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Assessing the Negative Impact of Single-Use Plastic Food Packaging: SWOC Analysis of the Eco-Friendly Alternative

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ABSTRACT

Purpose: The study investigates the effects of single-use plastic bags in food packaging on the environment, evaluates current policies, explores sustainable alternatives, and assesses the SWOC of sustainable packaging solutions.
Research Design: The analysis employs sources of secondary information, such as scholarly articles and industry publications to investigate the environmental consequences of plastic bags, existing legislation, consumer attitudes, and improvements in sustainable packaging alternatives.
Findings: Single-use plastic bags contribute significantly to environmental contamination, especially those affecting marine and terrestrial ecosystems. Global attempts to minimize plastic consumption largely depend on public engagement and successful policy implementation. However, sustainable packaging solutions face cost, accessibility and durability challenges that limit their widespread use.
Originality/Value: The research provides extensive assessment of the negative ecological effects of disposable plastic packaging and analyses sustainable alternatives using SWOC analysis. It gives crucial insights into the performance of present initiatives, identifies critical areas for future study, and makes concrete recommendations for improving laws and encouraging the adoption of eco-friendly packaging solutions.

KEYWORDS

Environmental and Trade, Sustainable Packaging, Single-Use plastic Packaging, Management of waste,

Government Policy, SWOC Analysis

1. Introduction

The packaging of food is a vital component of profitable food enterprises, enabling the delivery of quick dishes, ready meals, beverages, and snacks (Imam et al. 2012). Food packaging enhances the efficiency of handling, containing, and transporting food, thereby reducing losses at all the supply chain's phases (Wohner et al., 2019). Plastic food packaging helps to reduce worldwide loss of food and trash, and it costs more than one trillion dollars each year and makes up 10% of human caused greenhouse gas emissions (Springmann et al., 2018). Plastic food packaging, despite its benefits, generates significant waste and, it not managed properly, can enter oceans, damaging ecosystems and infecting humans. It reduces light penetration, damaging aquatic ecosystems like coral reefs (Pawar et al., 2016). Sea creatures can consume waste plastic, leading to malnutrition and reduced hunger, while also becoming entangled in plastic, hindering breathing and limiting vital body movements for migration, food collection, and evasion (Dias et al., 2012); (Li, W. C. 2016).

The global demand for plastic packaging for consumer items is on the rise, with a total global plastic manufacturing output of 288 million tons in 2012 (Parker & Laura, 2015). In 2015, global plastic waste reached 448 million tons, with 40% being single-use plastic (Parker & Laura, 2018), primarily used for food packaging (Ritschel, 2018). Annually, 90 million tons of plastic garbage are expected to pass through coastal regions and reach marine environments (Howard et al., 2019). Pollution from plastic can be danger to marine ecosystems, leading to malnutrition and hunger in fish and widespread human consumption. In 2016, the European Food Safety Authority warned that microplastic contamination in commercial fish poses a higher risk to human health (Trowsdale et al., 2017). Plastic packaging could be a practical and effective method for delivering items to customers (Verghese et al., 2015). Plastic has become as a low-cost packaging material, but industry experts believe it has benefits and drawbacks. Governments are encouraging single-use plastic consumption, but it is uncertain if buyers will accept these contradicting incentives. However, there is a rising study on this problem (Dilkes-Hoffman et al., 2019). Plastic, a significant and widespread substance used for packaging, is estimated to account for 40% of global plastic output, which exceeds 80 million metric tons each year (Muncke, J., 2021). Packaging is used in consumer goods, food, beverages, cosmetics, and pharmaceutics to improve safety, health, and convenience for both producers and consumers (FICCI,2016).

Plastic waste has a significant adverse environment impact, particularly in the food industry, where it is a primary source of pollution. As a result, it is critical to switch to environmentally friendly, single-use plastic packaging options. Environmental concerns have led to the increased usage of eco-friendly materials for packaging, such as recyclable, compostable, and biodegradable solutions, which degrade the environment more quickly than traditional plastics (Shah et al., 2008). Compostable packaging is an ecologically beneficial solution that, under specific conditions, breaks into non-toxic components, enhancing soil health and lowering the demand for clean resources, fostering a sustainable economy (Hopewell et al., 2009).

