

The Evolution of Plastic-Based Packaging in the FMCG Industry and its Environmental Impact

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Abstract:

This research explores the evolution of plastic-based packaging, including trays, jars, flow wrap, bread polybags, and laminates, within the Fast-Moving Consumer Goods (FMCG) industry and its environmental impact. Plastic packaging has revolutionized product distribution and convenience, yet it has also emerged as a major environmental concern due to its non-biodegradable nature and contribution to plastic pollution. The study delves into the historical progression of plastic packaging and its implications for the environment. It emphasizes the pressing need for sustainable alternatives and a circular economy approach to mitigate the adverse effects. The findings underscore the urgency of rethinking the future of plastic packaging in the FMCG sector to minimize its environmental footprint.

Keywords: Plastic packaging, FMCG industry, Evolution, Environmental impact

I. Introduction

Plastic packaging materials are characterized by their exceptional versatility, durability, and adaptability, making them a popular choice across various industries. With the ability to be molded into diverse shapes, sizes, and forms, plastic packaging materials offer unparalleled flexibility, enabling the creation of customized packaging solutions tailored to specific product requirements and consumer preferences. Known for their robustness and resistance to impact, breakage, and environmental factors like moisture and chemicals, plastic packaging materials ensure the safe and secure transportation and storage of products, maintaining their integrity throughout the supply chain. Their lightweight nature not only facilitates cost-effective transportation and distribution but also enhances the overall convenience of handling and using packaged products for manufacturers and consumers alike. Moreover, the transparency of many plastic packaging materials allows for easy product visibility and display, enabling consumers to examine product contents and quality prior to purchase, thereby fostering transparency and consumer trust. The ease of customization, including the ability to mold, shape, and color plastic materials, provides ample opportunities for branding, product differentiation, and marketing, enabling businesses to enhance their brand visibility and appeal to consumers. With relatively low production costs, plastic packaging materials offer a cost-effective solution for businesses seeking to minimize packaging expenses without compromising product protection or quality. Additionally, certain types of plastic packaging materials exhibit excellent barrier properties, safeguarding products from external elements such as oxygen and moisture, thereby extending shelf life and preserving product freshness. Understanding these diverse characteristics of plastic packaging materials is crucial for making informed decisions that balance product requirements, environmental considerations, and consumer needs, promoting responsible and effective packaging practices for businesses and consumers.

Plastic-based packaging has long served as a cornerstone in the Fast-Moving Consumer Goods (FMCG) industry, offering durability, cost-effectiveness, and versatility in preserving and presenting a wide array of

products. However, the burgeoning concern over its detrimental impact on the environment has necessitated a critical reevaluation of its role and evolution within this industry. From trays and jars to flow wrap, bread polybags, and laminates, the usage of plastic-based packaging has evolved significantly over the years, both in terms of its design and material composition. In light of the growing environmental consciousness, this evolution is now being shaped by a quest for sustainable alternatives and a heightened awareness of the urgent need for eco-friendly packaging solutions. This exploration delves into the trajectory of plastic-based packaging, examining its historical relevance within the FMCG sector and critically analyzing its contemporary and future implications in the context of the environment. By understanding the progression and impact of plastic-based packaging, it becomes possible to delineate the transformative measures required to foster a more sustainable and responsible approach to packaging in the FMCG industry. Plastic-based packaging has long been a dominant force in the FMCG (Fast Moving Consumer Goods) industry due to its versatility, durability, and cost-effectiveness. However, the environmental impact of plastic waste has become a pressing concern, leading to increased efforts in the development of sustainable alternatives and the evolution of plastic-based packaging itself. Following are brief overview of the evolution of some common plastic-based packaging in the FMCG industry and its impact on the environment:

Trays: Plastic trays have been widely used for packaging various food items. They are lightweight and offer good protection to the product. However, the disposal of these trays contributes to the growing plastic waste problem.

Jars: Plastic jars have been commonly used for packaging food products, cosmetics, and pharmaceuticals. The development of lightweight and more durable plastics has made them popular. However, their disposal and recycling pose significant challenges.

