

10-2024

## Eco-Friendly Packaging: Changing the Norm

Victoria C. Hoffmann  
*Old Dominion University*

Mujde Erten-Unal  
*Old Dominion University*

Follow this and additional works at: <https://digitalcommons.odu.edu/ourj>



Part of the [Environmental Engineering Commons](#)

---

### Recommended Citation

Hoffmann, Victoria C. and Erten-Unal, Mujde (2024) "Eco-Friendly Packaging: Changing the Norm," *OUR Journal: ODU Undergraduate Research Journal*: Vol. 11, Article 6.

DOI: <https://doi.org/10.25778/brwt-2h87>

Available at: <https://digitalcommons.odu.edu/ourj/vol11/iss1/6>

This Article is brought to you for free and open access by ODU Digital Commons. It has been accepted for inclusion in OUR Journal: ODU Undergraduate Research Journal by an authorized editor of ODU Digital Commons. For more information, please contact [digitalcommons@odu.edu](mailto:digitalcommons@odu.edu).

# ECO-FRIENDLY PACKAGING: CHANGING THE NORM

By Victoria Hoffmann\* and Mujde Erten-Unal†

## I. INTRODUCTION

Packaging has a long history, dating back to ancient times when humans used natural materials to collect, wrap, and transport their goods. Over time, packaging has evolved through its materials and methodologies to cater to consumers' needs and preferences in providing convenience, protection, and marketing opportunities. Over the past century, there has been an increasing awareness of the negative impact of packaging on the environment. As a result, efforts to reduce this impact have emerged, aiming to find more sustainable solutions. Therefore, this review seeks to provide insight into current and emerging packaging practices and, secondly, to explore the prospect of integrating these sustainable solutions into the high-demanding industry. The outline is as follows: Firstly, the review provides background on plastic packaging and the manufacturing process of all types of packaging. Then, it gives explicit details on eco-friendly packaging, exploring sustainable materials, manufacturing processes, and end-of-life solutions and their benefits and downsides. Finally, the review outlines the necessary strategic initiatives to reverse the damaging impact of packaging on the environment.

## II. EXISTING PACKAGING PRACTICES

Packaging is crucial in preserving and protecting products during transportation and storage. Over the years, various materials have been used for packaging, but plastic has been the most successful. It is versatile, durable, easy to produce, and can be molded into different shapes and sizes to accommodate different products (Ibrahim et al., 2022). It is used widely in various industries, including food, medicine, electronics, cosmetics, and other everyday items. Plastic

packaging has become so ingrained in our daily lives, from when we wake up and brush our teeth to when we go to bed and turn off the lights. However, despite its favorable characteristics and daily use, its harmful effects are undeniable.

The harmful effects of plastic are frequently disregarded due to a lack of awareness and accountability. Petroleum-based polymers commonly used to manufacture traditional plastic are not biodegradable and are challenging to recycle due to their complex composition (Ibrahim et al., 2022). Furthermore, plastic packaging production significantly contributes to greenhouse gas emissions, exacerbating the ongoing climate change crisis. Due to the characteristics of plastic, the only "safe" way to dispose of it is in a landfill. However, it is worth noting that during collection and sorting, some plastic packaging waste can escape and end up contaminating soil or waterways (Guillard et al., 2018).

### **III. ECO-FRIENDLY PACKAGING**

Given the damaging effects of plastic packaging on the environment, there is a growing concern about the need to shift towards more eco-friendly and sustainable packaging options. Eco-friendly packaging is an approach to packaging that aims to minimize these negative effects by developing new material solutions, reducing the overall packaging used, using recycled materials, addressing sustainability through the manufacturing and transportation process, and ensuring proper end-of-life care. It also requires being mindful of the source of materials and manufacturing practices; and choosing sustainable alternatives wherever possible, resulting in the least harmful impact on the ecosystem. While the shift towards eco-friendly packaging looks promising, it requires collective efforts from manufacturers, consumers, and policymakers to successfully implement it and create a lasting change.

### *Alternative Plastics*

Bioplastics are a great alternative to traditional plastic because they are ideally made entirely- but can also be partially- from biological renewable resources like corn starch, sugarcane, and vegetable fats and oils (European Union, 2022). Commonly used plastics such as polyethylene terephthalate (PET) and polyethylene (PE) can be created with more biological resources. These may not be biodegradable, but they use fewer fossil fuels, which helps to reduce emission rates. Additionally, numerous bioplastics are being tested to have the ability to break down naturally, hence adding the biodegradable characteristic (Interpack, 2023).

