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Research on comprehensive service ability evaluation system of cold chain logistics system for fresh agricultural products

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ABSTRACT

Cold chain logistics provide the quality assurance for fresh agricultural products from production to consumption. The loss in agricultural products logistics not only cause huge losses in the financial, but also cause limited land resources and environmental resources wasted. Agricultural products cold chain logistics comprehensive service ability refers to the cold chain logistics enterprise provide customers with competitive advantage at the lowest possible total cost. It realized through a series of logistics function activities. That is the comprehensive service ability of the optimal transportation of agricultural products logistics function activities to ensure the quality of agricultural products, reducing wear and tear. Comprehensive service ability evaluation system was based on the characteristics of fresh agricultural products present situation and development trend and previous studies. It is a comprehensive system that includes seven aspects, such as warehousing, distribution, food detection ability, cost control, logistics, financial services, information management ability, and ability to meet customer demand. And it can be detailed into 29 indexes. Analytic hierarchy process was used to define the weight. Fuzzy comprehensive evaluation method was used to evaluate the overall. The innovation of this research is that including logistics financial services and information management capabilities in building of cold chain logistics comprehensive service ability evaluation system. And this made the evaluation system more comprehensiveness and more forward-looking. The research results could be the reference for standard cold chain logistics enterprise service, the standard for the customer to evaluation and choose fresh agricultural products cold chain logistics enterprises, the advice for cold chain logistics enterprises to improve their service level.

KEYWORDS

Fresh agricultural products; Cold chain; Service capacity; Evaluation.



INTRODUCTION

As the improvement of living standards, the demanding for fresh agricultural products of Chinese people are growing. Fresh agricultural products includes fresh vegetables, fresh fruit, fresh of live aquatic products, livestock, fresh meat, milk and eggs and such agricultural products. China produced 28.61 million tons of eggs, 82.21 million tons of poultry, 61 million tons of fruit, nearly 702 million tons of vegetables, 59.06 million tons of aquatic products in 2012^[1]. The demand of agricultural products cold chain logistics increased rapidly as the production of fresh agricultural products growth. The proportion of the cold chain logistics in the whole agricultural production increase year by year, especially the high value of agricultural products represented by aquatic products and counter-season fruits and vegetables required higher cold chain logistics. The broad market demand promotes the formation of cold chain logistics market. Combined with the improvement of people's life, the advance of technical level and the government's strong support, the development of cold chain logistics market was further promoted. Fresh agricultural products require higher condition for packaging, transport, storage and such logistics links. Chinas' agricultural product damage seriously because lack of the proper cold chain logistics management. The circulation damage rate of fruits and vegetables, meat, aquatic products hit 25%, 12% and 15% respectively. Only fruits and vegetable annual loss hit 100 billion Yuan of above. In addition, the loss in agricultural products logistics also caused great waste of land resources and the environment resources. Management scientists say "Evaluation promote performed". Those build fresh agricultural products cold chain logistics evaluation system, and gradually implement the classification mechanism of cold chain logistics enterprises plays an important role on the development of cold.

FRESH AGRICULTURAL PRODUCTS COLD CHAIN LOGISTICS COMPREHENSIVE SERVICE ABILITY

Definition

Logistics capability is a specific logistics system, from accepting customer demand, order processing, sorting, transport of goods to the whole process of delivery to the customer, the response speed, logistics, order completed on time and the comprehensive reflection of the order delivery reliability. Logistics capability is the objective capability of the physical structure of logistics system, such as distribution center number and scale, transport capacity, sorting processing equipment capability etc, and reflects the comprehensive ability of administrators in the organization and management of the logistics operation process. Therefore, the logistics capability include not only the ability about transport goods, that is tangible elements, but also include organization and management ability on logistics process, that is intangible elements.

Logistics service ability is derived from one of the logistics enterprise's logistics enterprise's logistics capability ability. It is the ability to directly face to the customer. Murphy, Posit pointed out that the logistics service capability, such as EDI connection, transportation consolidation, warehousing, consultation and freight bill pay, is a drive pushing companies to high performance level^[2]. Lai, K H see logistics service capability as logistics enterprises' ability that how to meet customers' logistics demand and achieve better service performance through create and use of resources from the Angle of the resources^[3]. Li (2010) stated that logistics service ability refers to logistics enterprise's ability to improve enterprise performance by using combination, optimize enterprise internal and external resources and provide logistics service products to meet customer service requirements. Logistics service ability is the comprehensive reflection on order response, logistics cost, service quality etc^[4].

