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Research on Green Logistics Development in Chengdu-Chongqing Region under the Perspective of Game Theory

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ABSTRACT

Chengdu-Chongqing Twin Cities Economic Circle is an important growth pole for the formation of high-quality development in western China and has a unique and important strategic position in the overall situation of national development. Chengdu-Chongqing two places not only vigorously promote the construction of logistics corridors and infrastructure connectivity, but also promote the logistics of all kinds of factors of production, including reasonable flow and efficient agglomeration, and strive to promote the Chengdu-Chongqing two places to the green logistics, cost reduction and efficiency to make effective exploration. The paper first analyzes the current situation and problems of green logistics construction in the Chengdu-Chongqing area, and then establishes an evolutionary game model between the government, enterprises, and consumers based on the game theory perspective, to try to put forward reasonable suggestions for the development and construction of green logistics in Chengdu-Chongqing area.

KEYWORDS

Chengdu-Chongqing Twin-city Economic Circle; Green logistics; Game theory perspective

1. INTRODUCTION

As a pillar industry of the national economy, the logistics industry plays an irreplaceable role in modern economic development. Under the guidance of the idea of "green mountains are golden mountains", the Party and the State have been exploring the path of green development. In January 2022, the National Development and Reform Commission issued the "14th Five-Year Plan for the Construction of a Modern Circulation System", which puts forward the need to vigorously promote the green transformation of transportation and promote new modes of intensive, intelligent, and green logistics development. In January 2022, the National Development and Reform Commission issued the "Modern Circulation System Construction Plan in the 14th Five-Year Plan", which proposed to vigorously promote the green transformation of transportation and promote the new model of intensive, intelligent, and green logistics. According to the important documents of the central government and relevant state ministries and commissions, during the "14th Five-Year Plan" period and the coming period, it is of great significance for the high-quality development of the national economy to plan and promote the development of green logistics, to establish and improve the green logistics system, and to promote the improvement of the quality and efficiency of the logistics industry through the development of green logistics.

Focusing on the Chengdu-Chongqing region again, Chengdu-Chongqing two places not only vigorously promote the construction of logistics corridors and infrastructure connectivity, but also promote the reasonable flow and efficient agglomeration of all kinds of factors of production, including logistics. At the same time, with the accelerated development of the 5G network, big data,

artificial intelligence, and other technologies, the logistics industry has entered a period of rapid growth in the development of digitalization, "innovation", "green" and other keywords have been mentioned again and again. Many scholars, government, and enterprise managers have also conducted in-depth discussions around the theme of "digital and green logistics", to promote the Chengdu-Chongqing region to green logistics, cost reduction, and efficiency to make effective exploration. Therefore, the study of green logistics development in the Chengdu-Chongqing area is of great practical significance.

2. LITERATURE REVIEW

Currently, scholars at home and abroad have studied the development direction of green logistics, and the influencing factors of green logistics development, and some scholars have studied the green logistics development strategy from the perspective of game theory.

2.1. Development of Green Logistics

The research on green logistics in foreign countries is earlier than that in China. In the 1980s, with the concept of sustainable development being widely concerned, the environmental problems brought by transportation, packaging, facilities, and equipment in the logistics chain were also becoming more and more prominent, and academics began to pay attention to the environmental problems generated by the logistics industry. 1991, Muller pointed out that the environmental problems are the result of long-term accumulation, and that the environmental problems will change the way of logistics management. In 1996, Murphy and others proposed that recycled packaging is a good way to green logistics. So far, the academic community put forward the concept of "green logistics". With logistics gradually playing an increasingly important role in the national economy, as well as the guidance of the "green development concept", green logistics has become a hot topic for domestic scholars in recent years. Mao Yan studied the current situation of green logistics development in China and concluded that China actively promotes the development of green logistics in terms of industrial structure adjustment, technological innovation, and transportation, but at the same time, there are also problems such as insufficient green logistics regulations and policies, insufficiently in-depth supply chain management concepts, and insufficiently extensive application of technology and energy-saving products [1]. However, at the same time, there are also problems such as insufficient improvement of green logistics regulations and policy systems, insufficient depth of supply chain management concepts, and insufficient application of technology and energy-saving products. Jiang Xiaoru analyzes the current problems in the logistics industry from three aspects: green packaging, green storage, and green transportation, and makes reasonable suggestions for the development path of green logistics [2]. Jiang Xiaoru analyzed the current problems in the logistics industry from three aspects: green packaging, green storage, and green transportation, and made reasonable suggestions for the development path of green logistics.