Biodegradable plastics offer a promising solution and sustainable alternative to traditional plastics. These plastics are designed to naturally break down with the help of microorganisms and be used for environmental regrowth due to the compounds they break down into, as shown in Figure 1. The critical component in producing biodegradable plastic is the starch additive, which attracts the microorganisms to consume it after its use (Filiciotto, 2020). They can be made from biological resources and raw fossil materials, making them eco-friendly and versatile (European Union, 2022).

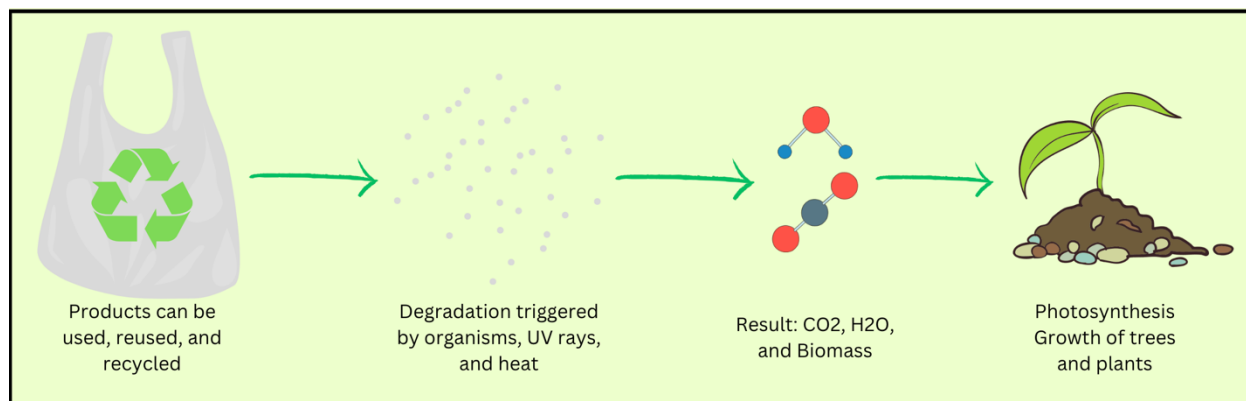


Figure 1: Biodegrading Process of Biodegradable Plastic (Figure based on Prosser, 2019)

The breakdown process of biodegradable plastics has no time limit and typically leaves residue after its full breakdown. In comparison, the term compostable plastics is less common but essentially the same as biodegradable plastic. The key difference is that compostable plastics have a tested time limit for breakdown and leave no residue. Biodegradable and compostable plastics need the ideal setting of a composting facility or the equivalent with the proper environment for their respective breakdown processes (BPI, Charlottesville Government).

As the world moves towards sustainable practices, alternative plastic materials have emerged as promising solutions for eco-friendly packaging. However, there are still many uncertainties surrounding these new materials. While bioplastics and compostable plastics are considered environmentally friendly, they come at a higher cost than traditional polymer plastics due to fewer production facilities, making them only available as alternatives for large companies willing to invest. The novelty of these materials has also left many companies skeptical about their effectiveness.

To be a viable alternative to traditional plastics, bioplastics and compostable plastics must compete in cost, durability, and overall effectiveness. Moreover, they must meet the same safety and regulatory standards as traditional plastics (Turkcu, 2023). While bio-based plastics have already shown promise, it is important to continue research efforts further to enhance their performance and capabilities for packaging applications. By having concrete support for these new materials, more companies will invest. Then, they can be more accessible and affordable, encouraging all companies to use alternative plastic materials.

### *Packaging Reduction and Recycling*

Many companies can take an immediate and effective step towards sustainability by reducing excess packaging. By doing so, companies can reap numerous benefits for themselves

and the environment. For instance, reducing excess packaging helps decrease the amount of plastic used in packaging, leading to less waste and emissions. This not only helps create a healthier environment but also reduces costs for businesses. While additional packaging may enhance the visual appeal of products and improve customer convenience, the negative impacts of increased waste and emissions far outweigh these benefits. Instead, companies can develop new marketing strategies to help them achieve their business goals without adding to the active pollution problem.

Using recycled materials is another practice that is easily adaptable for all companies. By utilizing recycled materials, companies can decrease the need for raw materials, preserve non-renewable resources, and reduce the impacts of emissions and waste within the environment. Moreover, using recycled materials is a simple and cost-effective solution that does not require innovation or invention, making it an accessible option for any company that utilizes packaging.

Recycling is also a well-known global process, thereby reducing the need for additional consumer education. It can also enhance a company's brand image and reputation as today's consumers are becoming increasingly eco-conscious and are more likely to support companies that demonstrate a commitment to sustainability. By using recycled materials, companies can show their customers that they are taking steps to reduce their environmental impact and contribute to a more sustainable future. Packaging made from recycled materials not only benefits the environment, but they can positively impact the company's reputation and bottom line.

