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Research on Green Supply Chain Management Optimization and Practice under the Constraints of Dual Carbon Targets

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Abstract. President Xi Jinping said in the 20th Party Congress report that we must build Beautiful China and develop green economy. Under dual carbon goals, green supply chain is key for ecological progress. Improving it can cut resource waste and pollution, supporting sustainable development. Our agricultural company has some green supply chain experience but still faces many practical problems. So we need improve management to boost sustainability. This paper studies the company's green supply chain. It defines core concepts using literature and divides processes into four parts via SCOR model: design, procurement, production, and recycling. It also builds an evaluation system and uses AHP and fuzzy methods to calculate scores. The results show four main issues: weak eco-design, incomplete supplier management, poor storage methods, and backward recycling tech. Reasons include low green awareness, bad information sharing, and lack of innovation. This paper suggests four improvements: raise awareness, perfect supplier system, build information mechanism, and innovate management rules. It also gives safeguard measures for staff, tech, and funding. This study provides targeted strategies to improve the company's efficiency. It also offers useful reference for other agricultural firms and promotes industry sustainability.

Keywords: Dual Carbon Goals, Agricultural Enterprises, Green Supply Chain

1. Introduction

President Xi Jinping said in the 20th National Congress report that we should actively promote carbon peaking and carbon neutrality. It is a major economic and social reform. Based on China's energy situation, we should establish new systems before ditching old ones and advance carbon peaking step by step. With dual carbon goals, low-carbon and green transformation become national strategy. Agricultural supply chain is important to national economy, and its green shift is key to dual carbon goals. Green supply chain puts green ideas into every link. The agricultural company has problems in green supply chain that harm environment and raise costs. This study analyzes how to optimize its green supply chain to cut emissions, improve resource efficiency, and support sustainable agriculture [1]. It also aims to improve product quality and safety, meet market demand, and boost industrial upgrading and competitiveness. This study supports dual carbon goals and provides guidance for agricultural enterprises [2]. This paper uses green logistics, SCOR model, circular economy theory, literature research, AHP, fuzzy evaluation, and questionnaire to analyze the company's green supply chain. It then puts forward optimization suggestions and safeguard measures.

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2. Basic model and method

SCOR model is developed by US Supply Chain Council. It is a standard framework with five core processes: plan, purchase, produce, deliver, return. It help enterprises optimize supply chain and improve efficiency. It uses best practices to build flexible supply network and is widely used by Global 500 companies [3]. This paper uses AHP and fuzzy evaluation to build an evaluation system for the agricultural company's green supply chain. It calculates weights and scores to make results more accurate. Circular economy started in 1960s by economist Kenneth E. Boulding. It is an important global strategy to solve resource and climate problems. It focuses on efficient resource use and includes economic, environmental and social value, which shows the turn to sustainable development. See Table 1 and Table 2 for details [4].

Table 1. Evaluation indicators for green supply chain management of agricultural products in companies

primary indicator	secondary indicator
Green Design	Ecotype Product R&D and Intellectual Property Strength
	The Compatibility of Product Design Concept with Green
	The Adaptation Degree of Product Design and Order Green Trend Change
	Product Life Cycle Recycling Characteristics
green procurement	index of supplier contract performance
	Material Quality Compliance Rate
	supply side environmental management system certification level
	Priority Evaluation of Cleaner Production Technology
	Construction and operation level of pollution prevention and control facilities
Green Manufacturing and Storage and Transportation	Collaborative Scheduling Efficiency of Production System
	integrated degree of intelligent production system
	Carbon Footprint Control Capability in Manufacturing Process
	index of equipment resource utilization efficiency
	Optimization level of warehouse system load
	logistics efficiency guarantee capability