Flow wrap: Flow wrap packaging is commonly used for products like candies, chocolate bars, and snack foods. It provides a tamper-evident seal and enhances the shelf life of the products. However, the single-use nature of this packaging contributes to the plastic waste issue.

Bread polybags: Polybags used for packaging bread and other baked goods help in preserving freshness and extending shelf life. However, they are often not recyclable in regular recycling streams.

Laminates: Plastic laminates are widely used for flexible packaging, providing barrier properties that preserve the quality and shelf life of various products. However, their complex structure often makes recycling challenging.

1.1 Evolution of Plastic Based Packaging and Impact that it is having on Environment

The evolution of plastic-based packaging in the Fast-Moving Consumer Goods (FMCG) industry has brought remarkable convenience, durability, and cost-effectiveness to the market. However, it has also left an indelible mark on the environment. Over the years, the proliferation of plastic trays, jars, flow wrap, bread polybags, laminates, and other packaging formats has contributed to the mounting problem of plastic pollution. These non-biodegradable materials persist in ecosystems for centuries, posing a severe threat to wildlife, marine life, and human health. As a result, the environmental impact of plastic packaging is a growing concern, prompting the industry to explore sustainable alternatives and innovate towards more eco-friendly solutions to address this pressing issue.

1.2 Evolution of Plastic Based Packaging in FMCG industry

The evolution of plastic-based packaging in the FMCG (Fast Moving Consumer Goods) industry has been marked by significant advancements and changes driven by technological innovation, consumer preferences, and environmental concerns. Plastic-based packaging has historically been favored for its versatility, durability, and cost-effectiveness, allowing for the safe and efficient distribution of various products. The evolution of plastic-based packaging within the FMCG industry can be broadly characterized by several key stages:

Early Adoption: In the mid-20th century, plastic-based packaging gained popularity due to its ability to offer superior protection and preservation for a wide range of products. This marked the beginning of the widespread use of plastic materials for packaging in the FMCG sector.

Technological Innovations: Over the years, advancements in manufacturing technologies led to the development of more sophisticated plastic packaging solutions, including improved barrier properties, enhanced shelf life, and customizable designs catering to specific product requirements.

Sustainability Concerns: As environmental awareness increased, the FMCG industry began to face mounting pressure to address the environmental impact of plastic-based packaging. Consequently, there was a shift towards exploring sustainable alternatives, such as biodegradable plastics, recyclable materials, and eco-friendly packaging designs.

Circular Economy Approach: More recently, there has been a growing emphasis on adopting circular economy principles within the FMCG industry. This involves the promotion of recycling, reuse, and the use of recycled content in packaging materials, fostering a more sustainable and resource-efficient approach to production and consumption.

Regulatory Changes: Governments and international organizations have implemented regulations and policies aimed at reducing single-use plastics and promoting the use of environmentally friendly packaging materials. This has led to an increased focus on developing biodegradable and compostable plastics and encouraging the adoption of eco-friendly packaging solutions.

1.3 The effects of packaging of FMCG products

The packaging of Fast-Moving Consumer Goods (FMCG) products has a range of effects that can significantly impact various aspects of the product lifecycle, consumer behavior, and the environment. These effects can be both positive and negative, depending on the specific context and characteristics of the packaging. Some key effects of packaging in the FMCG industry include:

Product Protection: Packaging serves as a protective barrier, safeguarding products from damage, contamination, and spoilage during transportation, handling, and storage. Effective packaging helps maintain product quality, integrity, and safety, ensuring that consumers receive goods in optimal condition.

Brand Visibility and Differentiation: Packaging plays a crucial role in enhancing brand visibility and differentiating products from competitors on store shelves. Eye-catching and innovative packaging designs can attract consumer attention and influence purchasing decisions, contributing to brand recognition and loyalty.

Consumer Convenience: Packaging facilitates ease of use and convenience for consumers, enabling them to access and use products efficiently. User-friendly packaging designs, such as resealable pouches and single-serve containers, cater to consumer preferences for on-the-go consumption and portion control.

Information Dissemination: Packaging conveys essential product information, including nutritional content, ingredients, usage instructions, and expiration dates, helping consumers make informed purchasing decisions. Clear and accurate labeling ensures transparency and builds consumer trust.

