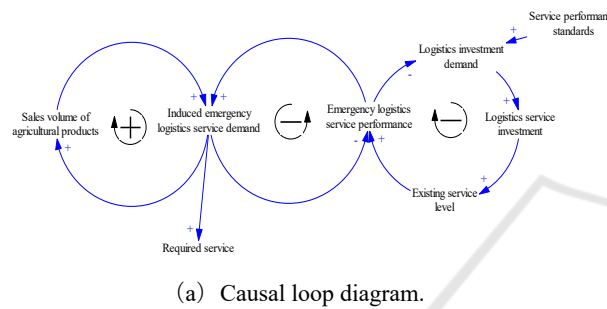


Figure 1: Structure of agricultural sales and urgent need model of emergency logistics.

### 3.2 Result

In this model, the sales volume of agricultural products is a cumulative quantity. Through the construction of the coupling system and data simulation, the simulation cycle is 100 weeks, which covers the period from the early stage of the epidemic in 2020 to the present. Due to the large amount of unsalable agricultural products under the epidemic

situation, the impact of insufficient stock of agricultural products is not considered here. The relationship between the investment service demand of emergency logistics service level and the sales volume of agricultural products is simulated. The research on sales volume mainly analyzes two variables, namely, the demand for emergency logistics service and the existing service level. The setting of Current data set takes the delay time of service investment =20 weeks and the time required to form the service =17 weeks. The parameters of data set 1 were set as delay time of service investment =6 weeks and time required for service formation =4 weeks. After simulation with VENSIM software, the behavior model was obtained, as shown in Figure 2.

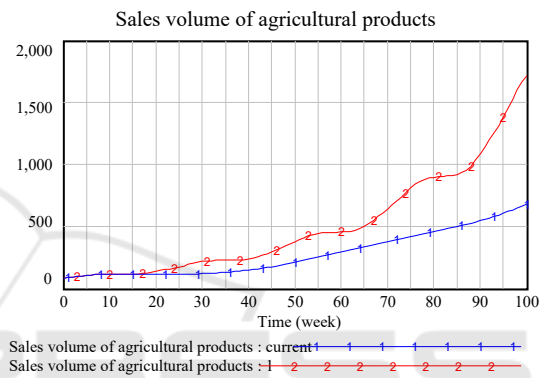


Figure 2: Scenario simulation curve of sales of agricultural products and sales of agricultural products in the urgent need model of emergency logistics.

In this simulation result, the sales volume of agricultural products in data set 1 is marked by line 2, which is significantly higher than that of line 1 in Current data set. It can be seen that the improvement of emergency logistics service level plays a decisive role in the sales of agricultural products, and it is necessary to accelerate the level of emergency logistics service: on the one hand, the delay time of emergency logistics service investment should be shortened; On the other hand, in the process of investment in logistics services, the time needed to form services should be shortened. Only by adjusting these two times at the same time and forming services as soon as possible can more sales of agricultural products be achieved in the process of epidemic. This requires local governments and regions to vigorously improve the service level of emergency logistics: on the one hand, knowing the main contradiction in the circulation process of agricultural products, they should try to improve logistics facilities and equipment and do a good job of the "first kilometer" in the field, so as to improve the service level of



emergency logistics as soon as possible; On the other hand, efforts should be made to drive the sales of agricultural products, so as to achieve online and offline sales promotion.

## 4 DISCUSSION

To realize the sale of fruits and vegetables is the primary consideration of farmers, the following solutions are proposed.

### 4.1 Cloud Warehouse Mode of Industrial Internet

The O2O management mode of agricultural logistics supply chain integrates online resources with offline resources and consists of agricultural production enterprises, wholesale centers and e-commerce platforms, so as to improve the flow efficiency of the logistics supply chain and reduce the corresponding logistics costs. Based on online publicity marketing and information interaction, online transactions are also the scale advantages presented by the integration of a variety of resources. The related offline operation will also be carried out at the same time. Through the effective integration of online and offline market and through setting up online flagship stores and physical stores, the problems related to the original logistics supply chain information and the agricultural products quality could be solved. Consumers can learn about the real information of agricultural products through a variety of platforms before they make online orders and wait for the third party logistics transportation.

### 4.2 The Refined Management of Standardized Emergency Logistics

With the continuous improvement of standardization of planting and management of tropical agricultural products, new technologies have been further promoted and applied and the output have been risen steadily and prices remained stable. The emergency logistics should be more efficient for the logistics needs of emergency situations. First, the emergency logistics command center should be established to design and improve the emergency system according to the previous health emergency or public events. Second, the government should use science and technology for the traceability management of agricultural products. More investment can be made in hardware and software to improve the service

efficiency of the network center and management center. Third, government should expand product sales channels in case of emergencies, re-inject economic vitality into enterprises, partially recover the market and supply basic living materials to the people.