Cold chain logistics refers to system engineering from frozen foods in the production, storage, transportation, sales, to the consumption of each link has been in low temperature environment in order to ensure the food quality and reduce loss of food. It is a low temperature logistics process that based on the progress of refrigeration science and technology, by means of freezing technology and refrigeration technology. Cold chain logistics is a huge system engineering that need higher, more complex, and need more Construction investment than the general normal temperature logistics system. As perishable food need higher organization coordination in the each link of cold chain for its timeliness requirements^[5].

Agricultural products cold chain logistics comprehensive service ability refers to the cold chain logistics enterprise provide customers with competitive advantage at the lowest possible total cost. It realized through a series of logistics function activities. That is the comprehensive service ability of the optimal transportation of agricultural products logistics function activities to ensure the quality of agricultural products, reducing wear and tear.

Under the enterprise resource constraints, enterprises need to focus on a particular market, to improve its market position in a particular field and build up enterprise's core competitiveness. Under the enterprise resource constraints, enterprises need to focus on a particular market. So that enterprise's core competitiveness were build and the market position in a particular field were improve. Fresh is the life and the value of the fresh agricultural products. For fresh agricultural products have characteristics such as high water content, Short of freshness and easy to rot, they put forward higher requirements for cold chain logistics comprehensive service ability. These are reflected in cargo damage cost increased due to the vulnerability of fresh agricultural products, transportation costs raised because of its perish ability, required higher transport technical for its specifications diversity. Now, there are three patterns of international food cold chain, namely self-run logistics mode, cold-chain logistics alliance mode, Third-Party Logistics. In our country, self-run logistics of agricultural products accounts for a large proportion, but the self-run logistics cost is high, difficult to adapt to modern social division of labor specialization and the development trend of organization. Cold chain logistics alliance mode form strategic alliances and establish agricultural products logistics center through linked agricultural producers, wholesale market, wholesalers, retailers, transportation, business, processing enterprises. It promotes the enterprises to actively participate in all nodes, and improve efficiency. The essence of Third-Party Logistics is agricultural products logistics outsourcing, that is to say agricultural production and sales enterprise entrusted its agricultural products logistics business to professional logistics companies in the contract (contract) manner, to focus on the enhancement enterprise core competitive. It is a long-term strategic, mutual penetration, mutual benefit business commission and the execution mode. No matter what kinds of logistics mode all can be seen as Third-Party Logistics, from the purpose of reduce logistics cost and improve the efficiency of logistics, using strategic business unit's view. In this way all logistics mode can be evaluated.

The composition of fresh agricultural products cold chain logistics comprehensive service ability

Under the enterprise resource constraints, different types of logistics service enterprises can provide different types of logistics services and expertise. On analyzing the logistics enterprise service ability, Ma Shihua (2004) proposed that logistics service ability can be divided by basic services ability and value-added services ability. He thought that distribution network structure, inventory strategy, customer demand information, order delivery cycle, logistics personnel, logistics equipment operation efficiency and reliability, and logistics information level have effect on customer service capacity^[6]. Liu Mingfei, Wang Yijun (2006) argue that the supply chain logistics service capability should be considered in a more comprehensive way from five aspects. Those were the logistics cost and logistics service quality, delivery speed, flexible and innovative ability^[7]. Chen (2008) thought the Third-Party Logistics provider will be the main body of logistics service industry. Third-Party Logistics's logistics capability affects the logistics service level and efficiency directly^[8]. Ma Lijuan (2012) selected the considerable quantitative indicators to evaluate the supply chain logistics service capability by using three indexes as the supply chain logistics service capability with basic service ability, flexible service ability and the innovation ability. And basic service ability can be divided into transport capacity, storage capacity, speed of service, information processing ability. Flexible service ability measured through flexible, reliability, responsiveness, and logistics cost. Innovation service ability mainly includes the logistics technology innovation and business innovation^[9].

According to analyzing of the predecessors' research, combining with the characteristics of fresh agricultural products, and the current development situation and future development direction of cold chain logistics industry, fresh agricultural products cold chain logistics comprehensive service ability include warehousing, distribution, food detection ability, cost control, logistics, financial services, information management ability, ability to meet customers demand.

CONSTRUCTION PRINCIPLE

Principle 1: combining quantitative index and qualitative index

In order to make the evaluation result more objective, the evaluation index must adopt the combination of qualitative and quantitative methods. Quantitative index can avoid the subjectivity of evaluation process in certain extent. Qualitative description when Indicators can't be quantified. This principle make up for the inadequacy of single use quantitative or qualitative methods. And it makes the evaluation results more objective and comprehensive.