Environmental Impact: The production, use, and disposal of packaging materials can have significant environmental implications. Excessive or non-recyclable packaging can contribute to waste generation, pollution, and resource depletion, while sustainable and eco-friendly packaging solutions can help minimize the carbon footprint and promote environmental stewardship.

Waste Management Challenges: Improper disposal and management of packaging waste can lead to environmental pollution and strain existing waste management systems. The proliferation of single-use plastics and non-biodegradable materials can exacerbate these challenges, necessitating the adoption of recycling and waste reduction initiatives.

Regulatory Compliance: Compliance with local and international packaging regulations is essential to ensure product safety, quality, and consumer protection. Adherence to packaging standards and guidelines is crucial for maintaining industry credibility and meeting legal requirements.

1.4 The benefits of packaging for the consumer and the manufacturer

Packaging serves a multitude of essential purposes for both consumers and manufacturers within the realm of product distribution and consumption. For consumers, packaging plays a vital role in ensuring product protection from damage, contamination, and tampering during transit, storage, and handling, guaranteeing the delivery of goods in pristine condition. It also facilitates easy access to crucial product information, including nutritional details, usage instructions, and expiration dates, empowering consumers to make informed choices and prioritize product safety. Additionally, packaging provides convenience and portability, enabling on-the-go lifestyles through easily transportable and single-serve options. Furthermore, it acts as a visual representation of a brand, aiding consumers in recognizing and identifying their preferred products, fostering brand loyalty, and facilitating brand trust and preference. For manufacturers, packaging serves as a tool for product differentiation, allowing products to stand out in a competitive market and creating a unique brand identity that resonates with consumers. Effective packaging design with appropriate barrier properties extends the shelf life of products, enabling manufacturers to reach a wider consumer base and distribute products over longer distances and timeframes. Moreover, packaging serves as a key marketing medium, allowing manufacturers to convey product benefits, promotional offers, and brand messaging, thereby enhancing brand visibility and stimulating consumer engagement and sales. Streamlining supply chain operations, efficient packaging ensures smooth logistics, reducing the risk of product damage or loss during transportation and storage, thereby optimizing distribution processes and ensuring cost-effectiveness for manufacturers. Balancing these diverse benefits with sustainable and eco-friendly packaging practices is crucial in promoting responsible and environmentally conscious packaging strategies for the future.

1.5 Trend in packaging industry in India

While the industry continues to evolve, it is important to note that the following trends may have further developed or changed since then. Some prominent trends in the packaging industry in India include:

Sustainable and Eco-friendly Packaging: There has been a growing emphasis on sustainable and eco-friendly packaging solutions, driven by increased environmental awareness and regulatory initiatives. This trend has led to the adoption of biodegradable materials, the promotion of recycling practices, and the development of innovative packaging designs that minimize environmental impact.

Technological Advancements: The industry has been witnessing technological advancements, particularly in the areas of smart packaging, digital printing, and automation. These advancements have improved production efficiency, enhanced product security, and enabled the integration of digital solutions for better traceability and supply chain management.

E-commerce Packaging: With the rapid growth of e-commerce in India, there has been a corresponding surge in demand for specialized packaging solutions tailored to the needs of online retail. This includes the use of durable and protective packaging materials to ensure the safe delivery of products, as well as the implementation of sustainable packaging practices to reduce waste generated from e-commerce activities.

Health and Hygiene Packaging: The COVID-19 pandemic has accelerated the demand for packaging that prioritizes health and hygiene. This includes the use of antimicrobial materials, tamper-evident packaging, and contactless packaging solutions, which help ensure the safety and integrity of products throughout the supply chain.

Customization and Branding: The trend towards customized and branded packaging has continued to gain momentum, driven by the desire to enhance product visibility and consumer engagement. Manufacturers are increasingly investing in attractive and personalized packaging designs that align with their brand identity and resonate with consumer preferences.

Regulatory Compliance: Compliance with evolving regulatory standards and guidelines has remained a critical focus for the packaging industry in India. Manufacturers are adapting to changes in regulations related to product safety, labelling requirements, and environmental sustainability, ensuring that their packaging practices align with the latest industry norms and standards.