Table 2. Evaluation index system of green supply chain management for agricultural products

objective	Primary Indicator B	secondary indicator
Evaluation of Green Supply Chain Management of Agricultural Products in China	Green Design (B1)	Ecological product R&D and intellectual property strength (B11)
		The Compatibility of Product Design Concept with Green (B12)
		The degree of adaptation between product design and the green trend of orders (B13)
		Product lifecycle recycling characteristics (B14)
	Green Procurement (B2)	Supplier Contract Performance Index (B21)
		Material Quality Compliance Rate (B22)
		Supplier Environmental Management System Certification Level (B23)
		Cleaner production technologies use priority assessment (B24)
	Green Manufacturing and Storage (B3)	Pollution Control Facilities Construction and Operation Level (B31)
		Production System Collaborative Scheduling Efficiency (B32)
		Integrative Degree of Intelligent Production System (B33)
		Carbon Footprint Control Capability in Manufacturing Process (B34)
		Device resource utilization efficiency index (B35)
		Warehouse System Load Optimization Level (B36)
		Logistics efficiency guarantee capability (B37)

3. Correlation formula

To make sure evaluation results scientific and reliable, the study strictly do consistency test process. It calculate consistency ratio (CR value) to check logic consistency of judgment matrix. When CR

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value is less than 0.1, the weight result have acceptable consistency level. If it not meet the standard, we need adjust the evaluation data again until it pass the test.See Tables 3, 4, and 5 for details [5].

$$CR = \frac{CI}{RI}(4-1) \tag{1}$$

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{2}$$

$$\mathrm{R_{ij}} = \frac{m}{n, \quad (i = 1,2,\ldots 20, j = 1,2,3,4,5)} \tag{3}$$

$$W_i \quad = \frac{\left(\prod a_{ij}\right)^{\frac{1}{n}}}{\sum_{i=1}^{n}\left(\prod_{j=1}^{n} a_{ij}\right)^{\frac{1}{n}}}, \mathrm{n=1,2...,n} \tag{4}$$

Table 3. Judgment matrix of primary indicator B

	B1	B2	B3	B4
B1	1	2.494	2.558	2.309
B2	0.401	1	2.041	2.273
B3	0.391	0.490	1	2.083
B4	0.433	0.440	0.480	1

Table 4. Judgment matrix of sub-index B1

	B11	B12	B13	B14
B11	1	2.564	2.525	2.924
B12	0.390	1	2.381	4.762
B13	0.396	0.420	1	2.825
B14	0.342	0.210	0.354	1

Table 5. Judgment matrix of sub-index B2

	B21	B22	B23	B24
B21	1	0.602	2.257	2.364
B22	1.660	1	3.448	3.704
B23	0.443	0.290	1	3.030
B24	0.423	0.270	0.330	1

After determining the evaluation index set, weight distribution, comment set, and the membership degree of each index, we will use Formula 5 to perform multi-level fuzzy comprehensive evaluation calculation. The formula is as follows:

$$B = A^T R \tag{5}$$

$$Greendesign = \begin{pmatrix} 43.79\% \\ 30.44\% \\ 17.38\% \\ 8.38\% \end{pmatrix}^T \cdot \begin{pmatrix} 3.54\% & 21.39\% & 31.43\% & 27.63\% & 16.01\% \\ 5.01\% & 24.54\% & 19.63\% & 30.71\% & 20.11\% \\ 1.58\% & 23.43\% & 24.42\% & 30.94\% & 19.63\% \\ 2.12\% & 25.03\% & 20.62\% & 28.33\% & 23.91\% \end{pmatrix}$$
$$= (3.53\%, 23.01\%, 25.71\%, 29.20\%, 18.55\%) \tag{6}$$

$$GreenProcurement = \begin{pmatrix} 28.40\% \\ 45.51\% \\ 16.75\% \\ 9.34\% \end{pmatrix}^T \cdot \begin{pmatrix} 3.50\% & 25.12\% & 21.03\% & 30.84\% & 19.51\% \\ 5.71\% & 22.61\% & 28.92\% & 26.22\% & 17.08\% \\ 3.96\% & 17.02\% & 31.59\% & 32.58\% & 14.85\% \\ 3.21\% & 26.41\% & 24.14\% & 30.29\% & 15.95\% \end{pmatrix}$$
$$= (4.31\%, 22.74\%, 26.68\%, 28.98\%, 17.29\%) \tag{7}$$

