

Overpackaging in the E-commerce Era: Drivers, Multidimensional Impacts, and Mitigation Strategies

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Abstract

With the rapid growth of e-commerce and online food delivery services, packaging has become increasingly important in protecting goods during transportation and enhancing customer experience when presented in nice packaging. However, this development has also led to widespread overpackaging, the excessive use of packaging materials beyond what is necessary for product protection and presentation. Overpackaging results in unnecessary resource consumption, increased waste generation, and additional environmental burdens. This paper reviews the existing literature to examine the current situation, the major causes, and the impacts of overpackaging across different aspects in the e-commerce era. In addition, the paper summarizes potential mitigation strategies proposed to address this problem. By synthesizing and analyzing findings from recent academic research, this study aims to provide a comprehensive understanding of how overpackaging has developed and how it affects environmental sustainability, economic efficiency, and consumer behavior. Finally, the findings emphasize the need for more sustainable packaging designs and improved waste management practices to reduce the negative impacts of excessive packaging.

Keywords

overpackaging, e-commerce, environmental impact, sustainable packaging, waste management

1. Introduction

With the expansion of global consumer markets and the rapid development of e-commerce platforms, packaging has become an essential component of product distribution systems. Packaging plays a critical role in protecting products from physical damage during transportation and ensuring that goods reach consumers in acceptable condition. In addition, packaging is often used as a marketing tool to enhance brand identity and influence consumer perception.

However, in many cases, packaging exceeds what is functionally required for protection and basic presentation. This condition is commonly defined as overpackaging. The phenomenon has become increasingly visible in online shopping and food delivery services, where products are frequently packaged with multiple layers, oversized containers, and decorative materials that do not contribute to product safety [1].

The rise of e-commerce has intensified this issue. Products often pass through multiple handling stages and long-distance transportation processes, which encourages the use of additional protective materials. At the same time, consumer expectations for visually appealing packaging have also influenced packaging design decisions. As environmental sustainability becomes a major global concern, the environmental and economic consequences of overpackaging have attracted growing attention from researchers and policymakers.

This paper aims to review existing academic literature to analyze the definitions, current situation, structural causes, and impacts of overpackaging. In addition, it examines mitigation strategies to reduce excessive packaging in modern supply chains.

2. Theoretical Background and Current Situation

2.1 Definitions, Characteristics, and Measurement of Overpackaging

Overpackaging generally refers to the use of packaging materials that exceed what is necessary for product containment, protection, and basic presentation [1]. Previous studies have identified several characteristics of overpackaging, including excessive layers, oversized containers, and the use of non-essential decorative materials [1,3]. In many cases, packaging design prioritizes marketing value and visual appeal rather than functional efficiency.

Research on paper and food packaging indicates that overpackaging can still occur even when recyclable materials are used. This is because environmental performance depends not only on material type but also on total material volume and design efficiency [1,4]. Therefore, using environmentally friendly materials does not necessarily eliminate the problem if packaging remains excessive.

Measurement of overpackaging is often based on indicators such as material usage, packaging volume, and the ratio between packaging weight and product weight. These indicators are commonly used in life-cycle assessment studies to evaluate the environmental impact of packaging systems [4].

2.2 Current Situation of Overpackaging in the E-commerce Era

The rapid growth of e-commerce has significantly increased the demand for packaging materials. Compared with traditional retail, online shopping requires products to undergo multiple transportation and handling processes, leading to the use of additional protective packaging, such as plastic cushioning, foam, and larger boxes.

Empirical studies indicate that packaging waste accounts for approximately 30–40% of municipal solid waste in many developed regions [5]. In the context of e-commerce, this proportion continues to grow as secondary and tertiary packaging become increasingly widespread. Moreover, packaging production and disposal contribute substantially to lifecycle greenhouse gas emissions, particularly when plastic materials are involved [4,5].

E-commerce logistics systems often prioritize product safety and customer satisfaction rather than packaging efficiency [2,3]. As a result, companies tend to use more packaging materials to reduce the risk of damage. At the same time, the popularity of “premium packaging” and unboxing experiences has further increased the complexity and volume of packaging.

