Cold Chain Logistics of Agricultural Products and Cost Structure Analysis from an E-commerce Perspective

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Abstract
Cold chain logistics has grown considerably in recent years with the application of information technology. The cold chain logistics of agricultural products (CCLoAP) was also expanded immensely in China, due to a rising demand from the market. The industry was operated in a more standardized and systematic manner, shifting more online, and was a major contributor to the economic growth in China. Nevertheless, lack of industry standard has hindered the growth of an integrated online sales platform for CCLoAP. Providing a background in relation to the progress, this paper explains the significance of CCLoAP and the way to set an industry standard. It proposes to build a fuzzy synthetic evaluation index system based on a more comprehensive multilevel evaluation model, with its help to summarize the digital marketing model of agricultural products in the country, and to discuss how online marketing cost affect the product price.

Keywords: Agricultural Products, Cold Chain Logistics, CCLoAP System, E-Commerce, Marketing Cost.

1. BACKGROUND
1.1 Overview
With the fast advance of information technology, China has entered into a computer era in which Internet became an increasing indispensable part of people's lives. China's economy made great progress, enabling ordinary people to access better life and at the same time changing their spending habits. One change is the rise of engagement consumption, which provides opportunity for CCLoAP go online possible (Sun et al., 2017). We have a good start, but there are three things that need to be considered: firstly, agricultural products need to be refrigerated during transportation, which is energy consuming and environment-unfriendly; secondly, cases of spoiled products occur frequently during the lengthy process of storage, transportation and further processing in an immature cold chain logistics system, at a time when food safety is becoming a growing source of public concern; lastly, the sales of agricultural products still confines to traditional retail stores, in which farmers get paid less because of too many parties involved in the circulation (Wang et al., 2017). Therefore, it is necessary to shorten circulation time and to explore new ways of marketing, in order to quicken the pace of building CCLoAP, reducing its environmental impact and food safety incidents.

1.2 Goal
This paper analyzes CCLoAP and its online marketing cost structure in the country from an e-commerce perspective, in order to offer some insights to standardize the industry, accelerate its progress and meet the market demand. Providing a background in relation to the progress of CCLoAP, It explains its significance and the way to set an industry standard, to build a more comprehensive multilevel evaluation model-based risk evaluation index system, on the basis of which to summarize the digital marketing model of agricultural products-O2O- in China and to discuss how online marketing cost affect the price of agricultural products.

2. CCLOAP FROM AN E-COMMERCE PERSPECTIVE

2.1 CCLoAP standard
Civilization has entered a new era after the birth of modern information technology. Standard of living was vastly improved, accompanied by a continuing increase in consumer demands, which rendered a standardized CCLoAP
(Jiang et al., 2017) seem imperative. The significance of a CCLoAP standard lies in: it is environmental friendly as it relies on internet as the primary platform; the online platform is more effective in meeting consumer demands, and in turn facilitate the formation of a CCLoAP standard.

2.2 Problems

China started late in CCLoAP compared to the developed countries. With an immature market mechanism and less friendly business environment, CCLoAP in China faces many problems. Figure 1 showed how products circulate in CCLoAP.

![Figure 1. Schematic Diagram of Circulation Chain of Cold Chain Logistics of Agricultural Products](image)

First of all, quality control during transportation was unreliable as unregistered vehicles were commonly used, quality equipment and qualified talents in shortage, on account of which a good portion of products being transported can’t make it to destination. Secondly, delivery was mostly done by manual labor instead of machines, without proper measure of refrigerating in the long process, causing damage to the products. Thirdly, delivery lacked efficiency as the market was not in perfect competition, less computerized and not standardized. Delivery trucks were poorly equipped, with nearly no value-added service (Zhu and Zhu, 2017). These were only just part of the whole picture. Other segments like storage, circulation plus and packing also have problems.

2.3 CCLoAP system

CCLoAP is a highly integrated system. One segment going wrong would affect other segments of the system, causing unwanted cost and reducing efficiency. Therefore, it is imperative to build a CCLoAP system with online platforms. For quality control during transportation all trucks should be strictly monitored and all products should be registered with information of their origin (Zhang and Liang, 2017). For delivery, machines with computer control should be used. For storage, it is better to use temperature control and refrigerating system, with ice-storage cooling technology and automatic stereoscopic refrigerator. In circulation plus and packing, improve the equipment that are being used, preferably in low temperature with computer control to assure food safety. For delivery, abide by the order form, lower transportation cost and reduce chance of damage by placing products in the truck in order of distance. Design an online delivery management system to enhance efficiency.

2.4 Measures

More efforts are needed to build a CCLoAP system. We should endeavor to: a. Create a dynamic and flexible standard system based on the weak segments that need more tests and improvements; b. Establish a monitoring agency for circulation; c. Use information technology to optimize management and facilitate information exchange; d. Government should encourage online retailers to promote CCLoAP and be a part of the community to build the CCLoAP system (Wen and Chen, 2016).

