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Development Strategy of Intelligent Logistics for Agricultural Products

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Abstract: The lagging informatization and intellectualization of the postharvest supply chain of agricultural products are the main factors that result in low circulation efficiency and serious losses in quality. The planning of intelligent logistics for agriculture products in China is necessary to improve the postharvest added value of agricultural products. In this study, we analyze the demand for intelligent logistics of agricultural products, summarize the development status, and investigate the problems existing in informatization, standards, quality, and professionals. In consideration of China's conditions, we propose development goals and key tasks of intelligent logistics for agricultural products in China by 2035. The results of the study show that strengthening policy support, improving the standardization system, and promoting personnel training are the foundations for intelligent logistics of agricultural products. Moreover, in China, the continuous innovation and extended application of new-generation information technology have promoted the transformation and upgrading of traditional agricultural logistics toward intelligent agricultural logistics. In the future, an intelligent, integrated, and green supply chain will be a major development direction for intelligent agricultural logistics. Therefore, this study provides a basic reference for improving the overall operational efficiency and upgrading the service quality of the agricultural logistics industry.
Keywords: agricultural products; intelligent logistics; informatization; policies and regulations; core technology; public information platform; 2035

1 Introduction

Intelligent logistics is a primary focus of academic research and a concept of industry development. It refers to expanding the capability of logistics system analysis, improving decision-making and intelligent execution, and enhancing the overall level of intelligence, networking, and automation through the use of intelligent technologies and advanced methods, such as intelligent hardware, the Internet of things (IoT), and big data [1]. The intelligent logistics of agricultural products refers to the advanced functions of system perception, comprehensive analysis, timely processing, and self-adjustment in transportation, storage, packaging, loading and unloading, circulation and processing, distribution, and other related links of agricultural product postharvest logistics.

Conditions of the logistics infrastructure have a significant impact on the implementation of intelligent logistics of agriculture products, primarily because their construction and development depend on the conditions of the logistics infrastructure. In China, the intelligent logistics of agricultural products started late, and as a result, the necessary logistics infrastructure has not sufficiently matured. In fact, it still lags behind in policy formulation, construction and supervision of a standardized system, professional personnel training, and other related aspects. Moreover, high-precision, low-cost sensing sensors and a coupled prediction model of the environment quality are also lacking. Besides, there is a low popularization and application rate of the Beidou navigation satellite system. These are distinct technical constraints. Therefore, reasonably evaluating the current development situation of China's intelligent logistics of agricultural products and precisely investigating the problems existing in development

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are prerequisites for the successful implementation of high-quality intelligent logistics of agricultural products in China. Therefore, it is of positive significance to solve targeted problems and formulate development goals and key tasks for intelligent logistics of agricultural products suitable for national conditions.

2 Intelligent logistics of agricultural products demand analysis

From a national perspective, the total number of social logistics showed a stable growth trend from 2010 to 2020. In the same period, the proportion of total logistics costs in the gross domestic product (GDP) dropped from 17.8% to 14.7%, and the overall logistics efficiency improved. In the context of the steady growth of China's logistics industry, the development of intelligent logistics of agricultural products can effectively reduce the proportion of logistics costs in GDP and promote the improvement of national economic efficiency. According to data from the National Bureau of Statistics [2], in 2017, the scale of China's fresh market products (including meat, aquatic products, poultry, eggs, milk, vegetables, and fruits) exceeded 1.3×10^9 t, and the cold chain transaction volume reached 470 billion CNY. In addition, the huge market scale, low cold chain circulation rate, and high postpartum loss have significantly increased the demand for intelligent logistics technology for agricultural products. While satisfying strong internal demand, the intelligent logistics of agricultural products can enhance the international market competitiveness of China's agricultural products, promote industrial upgrading, support consumption upgrading, and ensure food safety. Moreover, intelligent logistics of agricultural products will reduce energy consumption and emissions, and create favorable conditions for environmental protection and sustainable development through intelligent planning and resource sharing [3].