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Green Manufacturing and Storage & Transportation=

$$\begin{pmatrix}23.75\%\\16.52\%\\15.46\%\\14.15\%\\12.92\%\\6.36\%\\5.52\%\\5.33\%\end{pmatrix}^{T}\cdot\begin{pmatrix}3.82\% & 29.09\% & 22.16\% & 28.51\% & 16.42\%\\5.35\% & 20.96\% & 30.55\% & 28.71\% & 14.43\%\\3.30\% & 19.13\% & 25.33\% & 33.92\% & 18.32\%\\1.36\% & 24.24\% & 25.54\% & 34.52\% & 14.34\%\\4.29\% & 22.51\% & 25.03\% & 28.04\% & 20.13\%\\5.47\% & 25.23\% & 30.44\% & 24.32\% & 14.54\%\\3.90\% & 19.74\% & 34.82\% & 27.22\% & 14.32\%\\5.78\% & 25.35\% & 35.56\% & 20.78\% & 12.53\%\end{pmatrix}$$
$$=(3.92\%, 23.71\%, 26.83\%, 29.42\%, 16.13\%) \quad (8)$$

The score of "Eco-product R&D and patent strength (B11)" is 51.85, far below industry standard 70.20. The company not update patents on food processing, fresh-keeping or green packaging in recent years. Existing green patents not renew on time, R&D staff cut from 15 to 5. As Figure 4-2 show, it published patents from 2013 to 2018, peak at 10 items in 2013. Its highest R&D investment hit 3 million yuan, average 1.6 million yuan yearly, but no R&D spending after 2018. This show the company is backward in key R&D areas, can not keep up with industry green tech update. It have no layout in cutting-edge tech like biodegradable materials, which seriously block its green supply chain management improvement.The above content is reflected in Table 6.

Table 6. Comparison of B1 evaluation scores with industry benchmarks

evaluating indicator	Enterprise Score	industry benchmark	gap	Problem Level
Green Design (B1)	54.26	71.40	-17.14	Severely backward
Ecological product R&D and intellectual property strength (B11)	51.85	70.20	-18.35	Serious deficiency
The Compatibility of Product Design Concept with Green (B12)	54.24	72.80	-18.56	significantly behind
The degree of adaptation between product design and the green trend of orders (B13)	53.08	69.50	-16.42	Clearly insufficient
Product lifecycle recycling characteristics (B14)	52.81	73.10	-20.29	Severe defect

The score of "fit between product design and green concept (B12)" is 54.24, B13 get 53.08. The company have serious shortage in green packaging design. 82% of its packaging use non-degradable PE film, only 12% recyclable PET, compostable packaging less than 6%. It has big gap with leading companies: Driscoll's use 100% recyclable packaging, MUJI cut packaging waste by 95%, Baiguoyuan reduce carbon footprint by 37% with PLA bags. The company’s packaging take 450 years to degrade, produce 1200 tons non-degradable waste yearly, seriously backward in green design. Its green procurement score is only 56.04, far below industry benchmark 72.30, showing big flaws in supplier management, raw material control and environmental compliance.The above content is reflected in Table 7.

Table 7. Comparison of B2 evaluation scores with industry benchmarks

evaluating indicator	Enterprise Score	industry benchmark	gap	Problem Level
Green Procurement (B2)	56.04	72.30	-16.26	Severely backward
Supplier Contract Performance Index (B21)	54.05	70.80	-16.75	Serious deficiency
Material Quality Compliance Rate (B22)	55.71	75.20	-19.49	significantly behind
Supplier Environmental Management System Certification Level (B23)	53.62	68.90	-15.28	Clearly insufficient
Cleaner production technologies use priority assessment (B24)	55.40	74.10	-18.70	Severe defect

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4. Conclusion

This chapter evaluate the current situation of the company's agricultural green supply chain management. Through reading many literatures, it build a targeted evaluation index system for the company. It use expert scores to make judgment matrix, combine AHP and fuzzy comprehensive evaluation to analyze four core links: green design, green purchase, green production and storage, green recycle and treatment. It get scores of 4 first-level indexes and 20 second-level indexes, and find the results are not ideal. Then it make deep analysis, find four main problems: lack of eco idea in product design, incomplete supplier management system, unreasonable production and storage methods, backward recycle and waste treatment technology. It also analyze the main reasons, including weak green awareness, imperfect green supplier system, not timely supply chain information sharing, and insufficient green supply chain innovation power.

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