Proceedings of ICFTBA 2024 Workshop: Finance's Role in the Just Transition
DOI: 10.54254/2754-1169/144/2024.GA19086

Research on Optimization Ideas of Inventory Management Problems in Cold Chain Logistics

Kewen Wang[1,a,*]

[1]*Institute of Changchun University of Technology, 2055 Yan'an Avenue, Changchun City, Jilin Province, China*
a. wangkewen@ldy.edu.rs
**corresponding author*

Abstract: This paper analyses the characteristics of the existing cold chain logistics from the perspective of cold chain inventory, and puts forward the corresponding management optimization ideas in combination with the inventory of a supermarket. Using Activity Based classification, ten kinds of fruits in the inventory are classified, and reasonable management suggestions are put forward to finally achieve the purpose of optimization and improvement. This thesis is divided into five parts, the first part is an introduction which gives the background of cold chain logistics. The second part is the research status, which contains the current status of cold chain inventory management and research status. The third part is the problem analysis, which is an analysis and research on the current status of inventory in supermarkets and identifies several problems. The fourth part is the optimization solutions and suggestions for the problems of inventory in supermarkets respectively. The fifth part is the conclusion and the outlook for the future.

Keywords: the ABC classification method, cold chain logistics, inventory management.

1. Introduction

The development of cold chain logistics in China started late, with technology research and development and application lagging behind, and the scope of application has long been relatively limited and the level of application relatively low, which also makes the loss of fresh and live agricultural products in circulation remain high. A recent study by the Institute of Food and Nutritional Development of the Ministry of Agriculture and Rural Development reveals that each year, the weighted average loss and waste rate of China's seven major categories of food is 22.7% by weight, or about 460 million tonnes, of which 300 million tonnes of food is lost in the production and circulation chain. Inventory management is an important research topic for enterprises in the logistics system. Because inventory takes up a large amount of liquidity, due to the fact that in the field of cold chain, there is less research on the rationalization of inventory control of cold chain products, while the role of inventory in logistics cannot be ignored. Therefore, it is of great theoretical significance and practical significance to rationally control the inventory of a supermarket's fruits as an example in order to reduce the inventory cost according to the demand and deterioration of cold chain logistics.

DOI: 10.54254/2754-1169/144/2024.GA19086

2. Overview of the current state of research

2.1. Existing Issues in Cold Chain Inventory Management

Currently, cold chain logistics inventory management is facing a series of challenges. Firstly, market volatility and demand uncertainty is a major challenge for inventory management. Agricultural products have significant seasonality and randomness, and it becomes particularly difficult to predict future sales volume and demand trends. The high cost nature of cold chain logistics also places special demands on inventory management [1]. Maintenance of refrigeration equipment, energy consumption, and warehouse management under strict temperature control all make the inventory cost of cold chain logistics significantly higher than that of ambient logistics [2]. Furthermore, the risk of product deterioration is an item that cannot be ignored in cold chain logistics inventory management. With the global environmental awareness, low carbon and sustainable development have become the new focus of cold chain logistics.

2.2. Existing studies

Among the existing studies, Li L, Yang Y, Qin G investigated the optimization of the cold chain integrated inventory path problem considering carbon emissions [3].Doborjginidze G, Petriashvili L, Inaishvili M used a supply chain management (SCM) model to incorporate effective techniques to reduce costs, improve product quality, deliver goods and manage after-sales services, thus minimizing operating costs and improving production throughput and quality of products and services [4].Bozorgi analyzed the cold chain supply chain from financial and environmental perspectives. An inventory policy model considering holding and transport unit capacity was developed in cold chain supply chain [5]. Huang Can takes Zhuangning Cold Storage Company as an example, establishes ABC classification system to improve inventory efficiency, uses exponential smoothing method for demand forecasting and reduction of sluggish inventory, uses safety stock model to reduce purchasing cost, and uses RFID, EDI and other technologies to improve inventory management efficiency [6]. Wang Lulu studied the multilevel inventory of meat products in YR company and used the theory and improved model from the perspective of multilevel inventory in the supply chain in order to reduce the total cost of inventory in the supply chain [7].Torres-Paredes C, Rivera-Gonza D, Flores-Perez A used SLP tool, ABC Taxonomy and 5S to improve the company's service rate, the reduced service time and improved problems such as lack of available space in the company's inventory [8].

3. Problem analysis

This report is based on an inspection of the Home Park supermarket, in which ten types of fruits are taken as examples, and the relevant features of cold chain logistics are combined to analyse their inventories and put forward optimization suggestions. Cold chain logistics can be divided into two aspects: chilled and frozen, and in this report, it is mainly analyzed and discussed from the perspective of chilled. Cold storage has a very important role to play in ensuring the quality of fruits and prolonging their shelf life, so the role of cold storage is very important, so it is very important to optimize the inventory and make it more economically efficient.

