

Summary of the Influencing Factors of Green Supply Chain Pricing of Prefabricated Buildings under the Target of "Double Carbon"

Xinyu Wang, Yeqi Cao*, Zhaoyang Li, Ye Xu, Runkang Shen

North China University of Science and Technology, Tangshan, 063210, China

* Corresponding Author: 1556018942@qq.com

Abstract

Under the background of national "double-carbon", prefabricated buildings, as an important green building, are of great significance to its research on green supply chain. This paper summarizes the relevant literature and policy subsidies of the green supply chain of prefabricated buildings, discusses the influence of the building green degree, government subsidy policy and consumer preference on the supply chain respectively, and systematically analyzes the research framework of the green supply chain pricing decision of prefabricated buildings through the literature. Finally, the supply chain field of prefabricated buildings is discussed to provide theoretical reference for the sustainable development of the construction industry.

Keywords

Prefabricated Buildings; Green Supply Chain; Government Subsidies; Building Green Degree.

1. Introduction

As global climate change and environmental problems become increasingly severe, China clearly put forward the goal of "carbon peak" in 2030 and "carbon neutrality" in 2060. In the current context, the concept of "green supply chain" is put forward. Green supply chain refers to "the upstream and downstream relationship that integrates the concept of environmental protection and resource conservation throughout the whole process from product design to raw material procurement, production, transportation, storage, sales, use and scrapping, so that the economic activities and environmental protection" [1].

According to the report of China Building Energy Conservation Association, in 2021, the total carbon emission of the whole process of buildings in China accounted for 47.1% of the national energy-related carbon emissions of [2], and the construction industry undertakes an important task in achieving the "double-carbon" goal. As an important green building, the factory and assembled production mode is strong compatible with the green supply chain management concept [3], which can effectively solve the problems of excessive carbon emissions in the traditional construction industry. Therefore, it is of great significance to explore the influencing factors of the green supply chain pricing of prefabricated buildings. This paper arranges and analyzes the existing research literature for prefabricated building green supply chain, discusses the building green degree, government subsidy policy and consumer preference on the supply chain [4], and systematic analysis of the supply chain pricing decision. Finally, the prefabricated building supply chain development, to promote the construction industry in the direction of low carbon and efficient.

2. Literature References

At present, most literature studies mainly study the pricing decision of the green supply chain of prefabricated buildings from the perspectives of building greening, government subsidy policy and consumer preference. Therefore, this paper summarizes the current situation of supply chain research from the above three aspects.

2.1. Building Green Degree

Prefabricated buildings are important green buildings. Green buildings can not only reduce the consumption of energy and resources, protect the ecosystem, but also provide a healthier living environment for the residents, and promote the harmonious coexistence between man and nature. Building green degree is an important index to measure the impact of buildings on the environment and resource utilization efficiency in the whole life cycle. Taking the green degree of buildings into account in the pricing mechanism model of the green supply chain of prefabricated buildings, it can reflect the cost and value of the supply chain more comprehensively. H.P. Pan et al. used game theory to construct replicative dynamic equations under the condition of limited rationality, and compared and analyzed the influence of decisions made by developers and consumers under government incentive policies on the basis of considering the greenness of green buildings [5]. Y.F. Shi Considered environmental and economic factors, construct the social game model of green development evolution of construction enterprises under the public participation, and put forward the impact of public participation and government policies on the green development of construction enterprises [6]. X.X. Zhu et al. discussed the influence of consumer green preference, green building green degree and government subsidy on the green building market under three subsidy strategies: no subsidy strategy, developer cost subsidy strategy and consumer price subsidy strategy [7]. A. Karamoozian et al. helped managers to make the appropriate supplier selection by applying a new approach using the best-worst method (BWM) and the superiority and inferiority ranking (SIR) and considering the uncertainty of green supplier selection in the construction industry [8].

2.2. Government Subsidy Policy

In order to actively promote the development of prefabricated buildings, promote the improvement of the green supply chain in the construction industry and the low-carbon transformation of the construction industry, the government has introduced a variety of subsidy policies, such as financial subsidies, floor area ratio incentives, and preferential provident fund loans. These policies not only help to reduce the construction cost of prefabricated buildings, but also improve the market acceptance of prefabricated buildings, providing strong support for the sustainable development of the construction industry. H.B. Li et al. selected the three stakeholders of buyers, developers and the government to analyze the changes of the game strategies between buyers and developers under different government subsidy strategies [9]. F.L. Liu constructed the decision model of green housing supply and demand subject under different government subsidy strategies through the function of consumer utility and developer's profit, and explores the impact of changes in relevant parameters on developers' income and consumer utility under different subsidy government strategies [10]. W. Jiang et al. considered a two-echelon prefabricated construction supply chain consisting of a manufacturer and an assembler, aiming to investigate pricing and the assembly rate strategies and coordination under different subsidy objects [11].