### 4.3 Emergency IT Platform Construction

Many areas in Hainan have been affected by the epidemic, and the potential crisis may break out at any time, and the losses will gradually increase. Therefore, more and more people realize that it is imperative to strengthen the response, and emergency logistics plays a pivotal role in emergency work. Emergency logistics is a part of socialized logistics, and its development efficiency is restricted by the development level of logistics industry. Now most people no longer trade in cash, but choose mobile online payment for settlement. At the same time, the construction of vegetable basket project of government departments in offline transactions not only protects the interests of farmers producing agricultural products, but also protects the interests of consumers. The pandemic has accelerated changes in the way people buy and sell. With the help of mobile phones, most farmers can sell agricultural products online, increasing their own sales channels. Therefore, in order to better play the core role of the emergency logistics network platform, the supervision and tracking system of the production and marketing of agricultural products, distribution points, vehicles, emergency logistics enterprises and other situations should be included in the construction of the IT emergency platform.

## 5 CONCLUSIONS

In the period of sharp drops in market prices, how to implement subsidies to farmers is also a problem Hainan needs to consider. When the price rises, it is difficult to transport vegetables from the field to the public. The smooth transport link is crucial. Establish emergency logistics response mechanism and agricultural products emergency logistics system. The mechanism should guarantee the cooperation of the main body of emergency logistics. The construction of the emergency logistics response mechanism includes the construction and improvement of the coordination mechanism of the government, the improvement of the monitoring and early warning mechanism, the establishment of the social public

emergency mechanism, the improvement of the emergency report and information release mechanism. To change the awkward situation that emergency logistics is only paid attention to when disasters and epidemics come. We will encourage integrated use of post express service and supply and marketing resources, and give full play to the advantages of the postal network in terms of its wide coverage and high reliability. This is very different from the past, and now we have a situation where demand is unchanged or even increasing, but there is a shortage of supply. On the overall level, a large number of unsalable agricultural products are mostly caused by blocked circulation channels, but specific analysis will find that the situation of unsalable agricultural products in various regions varies greatly: some of the buyers did not purchase in accordance with the plan, which led to blocked sales; the village road closure led to limited logistics, so the agricultural products can not be shipped out; some agricultural products can not be sold because of the changes in past sales channels. Therefore, to solve the problem of unsalable agricultural products under the epidemic situation, IT platform of agricultural emergency logistics should be established and overall planning should be carried out.

## ACKNOWLEDGEMENTS

This research was supported by College Students Innovation Training Project of Hainan Province in 2020: "*Nanguo*" *Yunzhi Zhen Store* (S202013892022); Natural Science Foundation of Hainan Province in 2021(No.721RC605);2022the college level teaching quality engineering construction project Higher Education Teaching Reform - Specialty Innovative Curriculum Project (ZLGC20220527) "*Innovative Research on the Teaching Theory and Practice of Logistics Technology and Equipment*"; 2021 Teaching Quality and Teaching Reform Engineering Course Teaching and Research Office Construction Project of Guangdong Provincial Department of Education "*Intelligent Logistics Application Teaching and Research Office Construction*".

## REFERENCES

Slouf, M., Tijssens, L. M. M. & Wilkinson, E. C., 1986. Concepts for Modelling Quality of Perishable Products. Trends in Food Science and Technology.

- LONG D, WOOD D.,1995.The Logistics of Famine Relief.Journal of Business Logistics.
- INSTITUTE F.,2004.Humanitarian Logistics Software.San Francisco: Fritz Institute.
- Tucker,Mark;Napier,Ted L.,2002.Preferred sources and channels of soil and water conservation information among farmers in three mid western US watersheds.Agriculture,Ecosystems and Environment.
- Li Xiaohui,2015. Research on Emergency Logistics Planning and Scheduling. Jiangsu: Nanjing University of Aeronautics and Astronautics.
- Department of Industrial Policy and Regulation,2016 Ministry of Agriculture. National Policies and Measures to Implement the New Concept of Development, Accelerate Agricultural Modernization and Promote Farmers' Continuous Income Increase . Jilin Agriculture.
- Fu Yu,2019. Development and Countermeasures of Food Emergency Logistics System in Hainan. Logistics science and technology.
- Zhang Yi, Hou Hanping,2018. Preliminary Study on the Construction of China's Agricultural Products Emergency Logistics System under Emergencies. Shanxi Agricultural Economics.
- Zhang Jingyu, Dai Anna, Liu Yu, Fan Xiaoyan,2017. Study on Optimization of Fruits, Vegetables and Agricultural Products Emergency Logistics System. Journal of Anhui Agricultural Sciences.
- Chen Hongxia, QU Yuepeng,2020. Research on the Endogenous Mechanism of Rural Primary, Secondary and Tertiary Industry Integration based on the Cultivation of Competitive Advantages. China Soft Science.
- Li Liu, Cai Jian, LI Yi,2021. Influence Mechanism of E-commerce Platform on Agricultural Products Management: Technological Innovation Drive and Market Channel Expansion. Rural Economy.
- Cui Mi,2020. Development Countermeasures of Fresh Agricultural Products Supply Chain in China under the Background of COVID-19. Logistics Engineering and Management.
- Hu Wei,Shu Huifang,2022.Research on supply guarantee and emergency response system based on cloud platform under the background of major epidemic.Wireless Internet Technology.
- Zhang Qinrong,2021. Problems and Countermeasures of Agricultural Products Logistics in China under COVID-19.China Storage and Transportation.