From an enterprise perspective, the development of intelligent logistics of agricultural products can further reduce the loss of fresh product circulation by relying on information technology to improve corporate management efficiency. Moreover, relying on the rapid development of the sharing economy model of the Internet platform has brought novel ideas to logistics "cost reduction," and optimized and improved many aspects, such as cargo loss rate, management efficiency, and cost input, thereby reducing the cost of all aspects of logistics and helping enterprises increase profits. Furthermore, the data collection, analysis, and processing capacity of intelligent logistics of agricultural products enable risk prediction and timely adjustment services for enterprises to minimize unnecessary economic losses and improve their service level.

From the perspective of a producer, the development of intelligent logistics of agricultural products will open up the entire chain of agricultural products, becoming a catalyst for the efficient circulation of agricultural products, stabilizing and increasing the income of agricultural producers. Consequently, the implementation of intelligent logistics of agricultural products will expand the sales channels of agricultural products and reduce the unsalable risks of agricultural products, and significantly improve the loss rate of agricultural products, thereby increasing the profitability of agricultural operations.

3 Development status of intelligent logistics of agricultural products in China

3.1 Law and policy

In 2009, the *Plan for Adjustment and Revitalization of the Logistics Industry* proposed the construction and development of an intelligent logistics system. Subsequently, in 2010, the *Agricultural Product Cold Chain Logistics Development Plan* highlighted that China's cold chain transportation capacity and cold chain rate needs to be improved and that cross-regional long-distance transportation systems should be established to promote the integrated development of cold chain logistics. In 2014, the *Medium- and Long-term Plan for the Development of the Logistics Industry* introduced the goals and tasks of China's logistics development by 2020, and intelligent logistics was incorporated in 12 major projects. Recently, the development level of intelligent logistics in China has gradually improved, and the level of informatization has approached the global forefront. However, the integration of logistics and informatization is rather weak, and the development level of intelligent logistics lags behind that of developed countries. The pre-cooling rate of fruit and vegetable products, per capita cold storage capacity, and refrigerated truck refrigeration resource indicators, such as occupancy rate, cold chain transportation rate, and loss rate are also not up to the globally accepted standard. In 2016, the cold chain circulation rates of fruits, vegetables, meat, and aquatic products in China were 22%, 34%, and 41%, respectively. The direct economic loss caused by the deterioration of fruits and vegetables after harvest alone exceeds 100 billion CNY [4,5]. Therefore, China's intelligent logistics has significant room for improvement in both quality and quantity. Driven by favorable policies, such as mass entrepreneurship and innovation and the Belt and Road initiative, the cold chain logistics will provide

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new support for China's economic growth.

Legal and policy support are key to the rapid and healthy development of intelligent logistics. However, there is still a dearth of unified standards for control specifications, temperature control standards, and fundamental equipment for each link of agricultural products, which makes it difficult to effectively integrate and connect the resources of each link. Moreover, information asymmetry in supply chain upstream and downstream leads to information "island" and "chain break" phenomenon directly hindering the maintenance of agricultural product quality and safety, the economic value and integrated management of supply chain, and the construction of a flexible supply chain with high-risk resistance [6].

3.2 Infrastructure equipment level

According to the *Report on the Development of Cold Chain Logistics of Agricultural Products in China* (2018), the cold storage capacity in China is approximately 4.775×10^7 t (equivalent to 1.2×10^8 m^3), which is an increase of nearly five times compared with 2008. In addition, there are approximately 1.34×10^5 refrigerated trucks, a year-on-year increment of 16.5%. Moreover, the cold chain circulation rate and transportation rate of fruits and vegetables increased nearly four times and three times, respectively, compared with those of 2008. However, the per capita storage capacity and per capita number of refrigerated trucks are only 1/10 of those in developed countries, which is a significant gap. Moreover, statistics from the Cold Chain Logistics Professional Committee of the China Federation of Logistics and Purchasing indicate that in 2019, China's fresh food market transaction volume was 378 billion CNY and 485 billion CNY in 2020, an increase of 24.55% and 28.31% year-on-year, respectively. However, the annual per capita fruit consumption is approximately 60 kg, which is less than half of that in developed countries. The steady development of China's economy, accelerated formation of new patterns, continuous growth of personalized consumption, and the increasing demand for high-quality products will promote the continuous expansion of the demand market of China's cold chain logistics industry, which would broaden the development prospects of the cold chain market.

