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Research on the Implementation Paths and Effects of Green Logistics in E-Commerce Enterprises under the "Dual Carbon" Goals — A Case Study of JD Logistics

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Abstract

Under the "Dual Carbon" goals, the rapid growth of e-commerce logistics has intensified environmental pressures, making green transformation an urgent priority. This paper systematically investigates the implementation paths and effects of green logistics in e-commerce enterprises through a case study of JD Logistics. Employing literature review, case study, and comparative analysis methods, the study examines JD Logistics' green practices across four dimensions—green packaging, green transportation, green warehousing, and reverse logistics—and evaluates their effects based on corporate data. The findings show that JD Logistics has achieved notable environmental benefits, enhanced brand image, and gradually realized cost advantages. However, challenges persist, including cost-benefit imbalance, insufficient supply chain coordination, technological bottlenecks, and consumer behavioral inertia. Countermeasures are proposed from enterprise, industry, and government levels. This study enriches green logistics research in the e-commerce context and provides practical references for enterprises' green transformation.

Keywords

Green logistics; E-commerce enterprises; "Dual Carbon" goals; Implementation paths; Sustainable development

1. Introduction

The Implementation Plan for Science and Technology Supporting the Goals of Carbon Peaking and Carbon Neutrality (2022–2030) states that China aims to achieve carbon peaking before 2030 [1]. The logistics industry is a strategic tertiary industry underpinning national economic development, serving as a critical bridge connecting production, distribution, and consumption [2]. In 2023, China's e-commerce transaction volume reached 43.8 trillion yuan, accompanied by rapid logistics expansion. However, this growth has imposed considerable environmental pressure:

express packaging waste exceeds 10 million tons annually, transportation generates substantial carbon emissions, and warehousing energy consumption demands urgent attention [3]. Against this backdrop, how e-commerce enterprises can advance green logistics to achieve synergistic economic and environmental benefits has become a pressing practical issue.

The concept of green logistics originated in the 1990s, focusing on reducing environmental impacts and achieving efficient resource utilization. Scholars have integrated circular economy, corporate social responsibility, and green supply chain management theories into green logistics research, forming a "full-life-cycle greening" framework. Following the "Dual Carbon" goals, research has shifted toward carbon accounting, low-carbon technologies, and policy incentives, yet systematic case studies on e-commerce enterprises remain insufficient.

Theoretical significance: This study constructs a "paths–effects–problems" analytical framework, enriching green logistics research in the e-commerce context. Practical significance: It extracts replicable experiential models, offering references for small and medium-sized e-commerce enterprises and contributing to the "Dual Carbon" goals.

This paper's structure is as follows: First, it reviews relevant theories; second, it analyzes JD Logistics' green practices across four dimensions; third, it evaluates implementation effects; fourth, it identifies problems and causes; fifth, it proposes countermeasures from three levels.

Research Methods: 1) Literature review method—reviewing theoretical achievements and practical experiences; 2) Case study method—selecting JD Logistics for its representativeness; and 3) Comparative analysis method—comparing JD Logistics' carbon emissions and operational costs before and after its green transformation to evaluate the effects, and benchmarks domestic and international green logistics practices to identify gaps and improvement directions for Chinese e-commerce enterprises..

2. Theoretical Foundations

2.1. Green Logistics: Connotation and System

Green logistics refers to a logistics model that reduces resource consumption and environmental pollution throughout the entire logistics process, achieving coordinated economic, environmental, and social benefits [4-5]. Its core objectives are resource conservation, environmental friendliness, and improved resource utilization efficiency. The logistics industry's green transformation faces multiple challenges [6].

The green logistics system comprises four key components: green packaging—using recyclable materials to achieve reduction and harmlessness; green transportation—reducing carbon emissions through route optimization, new energy vehicles, and multimodal transport; green warehousing—employing energy-efficient

equipment and optimizing layouts to reduce energy consumption; and reverse logistics—establishing recovery systems for products and packaging waste to enable resource recycling.