2. Objectives

(1) To investigate the environmental consequences of disposable plastic bags utilized for packaging food.
(2) To evaluate the efficacy of current policies and regulations aimed at reducing the environmental impact of disposable plastic bags.
(3) To explore potential environmentally friendly alternatives to single-use plastic bags in food packaging.
(4) To evaluate the SWOC of environmentally friendly food packaging options.

3. Research Methodology

This study reviews secondary data from academic journals, government reports, industry publications,

and previous studies to analyse the negative ecological consequences of single-use plastic bags used in food packages and the potential of sustainable alternatives. It identifies relevant studies on plastic waste, consumer attitudes towards sustainable packaging, and policy effectiveness. The analysis shows the environmental threats posed by disposable plastics and the viability of transitioning to sustainable packaging.

4. Literature Review

The table summarizes research on the environmental effect of disposable plastic packaging for food, focusing on marine and land pollution, microplastic contamination, and consumer attitudes towards eco-friendly alternatives. It also discusses sustainable packaging transition strategies and biodegradable and reusable materials, guiding efforts to address plastic packaging-related environmental issues.

Table 1: Review of sustainable alternatives to disposable plastic packaging for food and their environmental impact.

Sl. No	Area of Study	Contribution	Reference
1	Environmental Impact of Single-use Plastic Food Packaging	The study investigates the environment impact of single-use plastic food packaging, focusing on its significant contribution to marine pollution and landfill trash. It emphasizes the importance of improving recycling and waste management methods to address the issues created by rising consumption and poor waste management.	Mishra et al., (2022).
2	Marine Pollution from Plastic Packaging	The study explores the substantial impact of single-use plastic packaging on marine pollution, specifically how it harms aquatic life via ingestion and entanglement. It underlines the harmful ecological impact of this packaging on marine environments and the importance of resolving these issues to preserve marine biodiversity.	Derraik, J. G. (2002).
3	Land Pollution from food Plastic Packaging	The study highlighted the significant impact of plastic packaging on land pollution, highlighting its long-term environmental consequences and the need for efficient waste management to address the issue of plastic packaging waste, which can take a long time to break down.	Barnes et al., (2009).
4	Microplastics from Degraded Plastic Food Packaging	The study reveals that plastic food packaging degrades into microplastics, which pose risks to future animal and human health due to their widespread distribution in the environment. It emphasizes the prevalence of microplastic pollution from food packaging and its possible health hazards while pushing for measures to minimize plastic food packaging consumption and	Andrady, A. L. (2011).

		contamination.	
5	Germany's Strategies for sustainable Food Packaging Transition	The study investigates Germany's attempts to move from single usage and packaging plastics (SUPP) to a sustainable economy, highlighting the trade-offs between efficiency, waste reduction, and recycling rates, including the need for long-term food packaging management strategies and the challenges in achieving this transition.	Schmidt, S., & Laner, D. (2021).
6	Food Packaging attributes among Canadian consumers	This study investigates the attitudes of Canadian consumers toward disposable plastic packaging for food and their inclination to pay more for eco-friendly alternatives. It demonstrates that, while most Canadians prefer to use less plastic, they are unwilling to pay more for environmentally friendly packaging.	Walker et al., (2021).
7	Reusable food packaging and its environmental impact	The study emphasizes the initial ecological impact of reusable food packaging made from fabric or heavier polymers but also emphasizes the long-term benefits of regular use, suggesting reusable packaging can significantly reduce environmental harm.	Chitaka et al., (2019).
8	Advancement in sustainable food packaging using nanocomposites	The research explores the use of nanotechnology in biobased polymers to create sustainable food packaging materials, offering enhanced barrier qualities, thermal stability, and antibacterial properties, thereby meeting the food industry's need for safer and more effective packaging solutions.	Peerzada et al., (2024).
9	Sustainable innovation in food packaging	The study examines the transition from petroleum-based to biodegradable bioplastics for food packaging, focusing on environmental sustainability, food safety, and preservation while exploring natural polymers' potential to reduce carbon emissions and improve packaging performance.	Khandeparkar et al., (2024).
10	Sustainable biological material for food packaging	The study evaluates the use of biopolymers and starch-based chemicals in food packaging to improve safety and reduce environmental impact, with an emphasis on health concerns, recyclability, and overall package quality, highlighting the importance of eco-friendly materials.	Elkhayat et al., (2024).