1.6 Recyclable Packaging market Size

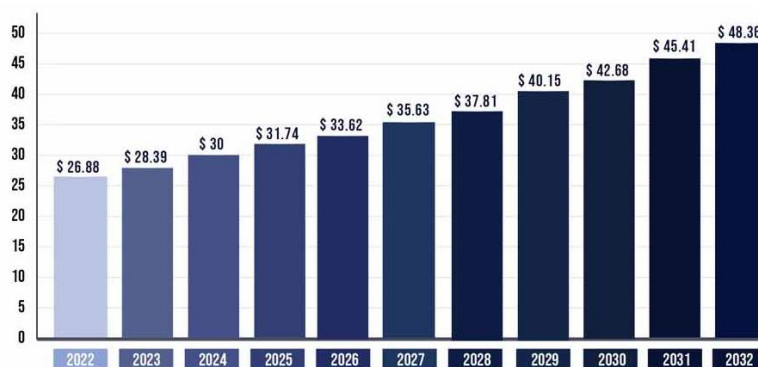


Fig 1: Recyclable Packaging market Size – 2022 to 2032 (USD)

The global market for recyclable packaging reached a size of USD 26.88 billion in 2022. Projections indicate that this market is expected to grow substantially, reaching approximately USD 48.36 billion by 2032. This growth is anticipated to occur at a compounded annual growth rate (CAGR) of 6.1% from 2023 through 2032.

The increasing emphasis on sustainability and eco-friendly packaging solutions is driving the expansion of the recyclable packaging market, with consumers and businesses alike seeking more environmentally responsible alternatives.

II. Literature Review

Kan & Miller (2022) stated that life cycle assessment (LCA) was being widely used to compare the relative impacts of different packaging materials for specific food products. However, the study observed that few studies had evaluated how a single packaging material contributed to a variety of food items. Plastic, a common material used for food packaging, was analyzed in the study. An analysis of 28 studies conducted LCA for food products to quantify the impact of plastic packaging relative to the total life cycle impact of food products. The study found that for most of the 13 environmental indicators reported, plastic packaging had been responsible for less than 10% of the total life cycle emissions of 23 out of the 30 foods studied. It was observed that relative packaging emissions tended to be higher for liquids and food products packaged in small quantities, although the absolute values of energy use and greenhouse gas (GHG) emissions had been small. The study also compared the results to a reference value of the emissions of vehicle travel to make LCA results more accessible to non-scientific audiences. The study concluded that the environmental impact caused by the packaging from per capita annual food consumption had been less than the environmental impact of per capita daily vehicle travel for most food products analyzed, although annual beverage consumption could be responsible for the equivalent impact of 76 miles of driving.

According to **Jacobsen et al. (2022)**, plastic waste, primarily from packaging, had been identified as a growing threat to nature and the environment and a waste of resources. They called for a greener, circular economy based on waste avoidance and recycling. The paper provided a systematic review of research, published in English between 2015 and 2020, on drivers and barriers of consumers' plastic packaging waste avoidance and recycling in private households. The focus was specifically on economically developed countries because they were responsible for the biggest share of plastic packaging waste and had implemented the most advanced and ambiguous legislation and regulation for plastic packaging waste prevention and recycling. The review identified 36 peer-reviewed articles that empirically addressed what motivated consumers to engage in these activities and what difficulties and hindrances they experienced in doing so in an effective way. The research found that the most important drivers of consumers' plastic packaging waste avoidance and recycling were environmental concern and task-specific benefits, while the most important barriers were lack of knowledge and understanding, as well as lack of opportunities, inconvenience, and task difficulty. The study also indicated that plastic packaging waste avoidance and recycling behaviors were interlinked, contingent on shared motives and understanding, which called for an integrated approach considering potential positive and negative spill-over between plastic packaging waste behaviors.