### *Manufacturing and Transportation*

While changing the physical packaging is an essential step towards achieving eco-friendliness, it's important to recognize that the manufacturing and transportation processes also

play a crucial role in the environmental impact. Therefore, the complete lifecycle of packaging needs to be considered rather than solely the end result. Sustainable manufacturing and transportation practices are just as crucial in switching to sustainable packaging. Where available, manufacturers should practice water recycling, limiting excess water use, energy efficiency, and using renewable power sources throughout their processes. Implementing these practices during the manufacturing of packaging will take time due to relying on numerous factors and variability through specific aspects of the process. However, it's important to be aware of what should be done and work towards taking steps towards creating a positive change.

Fossil fuel emissions are the top environmental effect during packaging's transportation phase. Most packaging is transported on trucks, planes, trains, and ships, which use diesel, a leading fuel in air pollution. Burning fossil fuels releases harmful gasses such as carbon dioxide, methane, and nitrogen oxide, which contribute significantly to climate change. Therefore, companies should implement the use of fuel-efficient vehicles and pallet utilization, where possible (Simon, 2012). By reducing the reliance on fossil fuels, we can help to mitigate the negative environmental impact of packaging transportation.

### *End-of-Life Solutions*

End-of-life solutions are critical for managing the growing problem of plastic waste. Without proper disposal methods, plastic waste can end up in landfills, oceans, and other natural environments, where it can take hundreds of years to forever to break down. This not only harms ecosystems and wildlife, but it can also negatively impact human health and quality of life. Having effective end-of-life solutions in place, such as recycling and composting, helps reduce the amount of plastic waste that ends up in these environments.

The main concern with biodegrading, or composting, is that despite the popularity of products that can decompose "naturally," an increase in waste accumulation is still a problem due to insufficient infrastructure for proper breakdown (Turkcu, 2023). In many cases, these products end up in landfills, contributing to the existing waste. As discussed previously, these plastics require specific environmental conditions for successful breakdown, and landfills and oceans are not one of them. Unfortunately, many companies focus more on selling their products as biodegradable to satisfy consumers rather than ensuring their packaging products are disposed of properly after use. This false advertising has created a misleading perception among consumers that their purchase of these products is helping mitigate the waste problem when, in fact, they are continuing to contribute to them.

#### **IV. MOVING FORWARD**

In a new industry market, there are lots of risks. In the packaging market, there are already established standards and materials that meet and exceed expectations; adding a new competitor creates tension. The consumers expect the new products to meet all standards and expectations and add a new category for their positive impact on the environment. These expectations create high-risk investments for companies entering this developing market. Whether their product can stand up against traditional packaging remains uncertain, as the quality of the packaging may be comparable. However, the ultimate decision lies in whether or not consumers will choose to purchase the product—currently, most products with eco-friendly packaging cost more than standard packaging (Turkcu, 2023). This increased cost plays a crucial role in shaping consumer selections towards sustainable products, as despite the desire to support sustainability, financial constraints often restrict their purchase. While the risks associated with



transitioning to a sustainable packaging market are valid, the urgent need for change in our approach to packaging is undeniable.

To address the environmental impact of packaging, it is critical to acknowledge that eco-friendly practices are a long-term solution. Effective strategies must be implemented, proactively monitored, and updated over time to undo the damage to the ecosystem. For example, to reduce emissions caused by packaging production, stricter monitoring and strategies must be implemented throughout the entire life cycle of packaging. Implementing these strategies will take time and yield results, but they are crucial for a more sustainable future.

Proper disposal of plastics made from biomaterials is another crucial aspect, but it involves education and collaboration between all participating parties. Businesses and consumers must be educated on the disposal process of biodegradable/compostable products, as these materials cannot breakdown anywhere. Educating all parties will help encourage investments in proper waste disposal infrastructure, making it more widespread and accessible. Additionally, consumer education ensures that the companies are held accountable for ensuring their products are appropriately disposed of due to the newfound common knowledge. This education can also prompt movements to call action on the government to support these initiatives through funding and other programs that would help promote the use of bio-based plastics. By promoting education and strategically investing in the research and development of biodegradable and compostable materials, we can ensure that they are disposed of properly and live up to their advertised benefits.