3. CCLOAP QUALITY CONTROL

A basic element in CCLoAP, temperature is controlled with precision. In addition, safety in every segment, from quality of the products, packing to storage, should be guaranteed in a standardized system (Wang and Zhang, 2016). Therefore, this paper uses a multilevel evaluation model to give a fuzzy synthetic evaluation of CCLoAP.
3.1 Model Creation

A multilevel evaluation model and fuzzy synthetic evaluation method is used to solve the safety issue. In this paper, fuzzy sets, obtained from triangle fuzzy numbers, represent concepts which are difficult to express in language (Zhou and Sun, 2015). To assure precision, triangle fuzzy numbers are introduced to create hypothesis for fuzzy sets M, which could be described as \((k, n, v)\). If there is fuzzy sets M in Domain U, \(U \in [0,1]\), the corresponding membership function is

\[
\mu_M(x) = \begin{cases} 
\frac{x - k}{n - k}, & x \in [k, n] \\
\frac{x - v}{n - v}, & x \in [n, v] \\
0 & \text{otherwise}
\end{cases}
\]

In this membership function, \(k \leq n \leq v\). K and V represents two ends of the fuzzy set. The further away they are from each other, the fuzzier the set and vice versa. The set is not fuzzy if \(V=K\). Establish fuzzy judgement matrix based on marked triangle fuzzy numbers. To get more accurate results, use triangle fuzzy numbers to represent the established fuzzy judgement matrix, then calculate the significance of factors with the help of logarithmic least squares and triangle fuzzy numbers, and apply muti-target decision to fuzzy environment (Tang et al., 2015). Follow these steps to build a multilevel evaluation model: categorize factor sets, define factor sets and evaluation criterion, sub-divide the sets based on their relations, and evaluate it with a single-level model and with the formula:

\[B_i = z_i^o R_i, \quad i = 1, 2, 3, \ldots, n\]

After the vector is obtained, build a multilevel judgement matrix with this vector as an independent factor, redistribute the percentage of different factors to get a second-level factor with the formula:

\[P = BV^T\]

3.2 Risk evaluation

The following steps should be taken to evaluate risks in CCLoAP: a. define the risk evaluation index system, calculate how much each criteria weigh, establish fuzzy judgment matrix to weigh factors and finally evaluate risks of the plan (Wan and Li, 2014). It is necessary to define domain first for the factors being evaluated and level of comment domain, and finally establish fuzzy relation matrix based on the relation of respective factors.

4. COST STRUCTURE ANALYSIS

It is necessary to expand and innovate the marketing channels for CCLoAP, in order to facilitate the change from offline transaction to modernized logistics and delivery. The author reviews the online marketing model of agricultural products and the cost structure, and analyze how the cost affect the price of the former.

4.1 Online marketing model of agricultural products

The online marketing of agricultural products refers to the selling of agricultural products through internet including online platforms. It has seen a rapid and dynamic growth in recent years thanks to the widespread application of information technology. At present the products are mainly sold in online retailer stores, vertical B2B, offline supermarkets, group buying and online platform of logistic companies. O2O combines online selling and services offline. After customers ordering products and paying online, or choosing going to a local store, the online retailers informs the supplier, delivering the product to supermarkets for pick-up, completing an O2O transaction. It renders higher customer satisfaction, but has a trade-off situation in which higher cost is incurred to maintain operation and service.

4.2 Cost analysis

As can be seen above the O2O model is centered on online retailers, supermarkets and logistics centers. Figure 2 below shows a O2O model of CCLoAP online dealers.
There are two types of costs incurred during this transaction. Expenses in opening stores and logistics centers, purchasing facilities, paying salaries and etc., which is fixed cost. Variable cost includes buying products, delivery fees, services and penalty cost (Chen et al., 2017).

4.3 Impact on product price

Discounts, optimized routes, service cost and information sharing could affect the price of agricultural products. With lower prices customers are more willing to place orders. It is also more cost effective to optimize the delivery routes as it cost more to deliver longer distances. In addition, price is also in direct proportion to the service cost. Despite the fact that services increase the overall product price, it is worth doing so to attract more customers. Information sharing in CCLoAP is another way to reduce cost and lower price.

5. CONCLUSION

It is of great significance to advance CCLoAP as it plays an important role in China's economic growth. Online retailers should seize the opportunity to improve technology, control cost, win customers, and successfully build a standardized CCLoAP.

REFERENCE

Wan Y.F., Li X.G. (2014). Experience and reference of cold chain logistics standardization in developed countries, Agriculture Outlook, 10 (04), 75-79.


Wen J., Chen H. (2016). "Internet plus" third party cold chain logistics of fresh agricultural products marketing network, The Rural Economy and Science and Technology, 27 (10), 60+64.