11	Consumer responses to eco-friendly food packaging	The study explores customer attitudes towards eco-friendly food packaging, highlighting challenges like product identification and competition, emphasizing the need for better understanding and effective promotion methods.	Ketelsen et al., (2020).

5. Result and Discussion

5.1 Environmental Effects of single-use plastic bags used for food packaging:

Single-use plastics are widely used and are leading cause of global pollution (UNEP, 2018). Nowadays, plastics are commonplace in our daily lives, influencing everything we do. The amount of plastic produced worldwide has risen over the past few years due to its usability (Geyer et al., 2017). Since 1950, as estimated 9.2 billion metric tons of plastic have been produced worldwide, with up to 6.9 billion metric tons ending up in landfills or, more dangerously, leaking into the environment (Brooks et al., 2018). Since 1950, 448 million metric tons of plastic have been manufactured yearly, with 40% utilized for single-use packaging, most commonly for quick disposal (Geyer et al., 2017).

The rise in waste made of plastic, primarily caused by the fast-food industry's rapid food production, was first identified in the 1970s. With numerous restaurants worldwide, the industry's trash is expanding, with the majority of solid waste being packaging waste. Traditionally, most of this waste was disposed of in landfills (Aarnio et al., 2008). The plastic waste may go to recycling centres, incineration plants, landfills, or into atmosphere (Geyer et al., 2017). Increased awareness of plastic pollution, particularly single-use plastic packaging, has recently dominated public attention (Schnurr et al., 2018). Most Frequently used plastics are not biodegradable, causing them to accumulate in landfills and natural ecosystems rather than decomposing (Walker and Xanthos, 2018; Karbalaei et al., 2018). Plastic packaging containers, due to their high strength-to-weight ratio, can save up to 3% of the total weight of the packed item (Andrady et al., 2009). Packaging is the largest source of plastic trash, accounting for nearly 50% of the worldwide weight (Oberoi et al., 2021).

Wealthy nations generate huge amounts of plastic waste per capita due to increased consumer purchasing power and expanded plastic packaging options. However, the amount of improperly disposed plastic waste in developed nations is decreasing as plastic waste management system improve. Middle class and low-income countries, on the other hand, are the most significant contributors to worldwide plastic pollution because of inadequate or non-existent waste management systems, which result in the improper disposal of up 90%of plastic waste (Ritchie et al., 2020).Effectiveness Of Policies on Reducing Plastic Bag Environmental Impact:

Plastic bags have a significant global environmental impact, leading to various policies to mitigate their effects. These include taxes, bans, and recycling programs. Outright bans, often combined with campaigns for reusable bags, help decrease plastic bag use. Single-use bag ban is also implemented in many countries and cities to encourage the adoption of reusable bags. Clapp and Swanston (2009) discovered that these kinds of bans greatly cut down on the usage of plastic bags, reducing pollution and lessening the harm to wildlife.

Levies, or fees imposed on plastic bags, are another effective policy tool. These policies discourage the use of single-use bags by raising their prices. Within weeks, Ireland's 2002 plastic bag fee resulted in a 90% decrease in usage (Convery et al., 2007). Subsequent research studies has confirmed the importance of financial incentives in promoting sustainable practices across multiple countries (Hopewell et al., 2009). Recycling drastically reduces the environmental effects of plastic bags by minimizing landfill trash and contamination. Programs like California's Plastic Bag Recycling Act encourage recycling, resulting in higher recycling rates and lower pollution levels. Retailers need to provide recycling bins for plastic bags (Hopewell et al., 2009). The effectiveness of a recycling program depends significantly on public engagement and successful execution (Rujnić-Sokele et al., 2017).

The European Union has implemented a comprehensive plan that combines levies, recycling initiatives, and restrictions to reduce the use of plastic bags. According to the European Commission, this strategy combines financial incentives, public awareness campaigns, and regulations to address the problem in many ways. Education and public awareness are crucial for successful policymaking. Dikgang et al. (2012) conducted research in South Africa and found that plastic bag levies and educational initiatives can significantly reduce the use of plastic bags while also raising consumer awareness of environmental issues.