Weber Macena et al. (2021) discussed the use of plastics for packaging and highlighted the advantages of plastics, such as flexibility and cost-effectiveness. However, they also pointed out that most plastics were single-use, which, combined with low recycling or reuse ratios, contributed substantially to environmental pollution. The study focused on the habits of Portuguese citizens concerning plastic food packaging and aspects related to sustainability. The results, obtained from a statistical analysis of data gathered through an online questionnaire, indicated that participants tended to think about the negative impact of plastic packages on the environment. A substantial fraction of respondents supported the avoidance of plastic utensils and reduction in the use of plastic bags. The study found that changing plastic consumption habits had not been an easy task but expressed optimism that society would increasingly move toward sustainable habits, questioning its actions and considering their impact on the environment.

Ugoeze et al. (2021) highlighted the extensive utility of plastic products in healthcare, food, and other essential areas but noted that the prevalence of single-use and discard-after-use plastic packaging materials had given rise to menacing plastic wastes that contaminated the environment. The paper emphasized that these threats could be reduced if plastic waste management approaches, especially recycling and reuse, were adopted, and enabling policies on the manufacture, use, and disposal of plastic-based packaging products were established. The authors stressed that effective measures would ensue if government and policymakers enhanced enlightenment efforts at various levels of society and implemented strict regulations over the management of plastic-based packaging materials.

Ahamed et al. (2021) addressed the issue of flexible packaging plastic waste (FPPW), which had become an omnipresent waste stream flowing into the natural environment annually. The study reviewed the entry routes, fate, exposure, and hazardous effects of mismanaged FPPW in various environmental compartments and assessed prominent technological solutions to treat FPPW. The authors also discussed holistic approaches regarding circularity and upcycling of FPPW into useful materials, decarbonization of the FPPW supply chain, substitution by bio-based and biodegradable plastics, and reduction of demand to mitigate the environmental impacts.

Taufik et al. (2020) focused on the potential environmental benefits of recycling and composting bio-based plastic packages and the importance of consumers perceiving bio-based packaging as environmentally-friendly. The study, conducted among German consumers, revealed that consumers perceived compostable bio-based packages as having more environmental benefits than fossil-based packages. However, they often disposed of compostable bio-based packages in an incorrect manner, not in line with the packaging label's instructions. The study found that consumers with a stronger familiarity with bio-based products more often correctly disposed of compostable bio-based packages, but not recyclable bio-based packages, relative to fossil-based packages. The authors suggested that increasing consumers' bio-based product familiarity might increase the levels of sustainable disposal.

Kuzmina et al. (2019) used an inductive scenario planning methodology to envision future scenarios of the fast-moving consumer goods (FMCG) industry in the context of a circular economy (CE). They developed five future scenarios that considered the integral role of consumers and IT within the circular economy and discussed how value was created within this context. The study provided insights into how the FMCG sector might participate in the circular economy and suggested future areas for research.

Agarski et al. (2019) analysed the environmental impact of the production of high-density polyethylene (HDPE) caps. They performed a life-cycle assessment and found that the largest amount of environmental loading in the injection molding tool manufacturing process was attributable to electricity and steel consumption. The study also showed that the environmental impact from electricity consumption could be reduced significantly if cleaner sources of electricity were used.

Lewis et al. (2010) provided a critical review of the role of life cycle assessment (LCA) in evaluating packaging sustainability. The paper discussed the benefits and limitations of LCA in comparing different types of carry bags and their implications for policy and practice. The authors emphasized the need for a broader sustainability analysis that considered various factors, including functionality, cost, convenience, and the availability of reuse and recovery systems when evaluating packaging design.

Cruz-Romero & Kerry (2009) discussed the growing interest in crop-based packaging materials as a more environmentally friendly alternative to traditional synthetic plastics. They highlighted the potential of crop-based biodegradable packaging materials and their environmental implications. The authors concluded that life-cycle analysis studies and environmental assessment data supported the further development of crop-based biodegradable packaging materials.

III. Significance of this Research

The significance of the adoption of plastic-based packaging in the mid-20th century within the FMCG industry cannot be overstated. This pivotal development brought about a range of far-reaching implications that shaped the industry's trajectory and broader societal trends:

Revolutionizing Packaging Practices: The introduction of plastic materials revolutionized traditional packaging practices by offering superior protection, versatility, and customization options. This enabled manufacturers to innovate their product designs and distribution methods, leading to the diversification and expansion of the FMCG market.