Cold chain informatization refers to the use of information and communication technology to realize the real-time monitoring and management of information, such as environmental temperature, humidity, equipment control status, upstream and downstream needs. Moreover, cold chain informatization supports the construction of a transparent cold chain system throughout the process, thereby promoting cold chain cost reduction and efficiency improvement, and improving operational efficiency. Cold chain digitization is a necessary means of transforming information into services. On one hand, cold chain digitization boosts the intelligent, smart, and unmanned development of cold chains. On the other hand, it supports the development of cold-chain intelligent equipment, improves the level of intelligent service, and promotes the transformation and upgrading of cold-chain intelligent manufacturing. The *Outline of Digital Transportation Development Plan* (2019) highlighted the necessity to accelerate the entire digital upgrade of freight logistics, strengthen the integration and interaction of transportation activities in physical and virtual spaces, and comprehensively enhance the overall competitiveness of the digital transportation industry. Therefore, there are many advantages of relying on digital technology to realize the mapping of the physical space of the cold chain to virtual digital space. For instance, it helps promote the interactive integration and in-depth perception of the environment and quality data, strengthen the coupling between the physical system and information model, open up the upstream and downstream information channels of the cold chain, and realize the arrangement, planning, and coordination of the entire cold supply chain, which has theoretical and practical significance [7,8].

3.3 Informatization and intelligent development

Refrigerated transportation is a key factor in ensuring the timely delivery of goods to ensure consumer satisfaction and correlate the economic cost input of the entire cold chain logistics. It also serves as a link to realize monitoring, traceability, and visualization of real-time information on the food quality and safety in cold chain logistics of agricultural products [9]. Recently, relevant research has primarily focused on dynamic optimization of distribution route, product information real-time feedback in the distribution process, operational strategies for adjustment and optimization, and intelligent transportation management systems. Moreover, the application of big data and cloud computing technology in all links of cold chain logistics has also been recognized, including, mining, processing, analyzing massive data, and optimizing the management process of cold chain logistics enterprises. Refrigerated transportation provides an information platform for the construction of the IoT for cold chain logistics of agricultural products, and guarantees improvement of the agricultural product transportation efficiency, stabilizing the compartment microenvironment, extending the shelf-life of agricultural products, and reducing loss during

agricultural product transportation. A future research direction is to solve the multi-objective optimization problem of the optimal distribution path based on the swarm intelligence algorithm [10].

Agricultural products still require temperature monitoring during the sales stage to maintain quality and improve market competitiveness. Accordingly, the informatization construction maintains the integrity of the quality and safety traceability of agricultural products before consumption and also benefits the recovery of recyclable items, such as radio frequency identification (RFID) tags and packaging materials. This can also improve food safety and consumer satisfaction. In 2015, China's first bulk agricultural product e-commerce trading platform (the agricultural product collection network) was released, which helped improve the standardization, intensification, scale, branding, and networking of agricultural product sales by adopting an online-to-offline model to realize direct transactions between farmers, cold chain logistics enterprises, and consumers, thereby removing the constraints of space, region, and time in the sales of agricultural products, effectively reducing agricultural product transaction costs, and providing tangible benefits to consumers. At present, the legal and regulatory system of the e-commerce transaction mode of agricultural products in China is still incomplete and far from perfect. Besides, the protection of transaction price control, agricultural product quality and safety traceability, consumer rights and interests, and other aspects are insufficient.

Over the recent years, China's total logistics volumes has continued to rise, artificial intelligence (AI), IoT, remote sensing, and other state-of-the-art technologies in logistics industry have been widely used, Internet Plus in transportation, distribution and other logistics links are relatively mature, related industries have high hopes for intelligent logistics of agricultural products. In terms of intelligent storage; therefore, high-tech logistics equipment, such as unmanned warehouses, logistics eyes, and voice assistants, have been gradually applied in the intelligent logistics of agricultural products [7,8]. Some network operators also regard the intelligent logistics of agricultural products as a key direction for future development of the agricultural economy and service industry in China. It is in the initial stage and has a broad scope and potential for future development.