Developing recycling infrastructure and reconsidering plastic packaging can also help improve waste management practices. Recycling can benefit from consistent technical standards, increasing reuse and value (Hanss et al., 2012). Although the negative impacts of plastic pollution on the planet, society, and the economy are becoming increasingly generally recognized, substantial research on legal and regulatory solutions to reduce the use of single-use plastics is still lacking (Xanthos & Walker, 2017). Plastics used for packaging have a short lifespan of one of three years, necessitating increased producer responsibility. Recycling food packaging is a crucial tactic in the against plastic packaging pollution since it necessitates collection, sorting, and processing to prevent contamination (Popescu et al., 2020; Kosior et al., 2020). Effective policies for reducing , including levies, bans and recycling programs, can be achieved when well-planned, executed, and public participation is encouraged. Combining legislative actions with public awareness campaigns can be achieved when well-planned, executed, and public participation is encouraged. Combining legislative actions with public awareness campaigns can significantly decrease plastic bag usage and environmental damage.

5.2 Sustainable Alternatives to Single-Use Plastic Bags in Food Packaging:

Single-use plastic bags widely used in food packaging, which has led to major environmental issues, contaminated landfills and oceans, and threatened human health and marine life (Jambeck et al., 2015). Single-use plastic bags are widely used in food packaging, causing serious environmental issues, polluting landfills and oceans, and threatening human health and marine life (Thompson et al., 2009). Government laws and consumer demand for eco-friendly products are driving the urgent need for sustainable alternatives to single-use plastic bags as environmental awareness among the general public rises (Hopewell et al., 2009).

To achieve sustainable goals, waste reduction and the use of alternative packaging materials must be integrated into the manufacturing and consumption of sustainable goods (Ertz et al., 2017). The many eco-friendly options for food packaging that this article will discuss include paper bags, compostable bags, biodegradable bags, reusable cloth bags, and edible packaging. A thorough summary of the available options for lowering the dependency on single-use plastics in food packaging will be provided by evaluating each one according to its components, advantages, disadvantages, and overall sustainability impact.

Table 2: Overview of Sustainable Food Packaging Alternatives

Alternative	Description	Application in Food Sector	Key Benefits	Challenges	References
Biodegradable Bags	Made from cornstarch, potato starch, or other plant-based materials.	Used for carrying food items, grocery packaging and takeout.	Decomposes faster than conventional plastics and reduces waste.	Requires specific conditions for decomposition.	Thompson et al., (2009).
Reusable Cloth Bags	Made from cotton, jute, or hemp.	Used for groceries, carrying produce and bulk food items.	Durable, reduces need for single use bags.	Higher initial cost, requires regular cleaning.	Wagner, T. P. (2017).
Paper Bags	Made from	Suitable for	Biodegradable	Less durable,	Rujnić-

	kraft paper or recycled paper.	bakery items, sandwiches, and other takeout items.	recyclable, made from renewable resouces.	can tear when wet.	Sokele et al., (2017).
Compostable Bags	Made from PLA or PHA that break down in composting environments.	Ideal for fresh produce, bakery items, and food waste collection.	Breaks down into organic matter and reduce landfill waste.	Higher cost, limited availability.	Song et al., (2009).
Edible Packaging	Made from materials like seaweed, rice, or potato starch that can be consumed.	Used for wrapping individual food items and specialty products.	Eliminates waste, provides a unique consumer experience.	Limited use cases; higher production costs.	Morillon et al., (2002).
Bioplastic Bags	Made from bio-based materials such as PLA or PHA	Suitable for various food packaging needs including fresh produce.	Derived from renewable resources and biodegradable.	Many not break down fully in all environments.	Geyer et al., (2017).
Plant-based Films	Thin, flexible films made from plant-based materials like algal or cellulose.	Used for wrapping food items or as liners.	Biodegradable, derived from renewable sources.	Less durable, may have limited availability.	Derraik, J. G. (2002).
Recycled Plastic Bags	Made from post-consumer recycled plastics, reducing the need for new plastic production.	Used for various food packaging purposes.	Reduces demand for new plastics, can be recycled again.	Still involves plastic, not biodegradable.	Hopewell et al., (2009).
Zero-Waste Packaging	Packaging designed to be reused or repurposed, aiming for no waste generation.	Used for high- end or specialty food products.	Minimizes waste generation often reusable.	Requires consumer participation, higher cost.	Lacy & Rutqvist (2015).