Cost Efficiency and Affordability: The cost-effectiveness of plastic-based packaging allowed for streamlined production, transportation, and storage processes. This not only reduced operational costs for manufacturers but also contributed to affordability for consumers, making a wider array of products accessible to a larger population.

Preservation of Product Quality: Plastic packaging's ability to preserve the quality and freshness of FMCG products significantly extended their shelf life. This was crucial for perishable goods and delicate items, ensuring that products reached consumers in optimal condition, thereby enhancing customer satisfaction and reducing waste.

Environmental Impact and Concerns: While the initial benefits of plastic-based packaging were significant, the subsequent environmental implications, particularly related to plastic pollution and waste, have underscored the need for sustainable alternatives. The long-lasting nature of plastic waste has led to environmental degradation, prompting the industry and consumers to prioritize eco-friendly and biodegradable packaging solutions.

Consumer Convenience and Accessibility: Plastic-based packaging enhanced consumer convenience by offering lightweight, portable, and user-friendly packaging options. This ease of use and accessibility played a crucial role in shaping consumer behaviors and expectations, contributing to the growing demand for convenient, on-the-go FMCG products.

IV. Significance of Sustainable Packaging: A Case-Study from a Supply Chain Perspective

In 2021, the European Union enacted a series of regulations targeting various single-use plastic products known for their detrimental impact on the marine environment. Single-use plastics are disposable items meant for a single use before disposal. Notably, the EU's measures have resulted in a significant reduction in single-use plastic usage, estimated at 10–20%. To contextualize this reduction, it's essential to understand the historical plastic waste generation trends up to 2010 and to project the global scenario by the end of 2025. This is particularly pertinent for regions, including the one ranking highest in plastic waste production, as depicted in Figure 1.

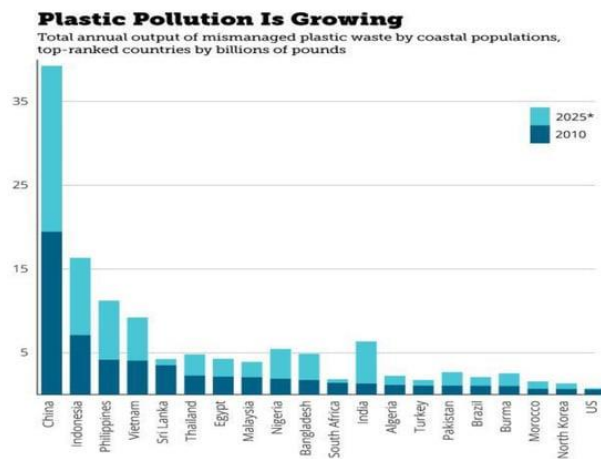


Fig: Plastic pollution is growing.

V. Scope of this Research

The evolution of plastic-based packaging in the FMCG industry has undergone significant transformations, encompassing technological advancements, sustainability considerations, consumer preferences, regulatory compliance, and industry-wide collaboration. Technological advancements have driven the development of more efficient manufacturing processes, innovative designs, and advanced recycling methods, aiming to improve the functionality and sustainability of plastic packaging. Concurrently, the industry has increasingly focused on environmental sustainability, leading to the exploration of biodegradable, compostable, and recyclable plastics, as well as the implementation of circular economy principles to minimize plastic waste and ecological impact. Understanding and responding to shifting consumer preferences and behaviors have become paramount, necessitating a keen understanding of consumer awareness, preferences for eco-friendly packaging, and the role of packaging in influencing purchasing decisions and brand loyalty. Compliance with evolving national and international regulations has become crucial, prompting companies to adhere to standards governing packaging materials, recycling targets, and sustainable packaging practices. Moreover, industry collaboration and innovation have gained prominence, fostering partnerships between manufacturers, retailers, research institutions, and policymakers to drive sustainable solutions and address collective challenges related to packaging sustainability and environmental impact. By recognizing the multifaceted nature of the evolution of plastic-based packaging within the FMCG industry, stakeholders can develop comprehensive strategies that prioritize environmental stewardship while meeting consumer needs and regulatory obligations.