4 Development analysis of intelligent logistics of agricultural products in China

4.1 Lagging informatization and low coverage

In 2020, China's per capita GDP was 10 504 USD, and it exceeded $10 000 USD for the second consecutive year. Consumers have entered new era of nutritional and healthy food manufacturing, where the main demand has shifted from quantity to quality satisfaction. It is necessary to promote the transformation and upgrading of China's cold chain logistics (from extensive to intensive, refined, and professional) to upgrade the consumption of fresh food. However, owing to the weak cold chain infrastructure and the lack of development in informatization technology, the lack of effectiveness and technology of transparent supervision, and the low rate of refrigerated transportation and cold storage utilization have led to the loss of fresh fruit circulation in China, reaching 30% [11,12]. Therefore, perfecting the cold chain logistics system, strengthening the construction of informatization and standardization, and accurately compensating for shortcomings in each link are key measures to address the growing consumer demand for high-quality fresh fruits in the market.

First, there is a relatively high proportion of small- and medium-sized enterprises in China's cold chain logistics, the level of informatization development among enterprises is uneven, and there is a lack of standardized and unified management. High-cost investment in the early stage of informatization construction is also a main obstacle impeding the development of informatization of small- and medium-sized enterprises. Therefore, in such special cases, the state can provide appropriate financial support or implement relevant preferential policies to promote the informatization construction and development of small- and medium-sized enterprises, thereby improving the unbalanced development of the informatization level of small- and medium-sized enterprises.

Second, the informatization coverage of the entire chain is incomplete and imperfect in the cold chain logistics of agricultural products. Cold chain enterprises emphasize information monitoring of high-efficiency links, such as refrigerated storage, refrigerated transportation, and refrigerated distribution, to realize the improvement of logistics efficiency while reducing circulation costs. Moreover, the relative negligence of informatization monitoring and management of the production, sales, and consumption links of agricultural products leads to chain breakage in the entire cold chain circulation process of agricultural products, such as informatization management and monitoring of agricultural product quality and safety. Therefore, the key to ensure the safe circulation of agricultural products in the entire cold chain, realize the integrated operation and management of production, supply, and marketing, and achieve the automatic and intelligent control of all links is to maintain the informatization coverage of the entire cold

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chain of agricultural products.

Lastly, the existing cold chain logistics information platform construction is primarily based on refrigerated road transportation in China, and it has not yet formed effective coverage in railway, water transportation, shipping, and other related modes of transportation. The lack of expansion is one of the main influencing factors forming the "information island" of cold chain logistics, which hinders information sharing and interaction between different logistics informatization platforms and restricts the multi-mode transportation of cold chain logistics and the improvement of cold chain logistics efficiency [13]. Moreover, huge capital and technological investments are needed in the initial stage of cold chain logistics informatization construction to solve the software problems of outdated refrigeration equipment, such as cold storage and refrigerated trucks and temperature monitoring and management systems.

4.2 Unsound standards and quality and safety issues

The formulation and implementation of cold chain logistics industry standards are prerequisites for ensuring standardized, large-scale, unified, and even global operations across the entire chain. With regards to cold chain logistics, there are 193 national, industry, and local standards promulgated in the 2017 edition of the *China Cold Chain Logistics Standards Catalog Manual*, which focuses on cold chain storage and transportation links and lacks standards covering the entire cold chain circulation and connecting different cold chain links. In terms of the construction and development of cold chain informatization, technical standards, such as data collection, transmission, processing, and communication, have not yet been clarified, which affects the construction of the cold chain logistics informatization platform to a certain extent [14,15]. In China, the prevailing compulsory enforcement power of cold chain logistics standards is insufficient, coupled with insufficient supervision of laws and regulations, and the combination is causing most standards to lose their guiding significance.

Historically, China's agricultural production has been dominated by individual smallholder production, with decentralized production and operation, and low concentration. In addition, agricultural automation technologies must also be improved. Generally, it is difficult to achieve quality standardization at the production source of agricultural products, and it is necessary to track and detect the quality of agricultural products in the entire chain. The fresh and active characteristics of agricultural products propose higher requirements for the cold chain to guarantee the transportation and storage links. The logistics cost is the principal component of the circulation cost of agricultural products. To a certain extent, it is necessary to use fine packaging and cold-chain equipment to reduce costs. However, agricultural products have large volumes, low value per unit volume, and high transportation and storage costs, making them less desirable in terms of logistics cost investment [16]. Moreover, the high requirements of cold chain logistics for the corresponding equipment pose high transportation risks. Once cold chain logistics encounter problems, the benefits of all participating links in the supply chain will inevitably be damaged.