2.3. Consumer Preference

As the main body of the market, the relevant preferences of consumers directly affect the market demand and price acceptance of prefabricated buildings. Consumers' low-carbon

preferences make the prefabricated building supply chain more green and sustainable. Integrating consumer preferences into the pricing mechanism model of the green supply chain for prefabricated buildings can not only help enterprises better adapt to the market demand and improve their profits, but also promote the green transformation and sustainable development of the whole industry. G.F. Liu et al. Starting from the demand side of green building, it uses the prospect theory and evolutionary game theory to build the evolution game model of the purchase intention of green building consumers under the government information disclosure mechanism, and analyzes the evolution and stability strategy of the system under the government information disclosure policy [12]. J. Wen et al. investigated how the prefabricated rate affects consumer preferences and order allocation while designing a three-echelon PCSC under a single-supplier structure, two-supplier structure, and dual-channel structure [13]. D.L. Meng based on differential game, explored in considering the influence of consumer preference for construction demand, composed of developers and contractors of construction supply chain under the punishment contract constraint based on decentralized mode, centralized mode of three different decision behavior model, and three single incentive contract and four kinds of combination contract model of the variables of building supply chain, and through simulation to explore the participants of the optimal carbon emission reduction behavior strategy [14].

3. Research on the Green Supply Chain Decision-making of Prefabricated Buildings

The industrial chain of prefabricated construction industry involves many subjects, including prefabricated components suppliers, construction units, real estate developers, governments, consumers, etc. At present, most of the research literature on the pricing decision of green supply chain of prefabricated buildings design the supply chain as secondary or tertiary, and does not clearly unify the names of supply chain members, but the basic government subsidy object is generally three subjects: upstream subject, midstream subject or consumer. Considering the government subsidy situation, from the perspective of green supply chain, taking the supply chain members as the subject of the game, and the centralized and decentralized decision game model [5] is constructed, so as to obtain the maximum profit, optimal price and optimal building green degree among the members. Comparative analysis of each game model, and then explore the impact of consumer preference on the supply chain.

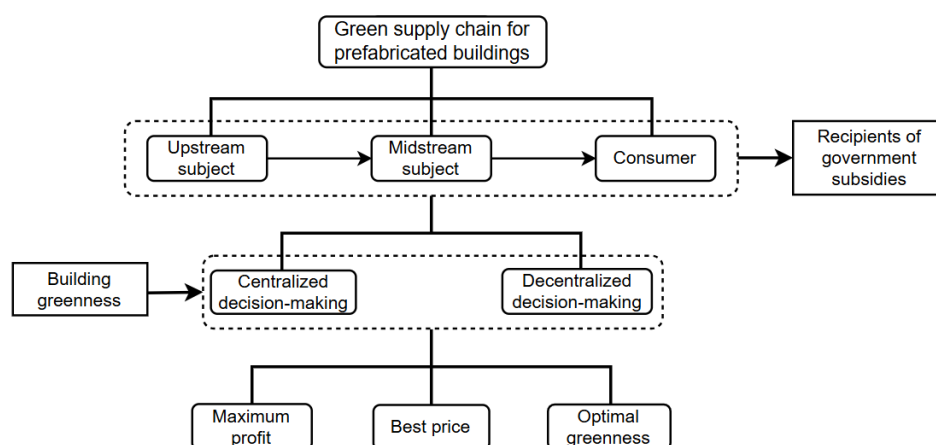


Fig. 1 Research framework of green supply chain pricing decision for prefabricated buildings

3.1. Government Subsidies

3.1.1. Government Subsidies to Upstream Entities (Raw Material Suppliers, Prefabricated Component Production Enterprises)

The upstream entities mainly include raw material suppliers, prefabricated component product research and development companies, etc., which are responsible for providing raw materials, research and developing prefabricated components, and conducting overall planning and deepening design. Government subsidy policy can encourage upstream entities to increase R & D income, promote their technological innovation in green building materials, efficient production process and other aspects, and promote the innovation and upgrading of [8] in prefabricated building technology. In addition, through financial subsidies, tax incentives and other measures, the production cost of upstream entities can be directly reduced, and finally more consumers can be attracted to choose prefabricated buildings, improving the market competitiveness.

3.1.2. Government Subsidies for Midstream Players (Prefabricated Builders)

The main body of the middle reaches mainly includes prefabricated components production and processing enterprises and construction companies, which are responsible for the production of prefabricated components and the construction and installation of prefabricated buildings. Government subsidies to the midstream subjects can reduce their production and construction costs, encourage the midstream subjects to introduce intelligent construction technology, improve the construction efficiency, and promote the industry to the development of intelligent and digital direction.

3.1.3. The Government to Subsidize Consumers

Government subsidies to consumers can directly reduce the cost of buying prefabricated buildings, improve consumers' willingness to buy, and promote market acceptance. Relevant studies show that the government subsidies to consumers, and the price, demand and profit of prefabricated buildings are all increased. The government subsidies can not only reduce the purchase cost of consumers, but also promote the [12], promote the large-scale development of prefabricated buildings, and improve the overall competitiveness of the industry.