5.6 SWOC Analysis of Sustainable Food Packaging Alternatives

SWOC analysis is a strategic method used by businesses to manage environmentally friendly alternatives by utilizing strengths, fixing weaknesses, capitalizing on opportunities, and overcoming barriers (Aithal & Kumar, 2015). Recent research has stressed the significance of SWOC analysis as a strategic tool for industry analysis and decision-making (Aithal, P. S. 2024). The following table provides an overview of sustainable food packaging solutions in comparison to single-sue plastic food packaging.

Table 3: SWOC analysis of sustainable food packaging options compared to single-use plastic packaging

Strengths	Weakness
➢ Reduces plastic waste significantly. ➢ Biodegradable and breaks down naturally. ➢ Seen as a healthier alternative. ➢ Enhance brand image by showcasing sustainability. ➢ Helps comply with environmental regulations. ➢ It avoids fines for noncompliance. ➢ Differentiates products in the market. ➢ Provides a competitive edge in the eco-conscious market.	➢ More expensive to produce than traditional plastics. ➢ Requires substantial initial investment for new machinery. ➢ Often less durable and moisture-resistant. ➢ It might not offer as much protection as plastic. ➢ Limited availability compared to plastic. ➢ Some consumers may resist change due to habits or cost. ➢ Higher costs may deter price sensitive consumers.
Opportunities	**Challenges**
➢ Growing market for sustainable products. ➢ Encouraged by environmental education campaigns. ➢ Innovations can boost efficiency while cutting expenses. ➢ Advance in materials and manufacturing processes. ➢ It is possible to get financial assistance and subsidies. ➢ Lowers initial costs and encourages adoption.	➢ Traditional plastics have a firmly established market. ➢ Competing with an established plastic supply chain is difficult. ➢ Regulatory requirements are complex, and standards vary. ➢ Compliance with complex regional regulations can be difficult. ➢ Some alternatives may necessitate significant amounts of natural resources. ➢ Comprehensive lifecycle assessments are required to validate overall benefits.

6. Discussion on Findings:

[1] Single-use plastic bags used for food packaging cause significant environmental deterioration, especially in marine and terrestrial areas.

[2] Plastic packaging in landfills can take hundreds of years to disintegrate, resulting in long term environmental harm.

[3] Policies such as bans, taxes, and recycling campaigns have been enacted globally to minimize plastic bag use.

[4] Success depends on public engagement and good execution.

[5] Sustainable alternatives to single plastics packaging, such as biodegradable bags, paper bags, reusable cloth bags, compostable packaging, are gaining widespread acceptance but are more expensive and limited availability.

7. Recommendations and Conclusions

[1] Increase public awareness of the environmental consequences of single use plastics and the benefits of more sustainable alternatives usage in food packaging.
[2] Encourage businesses to utilize ecologically friendly packaging through financial incentives and subsidies, making it more affordable.
[3] Develop and implement consistent regulations for sustainable packaging across areas to guarantee compliance.
[4] Invest in research and development of sustainable packaging materials and technologies to increase durability, cost effectiveness, and environmental performance.
[5] Encourage collaboration among governments, companies, and consumers improve waste management systems.

8. Limitations and Research Gaps

Research on single-use plastic packaging and sustainable alternatives is limited. With limited solutions for integrating sustainable materials into waste management systems and effectively removing large-scale plastic waste. The long-term effects of plastic waste and microplastics have been studied, but innovative strategies are lacking. Consumer attitudes show a reluctance to adopt sustainable packaging, necessitating future research on the practical uses and large-scale practicality of materials like nanocomposites and biopolymers. Addressing these barriers is crucial for reducing environmental impact.

9. Conclusion

Eco-friendly packaging must replace single-use plastics in packaging to lessen their adverse environmental effects and encourage sustainability. Effective legislation, such as taxes, bans, and recycling initiatives, is essential, as is public awareness and education. However, eco-friendly alternatives, such as biodegradable and reusable packaging, face difficulties such as higher production costs and scarcity. A comprehensive approach combining public education, financial incentives, consistent regulations, and ongoing research is required. Governments, businesses, and consumers must work together to develop effective waste management systems and promote environmentally friendly practices.

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