4.3 Lack of professional personnel

The development of intelligent logistics is inseparable from large-scale professionals, who are the main promoters and implementers of cold chain logistics informatization. Currently, practitioners of cold chain logistics informatization are primarily transition personnel in computer science, agricultural science, refrigeration, and other disciplines. Generally, they lack systematic knowledge of cold-chain logistics operations, management, and theoretical knowledge. Simultaneously, academic institutions fail to set up cold chain logistics majors in a timely manner, and enterprises lack enthusiasm to train cold chain logistics professionals because of cultivation costs. Collectively, such factors lead to the failure of talent scale and training speed to satisfy industrial development needs [17,18]. Colleges and universities should set up new cold chain logistics majors to alleviate the shortage of cold chain informatization professionals. Moreover, academic institutions should cooperate with cold chain enterprises, realize the accurate docking and sharing and utilization of educational resources and enterprise resources, and explore the characteristic training mode of cold chain logistics personnel with equal emphasis on theory and practice, and both knowledge and ability.

5 Intelligent logistics development goals in China

5.1 Development goals by 2025

China will construct informatization, digital, and networked infrastructure for agricultural product logistics; maintain continuous investment in infrastructure, such as logistics parks; refine relevant standard systems; establish

food safety early warnings and traceability intelligent cloud platforms and intelligent monitoring systems for the entire supply chain; and explore new models of social co-governance for food safety supported by big data.

We will integrate food safety source monitoring capabilities and control circulation and disease traceability data, to establish a food safety supervision data cloud platform; and develop the risk early warning model technology and establish an intelligent food safety early warning information platform, to realize the hierarchical management of food safety risks.

Considering the challenges that may be faced by the rapid development of the new food circulation model, the development of monitoring technologies and equipment that can trace the food cold chain and online sales of food will be emphasized, and food safety supervision data and public health monitoring data will be integrated to establish early warning and traceable technical systems.

Big data industry pilot and demonstration projects in intelligent logistics of agricultural products will be implemented considering four aspects: key technology product research and development, key field applications, industry support services, and resource integration and sharing. It is necessary to summarize experience, formulate norms, and conduct industry promotion and application.

5.2 Development goals by 2035

The integration of information technology, such as big data, cloud computing, and the IoT, is crucial to solve the problem of information islands that may exist in the intelligent logistics of agricultural product data, and bottlenecks in the number and quality of industry talents.

New information technology, such as cloud computing, big data, AI, and block chain, will be deeply integrated with food nutrition, health product design, and food safety supervision business, to build a national smart food big data cloud service platform; realize intelligent environment monitoring of food safety and quality based on Internet of Things and RFID; and form a food service quality system based on the value chain.

Other goals include developing a big data product system for the intelligent logistics of agricultural products with core competitiveness, cultivating big data application enterprises with industry characteristics, promoting the wide application of big data, and forming unique industry system solutions.

6 Suggestions

6.1 Law and policy

The timely improvement of the legal system, utilizing laws and policies to promote the transformation and upgrading of intelligent logistics of agricultural products to stabilize the market order, clarifying management responsibilities, and providing the necessary legal guarantee for the development of intelligent logistics of agricultural products are important to ensure its success [19]. In addition, the timely formulation and promulgation of legal documents related to green logistics to promote the intelligent logistics system of agricultural products into green supply chain ecological systems is also crucial to maintain long-term sustainable development. The management organization considers the reasonable demands of enterprise development. In addition, the operation of the enterprise adheres to the supremacy of customer needs and develops an intelligent logistics model for agricultural products that are comprehensively coordinated among management organizations, enterprises, and customers. The intelligent logistics industry for agricultural products involves the cross-cooperation of commerce, transportation, and information technology. Therefore, it is recommended that multiple administrative departments perform joint consultation and comprehensive management to solve the difficult problem of efficiently sharing multi-party information in the intelligent logistics of agricultural products. Therefore, it is necessary to analyze the operation mode of intelligent logistics of agricultural products, formulate relevant policies in a targeted manner, and implement necessary and stringent supervision and management practices.