2.2. Influencing Factors of Green Logistics

In the research on the factors affecting the development of green logistics, scholars try to develop it from multiple perspectives. Zhang Runzhuo studied the factors affecting the development of green logistics of a cold chain of agricultural products and concluded that the main influencing factors are technical facilities, cognitive level, human resources, institutional system, and so on [3]. Zhu Fangyang and Lai Liangrong analyzed the dynamic relationship between technological innovation, industrial structure upgrading, and green logistics based on the statistical data of 30 provinces, autonomous regions, and municipalities in China from 2011 to 2019 by using the PVAR model with impulse correspondence and variance decomposition, and concluded that, from a national perspective, there is strong coordination and different interactive effects between industrial structure upgrading, technological innovation and green logistics, while the technological innovation in the western region

has a weaker ability to promote industrial structure upgrading and green logistics development[4] The western region's technological innovation has a weaker ability to promote industrial structure upgrade and green logistics development. Cheng Zaoping and Zhang Xiaohong believe that the greening of the business process of enterprises is the most central influencing factor and that the government can play a greater role in promoting the green logistics of enterprises from the point of view of three different levels: enterprise, environment, and government [5]. The government can play a greater role in promoting green logistics for enterprises.

2.3. Application of Game Theory In Green Logistics

As the development of green logistics in practice is driven by multi-interested parties, all parties have mutual checks and balances and interest games, which have a differentiated impact on the implementation effect [6]. The development of green logistics in practice is driven by multiple interests. Therefore, the development process of green logistics inevitably involves the strategic choices of the government, enterprises, and consumers[7, 8]. In recent years, some scholars have tried to use game theory to study the development of green logistics. For example, Dong Yu and Yang Tingting, to explore the influence of various factors on the implementation of green logistics, constructed an evolutionary game model from the perspective of the participating subjects in the process of greening logistics, which includes the government, logistics enterprises, and users, and analyzed the evolutionary stabilization strategies of the game subjects under different circumstances, and concluded that the government's policy support and punishment have an important impact on the strategic choices of users and enterprises [9]. The government's policy support and punishment have an important influence on users' and enterprises' strategy choices. At the same time, only a few scholars have established a game model of green logistics development for specific regions concerning regional characteristics. Chen Xiaoyue discusses the barriers to the implementation of green logistics in Quanzhou City, cites the game model to demonstrate the government's behavior and the enterprises' behavior in implementing green logistics, and concludes that a certain external influence mechanism must be introduced to prompt the enterprises to consciously implement green logistics [10]. The study concludes that a certain external influence mechanism must be introduced to prompt enterprises to consciously implement green logistics.

To summarize, scholars generally agree that there is still much room for progress in the development of green logistics and that it is necessary for each subject: government, enterprises, and consumers, to play their due roles. However, there is still less literature to analyze the strategic choices of government, enterprises, and consumers in the development of green logistics from the perspective of game theory, and there is a lack of research on the direction of green logistics development in Chengdu-Chongqing region given its regional characteristics. Therefore, this paper firstly analyzes the current situation and problems of green logistics construction in the Chengdu-Chongqing area and then establishes an evolutionary game model among government, enterprises, and consumers based on the game theory perspective, to try to put forward reasonable suggestions for the development and construction of green logistics in Chengdu-Chongqing area.

3. ANALYSIS OF PROBLEMS AND CAUSES OF GREEN LOGISTICS IN THE CHENGDU-CHONGQING AREA

The Chengdu-Chongqing Twin Cities Economic Circle, as the "fourth level" of China's regional economic growth, has assumed the important mission of driving the faster and higher quality development of Sichuan and Chongqing and radiating the development of the western region, as well as solving the problem of a serious imbalance in the development of China's eastern and western regions. At the same time, the logistics industry is an indispensable pillar of economic development, in promoting the economic development of the Chengdu-Chongqing region at the same time, a large number of carbon emissions, excessive packaging, plastic pollution, and other issues for the

development of green logistics have brought about many problems and challenges [11]. The following are some of the issues that have been raised in the past few year

3.1. Insufficient Government Policy Support Affects Business Motivation

The development of green logistics is a long-term systematic project, and it is not enough to rely solely on market forces to promote the development of green logistics. For enterprises, purchasing better equipment, increasing investment in project funds, and carrying out technological and management innovations will all bring about a rise in short-term costs, but promoting the development of green logistics brings more social benefits and has little to do with the interests of enterprises. In addition, some advanced energy-saving and emission reduction plans, such as solar photovoltaic power generation, although the social benefits are huge, high investment costs and long payback cycle, are very much in need of national subsidies to promote the development of green logistics.[12, 13] The state subsidy is very much needed to promote the program.

3.2. Ideological problems make it difficult to have on-the-ground measures

From the results of the survey, many logistics companies in the Chengdu-Chongqing area believe that "green logistics" and "garbage classification" a difficult to land the advanced concept of the current operation and management of enterprises of little benefit. In the research, many logistics companies believe that green logistics is an important direction for future development, enterprises are also willing to contribute to the reduction of air pollution, reduce carbon emissions, but struggling to find the hand, it is not clear from what place to start to promote the development of green logistics. This problem is realistic, in the fierce market competition, if the promotion of green logistics development can not help enterprises to enhance market competitiveness, can not bring practical benefits for enterprises, the market is not advanced and practical cases and benchmarks, green logistics development is always difficult to implement.