These trends indicate that the expansion of online retail has intensified the environmental burden associated with packaging systems, making overpackaging a significant issue in modern consumer markets.

2.3 Structural Causes of Overpackaging

Overpackaging is not only the result of basic product protection or marketing strategies but is also influenced by structural mechanisms within modern logistics systems. One key factor is the packaging selection process used in automated warehouse operations. These systems often rely on standardized box sizes and algorithm-based matching, which may lead to inefficient packaging decisions. For example, small products are frequently placed in larger boxes due to limited size options or to prioritize operational speed over material efficiency.

In addition, logistics systems are typically designed to minimize product damage and return rates. This creates a risk-avoidance strategy that uses additional packaging to ensure product safety. While this approach may reduce short-term financial risks, it increases material consumption and long-term environmental costs [2,3].

Supply chain fragmentation also contributes to overpackaging. Products may pass through multiple distribution stages, and each stage may introduce additional packaging for protection or branding purposes. This layered packaging effect significantly increases total material usage.

Consumer behavior further reinforces these structural factors. Research shows that consumers often associate complex or premium packaging with higher product quality, which may encourage companies to maintain excessive packaging practices [6]. These combined factors suggest that overpackaging is a systemic issue embedded in both technological systems and market expectations.

3. Impacts of Overpackaging

Overpackaging has significant environmental, economic, and social impacts. From an environmental perspective, excessive packaging increases the consumption of natural resources such as paper, plastic, and energy used in manufacturing processes [4,5]. This leads to higher greenhouse gas emissions and greater environmental degradation.

Life cycle assessment studies demonstrate that packaging materials contribute to environmental impacts across all stages, including production, transportation, and disposal [4,7]. Increased packaging weight also increases fuel consumption during transportation, further amplifying carbon emissions.

In terms of waste management, overpackaging contributes to a growing volume of solid waste. Recycling systems often struggle to process complex packaging materials, especially when multiple materials are combined. As a result, a significant portion of packaging waste ends up in landfills, even when recyclable materials are used [5,6].

Economically, overpackaging increases production costs for companies and adds to transportation expenses due to heavier, bulkier packages. In addition, governments face higher costs for waste collection and processing [7].

Socially, the issue of overpackaging has raised public awareness of environmental sustainability. Consumers are becoming more conscious of packaging waste and are increasingly demanding environmentally responsible packaging solutions. This shift in consumer behavior may influence future packaging practices.

4. Discussion and Mitigation Strategies

The literature suggests that overpackaging results from a combination of structural, economic, and behavioral factors. While packaging is necessary to ensure product safety, excessive packaging creates a trade-off between protection efficiency and environmental sustainability.

One important mitigation strategy is optimizing packaging design. Companies can reduce material usage by improving packaging structures, minimizing space, and selecting materials with lower environmental impact [2]. Design improvements can significantly reduce both resource consumption and waste generation.

Another strategy involves improving logistics systems. More advanced packaging algorithms could optimize box selection based on product size and fragility, rather than relying on fixed box categories. This would reduce inefficiencies in packaging decisions.

Policy regulations also play a critical role. Governments can implement standards that limit excessive packaging or encourage the use of recyclable materials. At the same time, consumer education can promote sustainable consumption behavior by increasing awareness of packaging waste [6].

Overall, reducing overpackaging requires coordinated efforts among businesses, policymakers, and consumers. Technological innovation, regulatory frameworks, and behavioral changes must work together to achieve more sustainable packaging systems.

5. Conclusion

Overpackaging has become a significant issue in the e-commerce era, driven by the growing demand for product protection and an enhanced customer experience. This paper reviewed the definitions, current situation, structural causes, and impacts of overpackaging, and discussed potential mitigation strategies based on existing research.

The findings indicate that overpackaging contributes to increased resource consumption, environmental pollution, and economic inefficiencies. Addressing this issue requires improvements in packaging design, logistics systems, and policy frameworks.

Future research should focus on integrating packaging optimization technologies with sustainability frameworks to reduce environmental impacts while maintaining product safety.

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Conflicts of Interest

The authors declare no conflict of interest.

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