The supermarket is a chain of large-scale integrated supermarket organizations, through the actual visit inspection found that the supermarket fruit classification management is not fine. As the supermarket pays the same attention to all the fruits, the primary and secondary division of the fruits is not clear, failing to divide the fruits according to their importance, and the staff did not use scientific means to carry out the standard classification management of the fruits, which leads to some fruits with high value and short shelf-life not being able to be sold in time, and make the inventory

DOI: 10.54254/2754-1169/144/2024.GA19086

backlog and bring about huge losses. Therefore, irrational inventory classification management will lead to some high value, short shelf-life fruits can not be sold in time, and there is a backlog of inventory, thus increasing all kinds of costs of enterprises. For different fruits the optimal storage temperature is also different, supermarkets do not store them separately, which are likely to accelerate the rotting of fruits, resulting in the waste of stock has been economic losses.

Supermarkets have recruited poorly qualified staff with no theoretical understanding of inventory management and insufficient practical experience, and management is not sufficiently aware of the importance of inventory. These can be an unnecessary drain on stock, for example, some fruit cannot be stored in stacks. Many people believe that inventory fulfils its function as long as it stores the required products. However, proper inventory management can greatly reduce the cost of supermarkets.

In order to solve the problems identified above, according to the actual inspection and the data provided by the supermarket, the ABC classification method is used to improve the classification, due to the supermarket has a wide range of fruits but the report is limited in space, only ten of the fruits as a case study for the classification of the study, the specific classification and data analysis is shown in Table 1. Based on the unit price and stock quantity of each of the ten different fruits, their stock share amounts were calculated, and then their capital share of the total amount was calculated.

Table 1: ABC classification table of ten fruits

Fruit Name	Unit Price (CNY/kg)	Inventory (units: kilogram)	Amount of inventory occupied (units:CNY)	Amount proportion	The proportion of the accumulated amount	Type
blueberries	103.20	28.37	2927.784	22.37%	22.37%	A
fine navel oranges	25.80	79.72	2056.776	15.72%	38.09%	A
Yantai Fuji apples	15.98	105.03	1678.379	12.83%	50.92%	A
white-fleshed dragon fruits	13.98	90.83	1269.803	9.71%	60.63%	A
red grapefruit	19.96	60.78	1213.169	9.27%	69.90%	B
Sanya Australian mango	22.50	49.66	1117.350	8.54%	78.44%	B
red nectarine	17.80	49.93	888.754	6.79%	85.23%	B
Ningxia Selenium Melon	4.88	159.58	778.750	5.96%	91.19%	C
Banana	7.66	92.16	705.946	5.40%	96.59%	C
Shanxi Peach	11.98	37.21	445.776	3.41%	100%	C
Sum	-	-	13082.487	100.00%	-	

ABC classification, a classic inventory management tool, plays a key role in cold chain logistics inventory management due to its simplicity and effectiveness [9]. In the ABC classification, those

DOI: 10.54254/2754-1169/144/2024.GA19086

with a cumulative share of funds of 0-60 per cent are classified as category A, those with a cumulative share of funds of 60-85 per cent are classified as category B, and those with a cumulative share of funds of 85-100 per cent are classified as category C. Through the calculation of the above table, the following classification conclusions can be drawn:

Class A: blueberries, fine navel oranges, Yantai Fuji apples, and white-fleshed dragon fruits, a total of four kinds of fruits, which have a large proportion of sales, a high unit price of sales, and a relatively stable demand. Therefore, this type of fruit should be the supermarket's key focus on fruits, requiring strict inventory management strategies and timely tracking of inventory movements.

Category B: Red grapefruit, Sanya Australian mango, red nectarine, a total of three fruits, this category of fruit sales accounted for a moderate proportion, the unit price of sales is moderate, and there is a certain degree of fluctuation in demand. Therefore, this type of fruit should be a sub-focus of supermarkets to implement normal inventory management strategies.

Category C: Ningxia selenium melon, banana, and Shanxi hairy peach, a total of three fruits, which have an average percentage of sales, an average unit price of sales, and fluctuating demand. Therefore, this category of fruits should be a general concern for supermarkets and requires simple inventory management strategies.

4. Optimization ideas

It is important to classify the ten types of fruits into ABCs based on the classification and to use different inventory management strategies for the different types. For strict inventory management, it is required to manage the inventory items in a refined way, both in terms of stock quantity, location and time with precise control. For the different classifications, a special quick access area is proposed for Class A goods, along with a regular clearance mechanism for Class C goods. In addition to solving the problem of unclear classification priorities, other optimization suggestions were given to the business. When enterprises manage inventory, having an inventory management information system is the best way to improve management efficiency and build an effective inventory information management system in order to greatly improve inventory management efficiency. Moreover, both citrus fruits and tropical fruits are perishable foods and they have different optimum temperatures for storage, 0-2°C for citrus and 5-13°C for tropical fruits. So it is suggested that they can be stored separately in warehouses with different temperatures [10]. Some intelligent products can also be added, such as temperature and humidity sensors and ultrasonic sensors in the cold storage system [11].