3.3. The High Cost of Green Logistics Technology And Equipment Implements Insufficient Incentive

Green logistics development can not be ignored as an important issue of technological innovation, but one of the very prominent problems is that the green logistics technology and equipment one-time procurement cost is often higher, which will be a huge fixed cost for enterprises, will occupy a lot of liquidity, the enterprise procurement willingness is insufficient. Although many advanced energy-saving logistics technology equipment procurement costs are high, their use, can enhance operational efficiency, reduce operational energy consumption, and reduce the number of maintenance, from the long-term perspective instead of a great cost advantage. However, the reality is inevitable that short-term benefits are often more likely to be emphasized by enterprises, coupled with the uncertainty of the future, which makes the development of green logistics by logistics enterprises not enough motivation.

3.4. Duplicate and Transitional Packaging in E-Commerce Logistics

With the explosive growth of China's e-commerce business volume, the ensuing e-commerce logistics packaging problem has attracted the attention of scholars both at home and abroad and likewise has become one of the most important issues limiting the development of green logistics in the Chengdu-Chongqing area. According to the operation of the postal industry in 2021 announced by the State Post Bureau, in the whole year of 2021, the volume of China's express delivery business amounted to 108.3 billion pieces, a year-on-year increase of 29.9%, and the number of parcels accounted for more than half of the world, and the large volume of China's e-commerce logistics means that the environmental problems brought about by the express delivery packaging will also become more prominent. In the current packaging model, in order to avoid damage to goods caused by loading and

unloading during transportation, small items usually require multiple packaging, which uses plastic bags, tape, cardboard boxes, foam fillers, and other products, not only difficult to recycle and difficult to degrade, resulting in a serious waste of resources and environmental pollution, has become a serious social problem.

4. ANALYSIS OF THE GAME AMONG THE GOVERNMENT, ENTERPRISES, AND CONSUMERS

The green logistics development process discussed in this paper involves the following game players: government, logistics enterprises, and consumers. The government plays the role of regulator and policy maker in green logistics development. The government's strategies may include: formulating environmental protection regulations and standards to regulate the green logistics behaviors of enterprises; providing financial and tax incentives to encourage enterprises to adopt green logistics measures; investing in infrastructure development, such as green transportation networks and logistics centers; and carrying out research and development projects to promote technological innovation in green logistics. As for the development of green logistics, the strategies and actions of logistics enterprises are crucial to the promotion of the implementation and success of green logistics. Strategies that can be adopted include: energy consumption and carbon emissions can be reduced by optimizing transportation routes, cargo distribution, and warehouse layouts, e.g., by adopting intelligent dispatch systems and optimization algorithms to reduce the rate of empty loads and mileage traveled; vehicles and equipment can be renewed and upgraded to adopt more environmentally friendly and efficient technologies, for example, by using low- or zero-emission transportation; and by working with suppliers and partners to promote green supply chain management, for example, by working with environmentally certified suppliers and choosing to use environmentally friendly materials and packaging. Consumers also play an important role in the development of green logistics, and their strategic choices can have a positive impact on the promotion of green logistics: Consumers can choose to buy products with environmental certifications or labels, which are usually produced and transported with green logistics measures that reduce environmental impacts; Consumers can choose to buy products with small amounts of packaging or no packaging, which reduces packaging material use and waste. In addition, choosing recyclable or biodegradable packaging materials is also a green choice.

No matter what kind of strategy is chosen, the question that cannot be bypassed is whether the stakeholders can obtain the expected benefits from the implementation of the strategy, because if the strategy that can promote the development of green logistics is chosen, it is necessary to pay for the corresponding costs of human resources, material resources, financial resources, time and so on, in this case, through the trade-off between the costs and the benefits will result in a different choice of strategy, which may be to promote the development of green logistics, or may produce strategies unfavorable to the development of green logistics, and also produce a strategy game between the subjects of interest. The strategy chosen to promote the development of green logistics may also produce unfavorable strategies for the development of green logistics, which also produces a strategic game between the main interests. The government's game strategy has two kinds of positive and negative regulation; the enterprise's game strategy has two kinds of green and non-green; the consumer's strategy has two kinds of consumption and non-consumption. The specific game process between the three is as follows:

4.1. The Government-Business Game

Logistics enterprises are the key main body in the process of green logistics development, which plays an important role in technological innovation, talent training, industrial upgrading, etc. Logistics enterprises in the game process of green and not green two strategies. As the "invisible hand" of the government in the process of enterprise implementation of green logistics strategy, there

are two strategies positive supervision and negative supervision. If the positive regulatory strategy, the government will logistics enterprises to carry out logistics activities in the carbon emissions into the assessment indicators, and based on the results of the assessment develop appropriate incentives and penalties; at the same time, increase the policy support for the development of green logistics, which can be embodied in the financial support for technological innovation, logistics infrastructure construction. If a negative regulatory strategy is adopted, the government will relax the regulation of carbon emissions of logistics enterprises, and the support of various policies will also decline. Logistics enterprises will weigh the benefits and losses according to the government's policy, and choose between green and non-green strategies.