5.1 The environmental benefits of ecofriendly packaging

Eco-friendly packaging, characterized by its use of sustainable materials and minimal environmental impact, offers a range of crucial environmental benefits, contributing to the reduction of carbon footprint, waste generation, and overall ecological strain. Some key environmental benefits of eco-friendly packaging include:

- ✓ **Reduced Carbon Emissions:** Eco-friendly packaging often involves the use of renewable or recycled materials and promotes energy-efficient production processes, leading to lower carbon emissions and a decreased reliance on fossil fuels, thereby contributing to mitigating climate change.
- ✓ **Minimal Waste Generation:** Eco-friendly packaging emphasizes the use of biodegradable, compostable, or recyclable materials, resulting in reduced waste generation and lessening the burden on landfills. This promotes efficient resource utilization and encourages the adoption of a circular economy approach.

- ✓ **Conservation of Natural Resources:** Sustainable packaging materials, such as bioplastics, recycled paper, and plant-based fibers, help conserve natural resources by reducing the need for raw materials extraction and decreasing deforestation, thus preserving biodiversity and ecosystem integrity.
- ✓ **Lower Environmental Toxicity:** Eco-friendly packaging materials often contain fewer toxic chemicals and pollutants, reducing potential harm to ecosystems and wildlife. This fosters a healthier environment and minimizes the risks associated with pollution and environmental degradation.
- ✓ **Promotion of Sustainable Practices:** By advocating for eco-friendly packaging solutions, businesses and consumers contribute to raising awareness and fostering a culture of sustainability. This encourages the adoption of responsible consumption patterns and promotes the development of a more environmentally conscious society.
- ✓ **Enhanced Biodegradability and Composability:** Eco-friendly packaging materials, designed to be biodegradable or compostable, break down more efficiently in natural environments, reducing long-term environmental impact and promoting the regeneration of soil health and fertility.
- ✓ **Support for Circular Economy:** Eco-friendly packaging aligns with the principles of a circular economy, emphasizing the reuse, recycling, and regeneration of materials, thereby minimizing resource extraction, promoting resource efficiency, and reducing overall environmental strain.

5.2 The important qualities for packaging to be green

Green packaging, to be considered environmentally friendly, should embody a range of essential qualities that prioritize sustainability, efficient resource utilization, and reduced environmental impact. It should be biodegradable and compostable, allowing it to naturally decompose without causing long-term harm to the environment, while also being derived from renewable resources, such as plant-based fibers and recycled materials, to minimize reliance on finite resources. Emphasizing recyclability ensures that the packaging can be efficiently reused within existing waste management systems, supporting a circular economy and reducing overall waste generation. Additionally, employing energy-efficient manufacturing processes minimizes the environmental footprint, reducing carbon emissions and energy consumption while promoting sustainable production practices. Green packaging should also be free from harmful chemicals and toxins, ensuring the safety of ecosystems and human health, while simultaneously providing the necessary durability and protection for the product throughout its lifecycle. By sourcing and manufacturing through sustainable practices that adhere to ethical standards, green packaging promotes environmental conservation and social responsibility, contributing to a more sustainable and responsible packaging industry that aligns with global efforts to mitigate environmental challenges and foster a more sustainable future.

VI. Conclusion

The evolution of plastic-based packaging in the FMCG industry has undeniably revolutionized product delivery and consumer convenience. However, this advancement has come at a significant environmental cost. The proliferation of plastic packaging materials has led to an alarming increase in plastic pollution, endangering ecosystems and human health. The future of plastic-based packaging in the FMCG industry must be reevaluated with a keen focus on sustainability and environmental responsibility. To mitigate its impact on the environment, the industry must prioritize the development of eco-friendly alternatives, promote recycling and waste reduction, and actively engage in circular economy practices. Only through such measures can we aspire to strike a balance between consumer demands and environmental preservation in the packaging industry.

VI. Future of Evolution of Plastic Based Packaging

The future impact of the evolution of plastic-based packaging in the FMCG industry will be shaped by a culmination of various factors, including environmental concerns, technological innovations, consumer preferences, and regulatory frameworks. Key areas of impact are likely to include:

✓ **Environmental Sustainability:** The increased adoption of sustainable practices and the development of eco-friendly packaging solutions will significantly reduce the environmental footprint of the FMCG industry. Biodegradable and compostable plastics, as well as the implementation of recycling technologies, will help mitigate plastic pollution and contribute to the preservation of natural resources and ecosystems.