Despite the concerns surrounding the development of eco-friendly packaging, it is essential to implement sustainable solutions. With additional research and new strategies, the future of sustainable packaging can be secured, and a significant contribution to reducing waste

and protecting the environment can be made. There are currently limited set standards for what constitutes eco-friendly packaging. This lack of standards allows for creativity in developing new materials and techniques, which has resulted in numerous new inventions, innovations, and a newfound awareness of the manufacturing and transportation process. It also creates concern about whether these eco-friendly alternatives meet consumers' demands without compromising quality or affordability, as it is up against the tough competition of plastic. While there are still challenges to overcome, it is encouraging to see progress towards more sustainable packaging, and we must continue to prioritize eco-friendly solutions for the well-being of our planet and future generations.

## **V. CONCLUSION**

The transition to eco-friendly packaging may cause disruptive changes in the industry, but it is necessary to ensure sustainable development and protect our environment. This paper serves as a source to touch on all aspects of eco-friendly packaging and what more needs to be done to reassure uncertainty in the market. While there is still a need for further research, education, and strategy implementation, the shift towards eco-friendly packaging presents a hopeful opportunity. However, it is contingent upon the cooperation of manufacturers, consumers, and policymakers. By working together, sustainable practices can be introduced and maintained to create a positive and lasting environmental impact.

## REFERENCES

- BPI. (n.d.). *Biodegradable vs Compostable*. BPI. <https://bpiworld.org/biodegradable-vs-compostable>
- Charlottesville Government. (n.d.). *What's the difference between biodegradable and compostable?* Charlottesville Government. <https://charlottesville.gov/FAQ.aspx?QID=431#:~:text=If%20an%20item%20is%20certified,but%20this%20does%20leave%20residues.>
- EcoEnclose. (n.d.). *Bioplastics for eCommerce Packaging*. EcoEnclose. <https://www.ecoenclose.com/resources/bioplastics#:~:text=Used%20for%20biomedical%2C%20agricultural%20applications>
- European Union. (2022, January 18). *Biobased, biodegradable and compostable plastics*. European Commission. [https://environment.ec.europa.eu/topics/plastics/biobased-biodegradable-and-compostable-plastics\\_en](https://environment.ec.europa.eu/topics/plastics/biobased-biodegradable-and-compostable-plastics_en)
- Filiciotto, L., & Rothenberg, G. (2020). Biodegradable Plastics: Standards, Policies, and Impacts. *ChemSusChem*, 14(1), 56–72. <https://doi.org/10.1002/cssc.202002044>
- Goel, V., Luthra, P., Kapur, G. S., & Ramakumar, S. S. V. (2021). Biodegradable/Bio-plastics: Myths and realities. *Journal of Polymers and the Environment*, 29(2). <https://doi.org/10.1007/s10924-021-02099-1>
- Guillard, V., Gaucel, S., Fornaciari, C., Angellier-Coussy, H., Buche, P., & Gontard, N. (2018). The Next Generation of Sustainable Food Packaging to Preserve Our Environment in a Circular Economy Context. *Frontiers in Nutrition*, 5(121). Frontiers. <https://doi.org/10.3389/fnut.2018.00121>

- Ibrahim, I. D., Hamam, Y., Sadiku, E. R., Ndambuki, J. M., Kupolati, W. K., Jamiru, T., Eze, A. A., & Snyman, J. (2022). Need for Sustainable Packaging: an Overview. *Polymers*, *14*(20), 4430. PubMed Central. <https://doi.org/10.3390/polym14204430>
- Interpack. (2023, February 14). *Bioplastics in packaging*. Interpack. [https://www.interpack.com/en/Media\\_News/Tightly\\_Packed\\_Magazine/FOOD\\_INDUSTRIY\\_PACKAGING/News/Bioplastics\\_in\\_packaging](https://www.interpack.com/en/Media_News/Tightly_Packed_Magazine/FOOD_INDUSTRIY_PACKAGING/News/Bioplastics_in_packaging)
- Krishna, A., & Sokolova, T. (2023, April 21). *How Unnecessary Paper Packaging Creates the Illusion of Sustainability*. Harvard Business Review. <https://hbr.org/2023/04/how-unnecessary-paper-packaging-creates-the-illusion-of-sustainability>
- Prosser, D. (2019, April 16). *Why biodegradable plastic bags could be the future of sustainability*. IMMAGO. <https://immago.com/biodegradable-plastic-bags/>
- Simon, R., & Chen, Y. (2012). Packaging and the Supply Chain: A Look at Transportation. *Green Manufacturing*, 223–254. [https://doi.org/10.1007/978-1-4419-6016-0\\_10](https://doi.org/10.1007/978-1-4419-6016-0_10)
- Turkcu, D., & Tura, N. (2023). The dark side of sustainable packaging: Battling with sustainability tensions. *Sustainable Production and Consumption*, *40*, 412–421. <https://doi.org/10.1016/j.spc.2023.07.007>