Principle 2: combination of internal and external indicators

The merits of cold-chain logistics service quality were affected not only by the internal factors of cold chain logistics service enterprises, but also external environment. Consequently, when we screening index, not only internal factors but external factors need to be considered.

Principle 2: internal process indicators index combined with external customers

Introduced HACCP theory method to determine the critical control points in the process of fresh food cold chain logistics services, when construct the comprehensive cold chain logistics service capability evaluation system. Monitoring indicators should be established corresponding to each key control point and should be quantified. In addition, evaluation index about customers also should be pay more attention to. For customer as the service object will evaluate the service quality in most intuitive way.

CONSTRUCT ON COMPREHENSIVE SERVICE ABILITY EVALUATION SYSTEM OF COLD CHAIN LOGISTICS SYSTEM FOR FRESH AGRICULTURAL PRODUCTS

Determination of evaluation index

Construct on comprehensive service ability evaluation system of cold chain logistics system for fresh agricultural products based on analyzing the results of predecessors' research, referring the international development trend of cold chain logistics service enterprises, combining with the domestic cold chain logistics enterprise development situation, based on consultation and interviews with the logistics professional experts and practitioners, from the process variables and results of two dimensions, from the process variables and results of two dimensions, using the Key Performance Indicators (KPIs) screening indicators. This evaluation system include seven level indicators, storage capacity, distribution capability, food testing ability, cost control ability, Logistics financial service ability, information processing ability, ability to meet customer demand. The seven indicators can be further divided into 29 secondary indexes.

Storage capacity: Storage capacity is an indicator of metric storage function. It is referring to the number of maximum storage warehouse under certain conditions.

Distribution capability: Distribution refers to logistics activities, such as choosing goods, processing, packing, equipping delivery and designated place on time according to the customer request in economic and reasonable regional scale. Distribution ability reflects the logistics enterprise's ability to meet customer requirements to complete assignments distribution.

Food testing ability: Food inspection testing refers to inspect the food raw materials, auxiliary materials, semi-finished products, finished products and the quality of the by-products, in accordance with state laws and regulations and relevant standards, to ensure that product quality is qualified. The content of food inspection include sensory evaluation of food, test the nutrition ingredients, additives, harmful substances in the food. Food testing ability refer to cold chain logistics enterprises inspect on the service object during the service period in accordance with the relevant laws and regulations of the state regularly.

Cost control ability: Cost control is that the enterprises take a series of prevention and adjustment measures to all sorts of affecting factors and conditions, according to a certain period cost management goals in advance, within the scope of the cost control subjects' functions and powers, before or in the

process of production cost happened and cost control. Cost control ability reflects the strength of the enterprise for cost control. It reflects whether the enterprise can meet the requirements of cost control.

Logistics financial service ability: Logistics finance refers to the financing activities make logistics value-added using financial tools to effectively organize and adjust monetary activities in business in supply chain in modern logistics supply chain activities. Three main parts of the logistics financial are logistics enterprises, small or medium-sized financing enterprises and banks or other financial institutions. Three sides make its benefit in the activities of the logistics financial respectively.

Vendors can obtain loans from the bank by temporary mortgage right of cargo, is used to conduct business, improve the financing capacity of enterprises and capital utilization. Vendors can obtain loans from the bank by temporary mortgage right of cargo. Using this method the enterprises can improve the financing capacity of enterprises and capital utilization. For Banks, with tangible goods as collateral, and has a good reputation storage enterprises as a guarantee or the goods management, the loan risks are reduced. Banks can expand and stable customer base, set up their own competitive advantage, open up new profit source, absorption derived deposits through this business. For logistics enterprises, the development of the logistics financial business actually opens up new value-added services for its business. This business can not only promote the traditional warehousing business, achieve customers personalized, provide differentiated services, but also the logistics enterprises can be better integrated into the customer's goods production and sales in the supply chain as the bank and customer trust of a third party. And these strengthened the alliance with the bank and bring us new profit growth point at the same time. Thus Logistics enterprises, financing small and medium-sized enterprises and Banks tripartite win-win situation is achieved. So, the study of logistics finance can solve the problem of financing difficulties of small and medium-sized enterprises, provides a platform for the multi-level development of logistics enterprises. Also it can make the bank and other financial institutions more positive, more bravely the financing scale and expand its customer base.