For the staff to be familiar with the inventory management process, first of all, to improve the process of entry and exit, the fruit will be labeled management, the establishment of the fruit information base, after the procurement department according to the arrival list, acceptance of the fruit is qualified; Secondly, in the storage link, we should try to according to the characteristics of the fruit, the temperature, humidity requirements and the classification of fruits, the implementation of zoning storage, to ensure that the freshness of the fruits; Finally, the enterprise should be arranged for a specific Staff to do inventory plan, timely inventory, to prevent fruit decay loss, at the same time, inventory staff in the inventory process, found that the freshness of the fruit, notify the sales department for discount promotion processing, and the fruit that has decayed, counted as loss. All aspects of inventory management need to work together to ensure that each one is as good as it can be in order to minimize losses.

5. Conclusion

Based on the above analysis and research, the ten fruits are classified into three management categories. Blueberries, fine navel oranges, Yantai Fuji apples, and white-fleshed dragon fruits in

DOI: 10.54254/2754-1169/144/2024.GA19086

category A require strict inventory management strategies. The red grapefruit, Sanya Australian mango, and red nectarine in category B implement normal inventory management strategies. Category C, Ningxia Selenium Melon, Banana, and Shanxi Hairy Peach, require simple inventory management strategies. There are two other recommendations for this enterprise: (1) Establishment of inventory information management system, the use of intelligent refrigeration system. (2) Improve the process of inventory management.

This article leaves something to be desired, in that article it only looked at optimizing inventory from an ABC classification point of view. Further research will be done in the future and will use the Economic Order Quantity model, or EOQ model for short, to determine that the order quantity of inventory is very reasonable.

References

[1] *Lai, D.. (2024). Analysis of optimisation and innovation of food cold chain logistics management. Modern Food (06), 115-117. doi:10.16736/j.cnki.cn41-1434/ts.2024.6.038.*

[2] *Tian, Y., Zhang, Z., Chi, L., Zhu, M., Wu, J., & Shen, C.. (2023). Current situation, problems and suggestions for the development of cold chain logistics of agricultural products in China. China Food & Nutrition (05), 28-31. doi:10.19870/j.cnki.11-3716/ts.20230210.002.*

[3] *Li, L., Yang, Y., & Qin, G.. (2019). Optimization of integrated inventory routing problem for cold chain logistics considering carbon footprint and carbon regulations. Sustainability (Switzerland) 11 (17), 4628 (2019).*

[4] *Doborjginidze, G., Petriashvili, L., & Inaishvili, M. (2021). Optimization of Inventory Management in the Supply Chain. Journal of Communication and Computer, 16, 1-5.*

[5] *Bozorgi, A. H. A. (2014). Inventory Management Problem for Cold Items with Environmental and Financial Considerations (Doctoral dissertation, University of Central Florida).*

[6] *Huang, C.. (2023). Research on the optimisation of inventory management in Zhuangning Cold Storage Company (Master's thesis, Guangxi University). Master*

[7] *Wang, L.. (2019).Optimal control of multi-level inventory management for fresh meat products in YR Company (Master's thesis, Nanjing Agricultural University). Master's degree.*

[8] *Torres-Paredes, C., Rivera-Gonza, D., & Flores-Perez, A. (2022, October). Warehouse management model based on Lean Warehousing tools to improve order management using 5S tools, ABC Classification and SLP. In 2022 Congreso Internacional de Innovación y Tendencias en Ingeniería (CONIITI) (pp. 1-5). IEEE.*

[9] *Wei, J.. (2021). Research and Analysis on Food Safety in Cold Chain Logistics Warehousing - Taking Zhongkai Intelligent Cold Chain Logistics Park as an Example. Logistics Science and Technology (05), 152-156. doi:10.13714/j.cnki.1002-3100.2021.05.040.*

[10] *Ahmad, S. A. H., Ab Rahman, M. N., & Muhamed, A. A. (2020, August). Optimal temperature in cold storage for perishable foods. In Proceedings of the 5th NA International Conference on Industrial Engineering and Operations Management.*

[11] *Srivatsa, S. G., Bharadwaj, K. R., Alamuri, S. L., Shanif, M. M., & Shreenidhi, H. S. (2021, August). Smart cold storage and inventory monitoring system. In 2021 International Conference on Recent Trends on Electronics, Information, Communication & Technology (RTEICT) (pp. 485-488). IEEE.*