4.2. The Business-Consumer Game

For consumers, the level of logistics efficiency and logistics costs will affect their choice of goods to be purchased. The implementation of green logistics may lead to an increase in logistics costs and a decrease in logistics efficiency, which in turn will lead to an increase in the price of goods and a decrease in the timeliness of logistics, thus affecting consumers' utility expectations. Therefore, the strategic choice of whether logistics enterprises develop green logistics may affect consumers' purchasing decisions of commodities, and whether consumers consume related products and services will directly affect the income of logistics enterprises, which further affects whether logistics enterprises adopt green strategies.

4.3. The Government-Consumer Game

If the government adopts the strategy of positive regulation, it will subsidize logistics enterprises and provide tax incentives, which will encourage consumers to make the strategy of purchasing goods. Under the condition that enterprises implement a green logistics strategy, if the government negatively regulates, it will affect the rights and interests of consumers, and thus consumers will tend to choose the strategy of not consuming. On the other hand, since the government's goal is to maintain a healthy and prosperous logistics market and to promote a steady improvement in economic operation, whether consumers consume or not will affect the attitude and strength of government regulation.

5. CONCLUSIONS AND RECOMMENDATIONS

Chengdu-Chongqing Twin Cities Economic Circle as China's regional economic growth "fourth level", bears the drive of Sichuan and Chongqing and radiation-driven western region faster and higher quality development, to solve the serious imbalance in the development of China's east and west the important mission, and green logistics development is an important part of the high-quality development of Chengdu-Chongqing region. The article firstly analyzes the problems existing in the construction and development of green logistics in the Chengdu-Chongqing area, secondly discusses the game strategy choices of the government, logistics enterprises, and consumers in promoting the development of green logistics in the Chengdu-Chongqing area, and finally summarizes and analyzes and puts forward the following reasonable suggestions for the development of green logistics in Chengdu-Chongqing area.

The government should not only increase policy and financial support but also establish effective punitive measures. On the one hand, the development of relevant technology innovation support policies encourages logistics enterprises to introduce green logistics equipment; at the same time, the financial plan is appropriately tilted in the direction of green logistics, to ensure the allocation of market resources based on ensuring the implementation of the key technologies of green logistics capital investment, for the development of enterprises in the green logistics to inject more power. On the other hand, through effective punitive measures to build the last line of defense for the

development of green logistics, enterprises that do not seriously implement the green logistics development strategy to increase penalties, environmental pollution behaviors are divided into degrees of high fines, prompting enterprises to consciously abide by the development of green logistics related regulations and policies.

Make full use of the energy advantages of the Chengdu-Chongqing region to explore the road of new energy development and technological innovation, and break through the bottleneck of the high cost of green logistics facilities and equipment. To actively promote the development of intelligent logistics, logistics enterprises should strive to be the vanguard of logistics technology development, to create a smart supply logistics system supported by big data, network optimization, and sharing, intelligent collaboration, and become a demonstration enterprise for green logistics construction through high-tech empowerment. At the same time, the Chengdu-Chongqing region can actively play the advantages in new energy vehicle manufacturing, promote the green and low-carbon transformation of transportation tools, and actively expand the application of new energy and clean energy such as electricity, hydrogen, natural gas, advanced bio-liquid fuels and other new sources of energy in the field of transportation, vigorously promote and popularize the new energy vehicles, and gradually reduce the proportion of traditional fuel vehicles in new car sales and production and automobile ownership.

For the green packaging problem in e-commerce logistics, first of all, we should streamline the packaging, rationally plan the packaging method before packaging, and try to reduce the packaging that can be reduced, to avoid over-packaging and repetitive packaging from the source. Secondly, in the use of packaging, try to use recyclable packaging, which can minimize the waste of packaging; for neither reduce nor use recyclable packaging, you can use recyclable packaging materials such as cardboard boxes, so that packaging waste can be reused through recycling. Finally, for plastic products such as tapes, bags, fillers, etc., biodegradable products should be used as much as possible to reduce environmental pollution; however, it should be noted that biodegradable is not the same as green, and many biodegradable materials may not be environmentally friendly in the production and degradation process, and they may also bring serious pollution.

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