Information processing ability: Information flow is a very important part of the logistics link. Logistics information management is unified planning and organizing the logistics information resources, and reasonably controls the whole process of the logistics information collecting, processing, storage, retrieval, transfer and application. So that each link of the logistics supply chain can be coordinated, information can be shared and interacted, the information redundancy and errors can be reduced, auxiliary decision can be made, customer relationships can be improved.

Ability to meet customer demand: Cold chain logistics enterprises provide related services to customer needs, and ability to meet customer demand.

Details as Figure 1.

The determination of index weight

Evaluation sets $V = (V_1, V_2, V_3, \dots, V_m)$, here $m=7$, the evaluation sets of cold chain logistics service capability is $V = \{\text{Very satisfied, satisfied, general satisfied, basic satisfied, not satisfied}\}$. The weight of each evaluation factor index distributes using analytic hierarchy process (AHP).

First, after building the hierarchical model, each element of the same level of a hierarchy of the importance of a certain criterion are compared. Build two pair of comparative judgment matrix structure, and make the weight analysis. The weight is expressed by $\omega = (\omega_1, \omega_2, \omega_3, \dots, \omega_i)$. Among them, ω_i is the weight of the i -th secondary indexes? All the comparison results were expressed with matrix form $A = (A_{ij})_{m' \times n'}$. m', n' is the number of secondary and tertiary evaluation index. A is judgment matrix.

A_{ij} is said with 1 to 9 scale values.

Second, Consistency check is done to the judgment matrix form after the judgment matrix given.

The method is as follows.

Calculate A consistency index

$$CI = \lambda_{\max} - S / (S - 1) \tag{1}$$

- S is the order of judging matrix form, λ_{max} is the largest eigenvalue of the judge matrix A.
- (2) Query the average random consistency index *RI*
- (3) Calculate the consistency ratio

$$CR = CI / RI \tag{2}$$

When $CR < 0.1$, the consistency of judgment matrix can be accept. Otherwise the judgment matrix need to be paired comparison, or need to be adjust in order to make it have acceptable consistency.

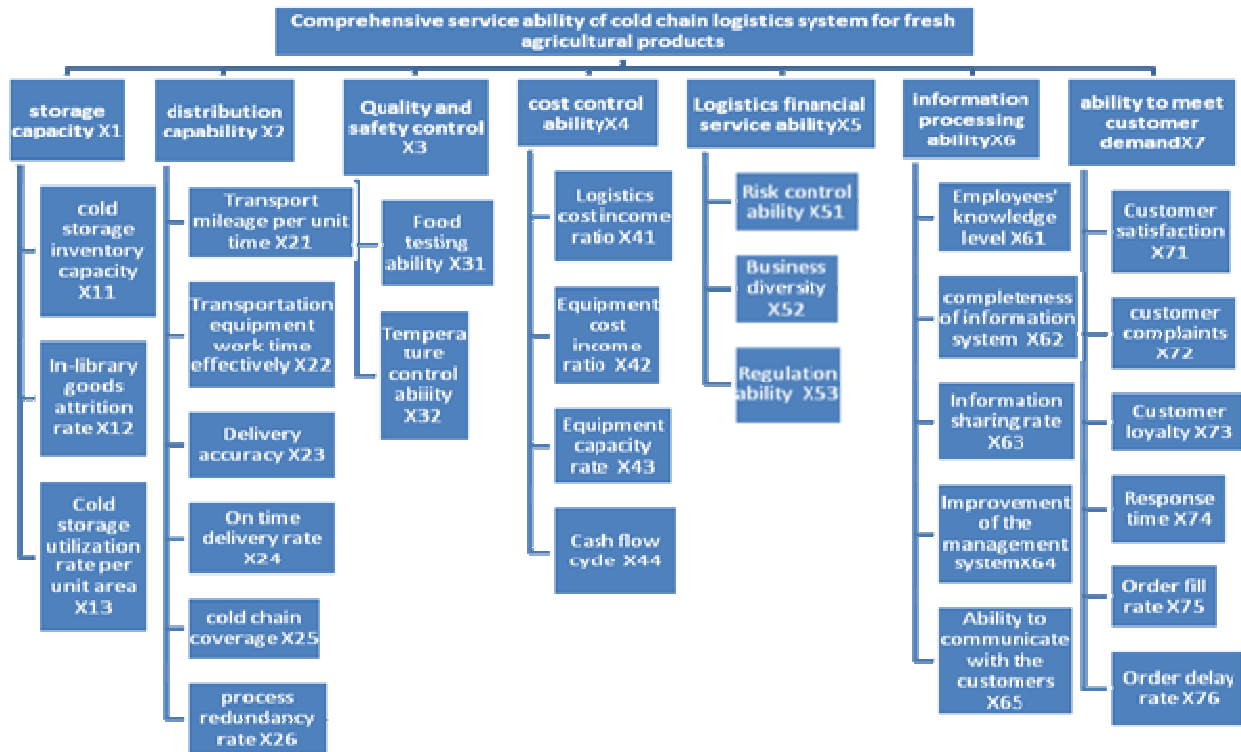


Figure 1 : Comprehensive service ability of cold chain logistics system for fresh agricultural products