2.2. The "Dual Carbon" Strategy and Corporate Environmental Responsibility

The "Dual Carbon" goals are a major strategic decision based on China's commitment to sustainable development. "Carbon peaking" refers to emissions reaching their peak and then declining; "carbon neutrality" means achieving net-zero emissions through afforestation and emission reduction. As a key pillar of the national economy, the logistics industry has significant environmental impacts, and its sustainable development is crucial [7]. Enterprises must not only comply with regulations but also proactively assume green transformation responsibilities.

2.3. Environmental Challenges of E-Commerce Logistics

E-commerce logistics faces four major environmental challenges: 1) excessive packaging—multi-layer methods causing resource waste, 2) high transportation emissions—road transport dominance with high empty-load rates, 3) high warehousing energy consumption—large centers requiring substantial lighting, air conditioning, and sorting equipment , and 4) packaging waste recovery—single-use packaging and low consumer recycling awareness leading to environmental pollution.

3. Case Study: JD Logistics' Green Practice

3.1 Overview and Development Drivers

JD Logistics, established in 2007, is a leading integrated supply chain logistics service provider in China. By end-2023, it operated over 1,500 warehouses (30 million m^2) and possessed more than 200,000 delivery vehicles, building a nationwide network serving e-commerce, FMCG, home appliances, and apparel.

Drivers for green development: 1) Policy drivers—"Dual Carbon" goals and express packaging policies impose clear requirements, 2) Market drivers—green consumption trends enhance consumer identification and loyalty, 3) Economic drivers—long-term cost reduction through reusable packaging and route optimization, and 4) Strategic drivers—JD.com's sustainability strategy positions green logistics as a core business priority.

3.2. Implementation Paths

3.2.1. Green Packaging

JD Logistics launched the "Green Stream Initiative" promoting reduction, recyclability, and harmlessness. Specific measures include: "slimming tape" to reduce usage; electronic waybills saving over 200,000 tons of paper annually; "original packaging"

collaboration with suppliers to reduce secondary packaging. The "Green Stream Box," a reusable plastic box with a per-use cost one-third that of cartons and over 100 uses, significantly reduces waste. Reusable insulated boxes replace foam for fresh food delivery. The company is also phasing out non-degradable plastics and promoting biodegradable alternatives through industry collaboration [8].

3.2.2. Green Transportation

JD Logistics builds a green transportation system through: 1) New energy vehicles—primarily for urban delivery, reducing fuel consumption by over 100,000 tons and CO_2 emissions by over 300,000 tons annually, with hydrogen vehicles explored for line-haul, 2) Route optimization—using big data and AI to optimize delivery routes in real time, reducing empty-load rates and mileage, and 3) Multimodal transport—promoting rail-road and sea-road intermodal models to increase low-carbon transport share.

3.2.3. Green Warehousing

JD Logistics' "Asia No.1" intelligent logistics center employs smart lighting (30% energy saving), intelligent temperature control, and automated sorting. Rooftop photovoltaic systems across multiple centers generate clean energy for warehouse operations, achieving self-sufficiency. IoT-based intelligent management optimizes inventory layouts and reduces handling frequency [9].

3.2.4. Reverse Logistics and Recovery Systems

JD Logistics has set up packaging recycling bins at delivery stations nationwide and launched a points-based recycling incentive program. It also conducts recycling of used clothing, old appliances, and mobile phones in collaboration with charitable organizations [10].

3.3. Implementation Effects

- Environmental benefits: By end-2023, through the Green Stream Initiative, JD Logistics reduced packaging material use by over 800,000 tons and tape use by over 3 billion meters; new energy vehicles and route optimization reduced CO_2 emissions by over 1.5 million tons; photovoltaic projects generated over 1.5 billion kWh.
- Brand image enhancement: Over 70% of consumers identify with JD Logistics' green practices and prefer its services.
- Cost advantages: Green Stream Boxes save over 1 billion yuan annually in packaging costs; photovoltaic projects save over 300 million yuan annually in electricity expenses.

4. Problems and Cause Analysis

4.1. Existing Problems

4.1.1. Cost-Benefit Imbalance

The substantial upfront capital required for reusable packaging—spanning R&D, deployment, sanitation, and warehousing—combined with the high procurement costs of new energy vehicles and the necessary charging infrastructure, places significant strain on the overall cost-benefit equilibrium.