3.2. Two Decision Models

Centralized decision-making pursues the overall profit maximization of the supply chain. The members of the supply chain are cooperative relations, and jointly decide the market price of the product and the green degree of the building. The decentralized decision pursues the profit maximization of supply chain members, using game theory [13] like Stackelberg to determine the decision variables of game leaders first, and then determine the decision variables of followers. Related studies show that under the centralized decision, the market price of products is low, but the green degree of buildings and the overall profit of supply chain are higher than the results under the decentralized decision. However, in practice, it is difficult for both sides of the supply chain to grasp the whole picture of the supply chain in real time and realize complete information sharing. In order to pursue their own profits, each enterprise will not completely in accordance with the agreed decision, and then can not achieve the real centralized decision. Therefore, many literature studies introduce revenue sharing and other contract mechanisms to coordinate the interest [14] among members of the supply chain, improve the overall profit of the supply chain, coordinate the supply chain to achieve the effect of centralized decision-making, and adjust the revenue sharing ratio, so that members of the supply chain can better respond to the changes of market demand.

4. Conclusion

The pricing mechanism of the green supply chain of prefabricated buildings is a complex system, which is comprehensively influenced by many factors. Based on the findings and conclusions obtained from the current relevant literature research, this paper summarizes the role of the following influencing factors on its pricing decision:

- (1) The higher the building green, the better the supply chain performs in resource utilization, environmental protection and sustainable development, but it may also lead to increased costs. Therefore, the need to balance the relationship between green degree and cost in the pricing mechanism in order to achieve the dual goals of economic benefits and environmental benefits of the supply chain.
- (2) Government subsidy policy can encourage enterprises to adopt low-carbon technologies, which directly affects the cost of the supply chain, and thus affects the pricing strategy.
- (3) Consumer preference directly affects the market demand and price acceptance of prefabricated building products, and then affects the investment of supply chain members in green technology, environmental protection materials and other aspects, and improves the sustainable development ability of the supply chain.

References

- [1] H. Li, C.X. Wu: Review of green supply chain research based on CiteSpace, Project Management Technology, Vol. 22 (2024) No.3, p.74-80.
- [2] Research Report on China Building Energy Consumption and Carbon Emission (2023), Building, Vol. (2024)No.2, p. 46-59.
- [3] X.R. Yu: Research on the main profit distribution of the green supply chain of prefabricated buildings based on the Shapley value of the cloud center of gravity (MS., Qingdao University of Technology, China 2023).
- [4] Y.X. Yao, Y.Q. Qi: Review of government subsidy factors in green supply chain decision-making, Inner Mongolia Science and Technology and Economy, Vol. (2023) No.13, p.14-18+89.
- [5] H.P. Pan, X.Y. Wang: Research on the key subjects of green building game based on green degree, Journal of Anhui University of Science and Technology (Social Science Edition), Vol. 24 (2022) No.1, p.12-18.
- [6] Y.F. Shi, Y.F. Liu, T.L. Zhang: Research on the green development strategy of construction enterprises based on the evolutionary game, Journal of Xi'an University of Technology, Vol. 40 (2024) No.3, p. 350-361.
- [7] X.X. Zhu, F.L. Liu, X.R. Yu: Research on the impact of different government subsidy strategies on the green building market under the "double-carbon" target, Journal of Shenyang Jianzhu University (Social Science Edition), Vol. 25 (2023) No.4, p. 354-360.
- [8] A. Karamoozian, D.S. Wu, C.C. Luo: Green Supplier Selection in the Construction Industry Using a Novel Fuzzy Decision-Making Approach, Journal of Construction Engineering and Management, Vol.149 (2023) No.6.
- [9] H.B. Li, F.Y. Guo, L. Zhao , et al.: Research on the incentive strategy of green building market based on the perspective of government subsidy, Project Management Technology, Vol. 22 (2024) No.5, p. 49-56.
- [10] F.L. Liu: Research on the decision-making behavior of the supply and demand subjects in the green housing market under different government subsidy strategies (MS., Qingdao University of Technology, China 2023).
- [11] W. Jiang, L.Q. Pu, M.Q. Q , et al.: Pricing, assembly rate optimizations and coordination for prefabricated construction supply chain with government subsidies, Humanities and Social Sciences Communications, Vol 11 (2024) No.1.

- [12] G.F. Liu, Y. Xie: Research on the evolution of green building consumers under the government information disclosure mechanism, *Technology and Economy*, Vol 36 (2023) No.5, p. 106-110.
- [13] J. Wen, Y.C. Hua, Y. Meng , et al.: Pricing Models under Three-Echelon Prefabricated Construction Supply Chains with Consumer Preferences, *Sustainability*, Vol 16 (2024) No.2.
- [14] D.L. Meng: Research on carbon emission reduction behavior strategies of low-carbon building supply chain considering consumer preferences (MS., Yanshan University, China 2022).