6.2 Standardization system construction

It is necessary to establish a standards system for intelligent logistics informatization of agricultural products to provide effective standardization guidelines for industrial development. Specifically, the intelligent logistics of agricultural products relies on data collection, transmission, and processing, realizes intelligent monitoring and control in each link through the IoT, and realizes the association and coordination of each link. The relevant process relies on the use of specific software and hardware, information transmission, and processing, and it is recommended to formulate standardized and unified industry standards to support comprehensive cost reduction. Raising awareness

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of the significance of modern logistics standardization; organizing professional forces in the industry and standardization; formulating high standards for software programs, information interfaces, information security, and other standards; and completing the intelligent logistics standard system for agricultural products are critical aspects.

6.3 Core technology breakthrough

Executing the innovative application of information technology in intelligent logistics of agricultural products is useful for improving the intelligent, professional, and convenient service capabilities of intelligent logistics of agricultural products. It can be achieved by improving the loss rate of goods, management efficiency, expenses, and costs; and guarantees the technical improvement of industry profits. In complete consideration of the data collection, analysis, and processing capabilities of intelligent logistics of agricultural products, it is necessary to support enterprises to enhance service levels through risk warning and information technology. Besides encouraging enterprises to apply new technologies, such as automated warehouses, logistics robots, and drones, they should be provided with necessary policy and financial support; quickly break through the bottlenecks of new technology application; and improve the timeliness and convenience of intelligent logistics of agricultural products. In addition, video recognition, GPS, and GIS are the primary technical methods for realizing dynamic perception in the current intelligent logistics of agricultural products. The follow-up should combine remote sensing, AI, big data, and cloud computing to achieve logistics quality, environment, location, road conditions, and other multi-source information comprehensive perception and regulation, thereby establishing a modern logistics service model that integrates management, control, and operation [20,21].

Learning from the concept of group intelligence crowdfunding, it is necessary to introduce a crowdsourcing model in the intelligent logistics of agricultural products to realize the efficient organization of social idle distribution resources through the empowerment of Internet platforms and mobile network technologies, and explore new distribution models. It is recommended that agricultural product logistics enterprises actively adopt software and hardware systems based on the new generation of information technology, perform common technology application improvements, simultaneously expand foreign exchanges and cooperation, and track and lead the industry's international development trends.

6.4 Public information platform construction

Developing public information platforms for intelligent logistics of agricultural products and integrating social logistics resources to better serve economic, social, and agricultural development is urgently required. Intelligent logistics of agricultural products is an integrated, intelligent, and efficient service model. The entire logistics system should rely on an integrated, digital, and intelligent logistics public information platform to achieve comprehensive management and control of related logistics systems [22]. A new generation of information technology is used to establish intelligent logistics information platforms for agricultural products, integrate transportation, warehousing, finance, distribution, freight forwarding, and other social logistics resources, and efficiently contact key links, such as warehousing, transportation, and distribution. Integrating supplier material supply, intelligent production system, third-party logistics company's intelligent logistics system, and terminal sales system to provide necessary fundamental logistics information for the information systems of production, sales, and logistics enterprises. Moreover, the establishment of cooperative working mechanisms for industry management and standardized market management is necessary to support reasonable and necessary logistics information sharing, processing, and application, break distances and information barriers, and realize cross-link communication in the agricultural product supply chain.

6.5 Talent training

The key to enhancing the core competitiveness of the development of intelligent logistics for agricultural products lies in professional talent training. Therefore, encouraging relevant enterprises to actively develop intelligent logistics to train professionals is imperative. The talent training process performed in colleges and universities should reflect the integration of multiple disciplines and simultaneously focus on the combination of science and technology [23]. Integrating academic institutions (colleges and universities), research institutes, and logistics enterprises to explore the establishment of joint training mechanisms and cultivating innovative, managerial, and technical talent based on an education model that integrates theory and practice is useful to promote the synchronization of logistics education with industry development. Learning from the experiences of developed countries is an effective way to continuously improve talent growth and incentive mechanisms to provide sufficient human and intellectual support

for the development of intelligent logistics for agricultural products [24,25].

References

[1] Dong X Y. How does the exhibition economy drive the transformation of local industries: China Baigou International Luggage Expo rises to a new peak [J]. Textile Apparel Weekly, 2018 (25): 38. Chinese.

[2] Ma S S. Cold chain logistics of agricultural products has great potential [J]. China Logistics & Purchasing, 2018 (9): 46–47. Chinese.