✓ **Technological Advancements:** Continuous advancements in manufacturing and design processes will lead to the creation of more efficient, durable, and environmentally friendly plastic-based packaging. This will promote the development of innovative materials and methods, ensuring that the industry keeps pace with emerging technologies and sustainable trends.

✓ **Consumer Awareness and Preferences:** Growing consumer awareness of environmental issues will drive a shift in preferences towards products packaged with sustainable materials. The demand for eco-friendly packaging options is likely to influence product choices, brand loyalty, and overall consumer behavior, prompting manufacturers to prioritize the use of environmentally responsible packaging materials.

✓ **Regulatory Frameworks and Policies:** Strengthened regulatory frameworks and policies will play a crucial role in shaping the future of plastic-based packaging in the FMCG industry. Increased regulations on the use of single-use plastics, the promotion of recycling initiatives, and the implementation of extended producer responsibility programs will encourage companies to adopt sustainable packaging practices and comply with environmentally conscious standards.

✓ **Industry Collaboration and Innovation:** Collaborative efforts among industry stakeholders, including manufacturers, retailers, and policymakers, will foster the development of effective and sustainable packaging solutions. Joint initiatives focused on research, development, and the implementation of best practices will contribute to a more cohesive and environmentally responsible approach to plastic-based packaging in the FMCG sector.

6.1 The future of packaging industry in India

The future of the packaging industry in India is likely to be shaped by several key trends and factors, reflecting the evolving needs and challenges in the country. While it's important to note that the industry is subject to various external influences and changes, here are some potential aspects of the future of the packaging industry in India:

✓ **Sustainable Packaging:** A strong global and local focus on environmental sustainability will drive the adoption of eco-friendly packaging materials and practices. Biodegradable and compostable packaging, as well as recycling initiatives, will gain prominence to address concerns about plastic waste and its impact on the environment.

✓ **Rise of E-commerce:** The growth of e-commerce in India is expected to continue, necessitating packaging solutions that cater to the unique requirements of online retail. This may involve more secure and efficient packaging, as well as increased use of corrugated boxes and flexible packaging.

- ✓ **Urbanization and Convenience:** With rapid urbanization, consumer lifestyles are changing. Packaging that offers convenience, smaller portions, and ready-to-eat options will be in demand. Packaging designs that cater to the on-the-go lifestyle of urban dwellers will become more prevalent.
- ✓ **Regulations and Compliance:** The Indian government is likely to implement more stringent regulations concerning packaging materials and waste management. Manufacturers will need to comply with extended producer responsibility (EPR) programs and other measures aimed at reducing environmental impact.
- ✓ **Innovative Materials and Designs:** The use of advanced materials and innovative packaging designs will be a focus area. This includes smart packaging solutions, such as QR codes for product information, and technologies that extend the shelf life of perishable goods.
- ✓ **Safety and Hygiene:** The ongoing COVID-19 pandemic has highlighted the importance of packaging in ensuring the safety and hygiene of products. Antimicrobial and tamper-evident packaging solutions are expected to gain traction.
- ✓ **Customization and Branding:** Packaging will continue to play a significant role in branding and product differentiation. Manufacturers will invest in attractive and customized packaging to stand out in a competitive market.
- ✓ **Local Manufacturing:** The "Make in India" initiative is likely to encourage local production and reduce reliance on imports. This may lead to increased demand for packaging machinery and materials produced within the country.
- ✓ **Export Opportunities:** India's packaging industry has the potential to tap into global markets. The industry can cater to international demands for sustainable and cost-effective packaging solutions.
- ✓ **Economic Growth:** As the Indian economy continues to grow, the FMCG, pharmaceutical, and food and beverage sectors are expected to expand. This will drive an increased demand for packaging solutions to cater to these growing industries.
- ✓ Overall, the future of the packaging industry in India will be marked by a transition towards sustainability, innovation, and the need to adapt to changing consumer and regulatory dynamics. Industry players who embrace these changes and invest in cutting-edge technologies and practices are likely to thrive in this evolving landscape.

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