4.1.2. Insufficient Supply Chain Coordination

Upstream suppliers still use excessive packaging despite the "original packaging" concept; downstream consumers lack green awareness, consider reusable boxes unsanitary, and show low recycling participation. Limited collaboration with other logistics enterprises prevents industry-wide synergy.

4.1.3. Technological and Standardization Bottlenecks

New energy vehicles have limited range and long charging times; biodegradable materials lack sufficient strength and water resistance. China's green logistics standards for packaging dimensions, recycling procedures, and carbon accounting remain ununified, hindering large-scale promotion.

4.1.4. Consumer Awareness and Behavioral Inertia

Participation is further undermined by consumer-side challenges: insufficient knowledge about green logistics, reluctance to absorb potential price hikes, cultural or habitual preferences for decorative packaging, and the physical inconvenience of under-serviced recycling stations.

4.2. Cause Analysis

External causes:1) The incentive framework remains underpowered, as existing fiscal and tax instruments have yet to reach a threshold that effectively stimulates investment, 2) The physical infrastructure, particularly for charging and packaging collection, suffers from both quantitative deficits and qualitative disparities across regions, and 3) The regulatory environment is characterized by fragmentation, with no binding consensus on carbon accounting protocols, recyclability criteria, or NEV performance benchmarks—a lacuna that precludes any coordinated, scalable implementation.

Internal causes: 1)Departmental misalignment, wherein procurement's cost-cutting priorities override sustainability requirements, and 2) underinvestment in green technology R&D, with JD Logistics' innovation spending (under 1% of revenue) falling significantly short of the 5% industry benchmark set by international leaders.

5. Countermeasures and Suggestions

5.1. Enterprise Level

- Build a strategic green supply chain management system—integrate green development into corporate strategy, set clear carbon reduction and recycling targets, strengthen upstream/downstream collaboration, and establish cross-departmental working groups.
- Increase green technology innovation investment—intensify R&D in biodegradable materials and low-carbon technologies, and strengthen university-industry collaboration.
- Design consumer incentive mechanisms—introduce green consumption points systems, strengthen public education via social media, and improve recycling convenience with community collection points and door-to-door services.

5.2. Industry Level

- Establish green logistics standards—unified standards for green packaging, carbon accounting, and packaging recycling to provide regulatory guidance.
- Build shared reverse logistics platforms—integrate industry recycling resources, establish rental platforms for reusable packaging, and create information-sharing platforms for experience exchange.
- Strengthen industry self-regulation and green certification—formulate self-discipline conventions, establish green logistics enterprise certification, and strengthen supervision.

5.3. Government Level

- Improve incentive-constraint balance—increase fiscal subsidies for green technologies, implement tax incentives for green logistics enterprises, and impose environmental taxes on excessive packaging and high carbon emissions.
- Strengthen education and talent development—integrate green logistics into the education system, promote public awareness, and support universities in offering green logistics programs to cultivate interdisciplinary talent.

6. Conclusions and Outlook

6.1. Main Conclusions

- Green logistics implementation paths for e-commerce enterprises should cover green packaging, green transportation, green warehousing, and reverse logistics, achieving full-process greening through technological and managerial innovation.
- JD Logistics has developed a comprehensive green logistics framework anchored in four pillars: the Green Stream Initiative, new energy vehicles, photovoltaic power generation, and packaging recycling. This systematic approach has not only generated tangible environmental and economic returns, but also enhanced corporate reputation, offering a referenceable pathway for peers pursuing similar transitions.

- Challenges—cost-benefit balance, supply chain coordination, technological bottlenecks, and consumer awareness—require coordinated efforts from enterprises, industry, and government.

6.2. Research Outlook

This study is confined to JD Logistics and does not encompass SMEs; consequently, the generalizability of its findings requires further validation. Future research should expand the sample coverage to include enterprises of varying scales and sectors, and develop robust evaluation frameworks to enable quantitative assessment of green logistics performance.

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