[3] He L M. Development status and trend of intelligent logistics in China [J]. China National Conditions and Strength, 2017 (12): 9–12. Chinese.

[4] Shen R. Break the short board of the industry shipping cold chain layout of the whole supply chain [J]. China Storage & Transport Magazine, 2018 (11): 86. Chinese.

[5] Xiong T. Key technologies and industrial application of fruit and vegetable probiotics fermentation [J]. The Beverage Industry, 2016, 19(5): 71–73. Chinese.

[6] Zhao H X, Liu S, Tian C Q, et al. An overview of current status of cold chain in China [J]. International Journal of Refrigeration, 2018, 88: 483–495.

[7] Li Y F. Watch the new progress of intelligent logistics from the Report [J]. China Storage & Transport, 2019 (2): 37–39. Chinese.

[8] Anonymos. Five trends in intelligent logistics in 2019 [J]. Pearl River Water Transport, 2019 (1): 36–38. Chinese.

[9] Leng Y T. The development of cold chain logistics needs to make up for multiple weaknesses [J]. China Food Industry, 2019 (9): 42–43. Chinese.

[10] Bian H, Wang K Q. Discussion on the development trend of cold chain logistics industry of aquatic products in China [J]. Liaoning Economy, 2013 (4): 70–71. Chinese.

[11] Hu Y D, Yang X L. Discussion on the development of cold chain logistics of aquatic products [J]. Henan Fisheries, 2011 (1): 37–39. Chinese.

[12] Zhang G B, Liu Y. Application of big data and cloud computing technology in agricultural products cold chain logistics informatization [J]. Global Market Information Guide, 2015 (27): 67. Chinese.

[13] Huang X, Huang Y D, Shi C D. Intelligent logistics model and system design of Weifang modern agricultural industrial park [J]. China Economist, 2020 (1): 185–187. Chinese.

[14] Zhao Z Q, Zhang L T, Hu Z B. Construction and operation model of intelligent supply chain of agricultural products in the era of new technology [J]. Commercial Times, 2019 (11): 132–135. Chinese.

[15] Chen Y T, Huang H L. Research on the “last mile” crowdsourcing distribution model of fresh products e-suppliers in China [J]. China Business and Market, 2017, 31(2): 10–19. Chinese.

[16] Lun Z L, Guo Q F. Research on the development mode of e-commerce logistics of agricultural products [J]. World Agriculture, 2017 (8): 106–110. Chinese.

[17] Li M. Researcn on development strategy of China Railway Express Co., Ltd. change into logistics [D]. Chengdu: Southwest Jiaotong University(Master’s thesis), 2008. Chinese.

[18] Han L M. Construction of intelligent logistics park information platform under big data environment [J]. China Market, 2018 (24): 185–186. Chinese.

[19] Shan H X, Yu Q H, Gao B. Business development of agricultural product logistics center based on “Internet+” – Taking the agricultural products logistics park of Guiyang as an example [J]. Logistics Sci-tech, 2019, 42 (4): 103–105. Chinese.

[20] Duan J M, Chang Y J, Li Z X, et al. Obtain the optimum of logistics delivery network with annealing algorithm [J]. Strategic Study of CAE, 2012, 14(7): 109–112. Chinese.

[21] Zhou L Y, Wang C. Research on hydrogen production and its application in green transportation and logistics based on non-gridconnected wind power system [J]. Strategic Study of CAE, 2015, 17(3):50–55. Chinese.

[22] Kuang M, Kuang D. Analysis on the development and innovation path of China’s smart logistics industry [J]. Gansu Social Sciences, 2019 (6): 151–158. Chinese.

[23] Zhang C X, Peng D H. Countermeasures on how to develop China’s smart logistics [J]. China Business and Market, 2013, 27(10): 35–39. Chinese.

[24] Shen J L. Research on the development strategy of China’s intelligent logistics based on the Belt and Road strategy [J]. Journal of Shanxi Institute of Economic Management Institute, 2018, 26(3): 64–70. Chinese.

[25] Zhang H B, Luo Y X. On the flexible choice of logistics management mode in enterprises under efficiency uncertainty [J]. Strategic Study of CAE, 2008, 10(9): 88–91. Chinese.