(4) Determine the evaluation matrix. The relationship between each evaluation factors and evaluation level, that is the fuzzy relation from *U* to *V*, can be decrypted as available evaluation matrix *R*.

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} & r_{16} & r_{17} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} & r_{26} & r_{27} \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ r_{p1} & r_{p2} & r_{p3} & r_{p4} & r_{p5} & r_{p6} & r_{p7} \end{bmatrix} \tag{3}$$

(p=2,3,3,4,5,6,6)

In the formula, p said the number of indicators that be contained in the per level index system. r_{pm} ($0 \leq r_{pm} \leq 1$) is the membership degree of each secondary, tertiary index of the m evaluation grade.

Fuzzy comprehensive evaluation

Weights ω and evaluation membership matrix R 's comprehensive process can be expressed as formula (4)

$$A \circ R = (b_1, b_2, b_3, b_4, b_5, b_6, b_7) = B \quad (4)$$

In the formula, b_1, b_2, \dots, b_7 means the membership degree of index for evaluation grade.

“ \circ ” is the fuzzy synthetic operator. Get the membership degree of B which primary index for evaluation grade, through fuzzy comprehensive evaluation. See B as the fuzzy relationship matrix Q of secondary fuzzy comprehensive evaluation. $Q = (B_1, B_2, \dots, B_n)^T$, $B = A \circ Q$. Then the secondary fuzzy comprehensive evaluation results of the agricultural products cold chain logistics service capability can be got it. Quantified each element of quantitative evaluation set V , calculate results using formula $P_i = B_{iv}^T$.

CONCLUSION

This paper analyzed the characteristics of fresh agricultural products cold chain logistics, Construct the fresh agricultural products cold chain logistics enterprise service evaluation system which includes 7 first-level indicators, 29 secondary indexes, based on the principle of combining quantitative indicators and qualitative indicators, the combination of internal and external indicators, internal process indicators and external customers. The paper also evaluates comprehensive service ability of fresh agricultural products cold chain logistics to using analytic hierarchy process (ahp) and fuzzy evaluation method.

This evaluation system could be used to regulate the behavior of cold chain logistics enterprise service, also it could be used for the customer evaluation, selection of fresh farm products cold chain logistics enterprises with certain standards, or for fresh agricultural products cold chain logistics enterprises to evaluate their own service level, improve their service level, provide the reference. Scientific and efficient of fresh agricultural products cold chain logistics system not only can effectively reduce the wastage of the products, reduce the comprehensive cost of agricultural products, but also can save the land resources effectively and protect the environment.

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REFERENCES

- [1] National Bureau of Statistics of the People's Republic of China, <http://www.stats.gov.cn/tjsj/>.
- [2] P.R.Murphy, R.F.Poist; Third-party logistics usage: An assessment of propositions based on previous research, *Transportation Journal*, **4**, 26-35 (1998).
- [3] K.Lai; Service capability and performance of logistics service providers, *Transportation Research Part E*, **5**, 385-399 (2004).
- [4] S.Li, Q.Zhao; Evaluation of ability of Logistics services based on entropy weight-double base points, *Journal of Beijing Jiaotong University*, **2**, 37-41 (2010).
- [5] L.Fei, Y.Jiang; Barrier analysis on small and medium-sized food enterprises implementing HACCP in cold chain logistics, *Business*, **10**, 187 (2013).
- [6] S.Ma, T.Chen; Elements & evaluation method of supply-chain-based logistics service capability, *Computer Integrated Manufacturing Systems*, **13**, 744-750 (2007).

- [7] M.Liu, Y.Wang; The Model of Studying Supply Chain Logistics Service Capability Maturity, *Commercial Research*, **26**, 63-65 (2006).
- [8] J.Chen, X.Wei, D.Zhu; Research on the Logistics capability Composition of Third party Logistic Providers, *Xinjiang Finance and Economics*, **6**, 70-75 (2008).
- [9] L.Ma; Analysis on supply chain logistics service capability and evaluation, *Modern Business Trade Industry*, **1**, 26-27 (2010).