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Exploring the Eco-Friendly Horizon: A Comprehensive Review on the Sustainability of Cosmetic Products

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KEYWORDS Cosmetic Sustainability; Environmental Impact; Social Responsibility; Economic Viability; Consumer Awareness	ABSTRACT: This comprehensive review delves into the multifaceted dimensions of sustainability within the cosmetic industry, encompassing environmental, social, and economic aspects. The environmental segment scrutinizes the life cycle of cosmetic products, analyzing raw material sourcing, manufacturing processes, packaging materials, and disposal methods. The social perspective assesses the impact of cosmetic production on communities, emphasizing fair labor practices, human rights, and social responsibility. Economic sustainability is evaluated through the lens of long-term viability and resilience in the cosmetic industry. Furthermore, the review sheds light on the role of consumer awareness and education in influencing sustainable choices. As the cosmetic industry navigates the evolving landscape of sustainability, this review provides a synthesized understanding of the challenges, innovations, and opportunities associated with creating and maintaining sustainable cosmetic products. By exploring the intricate interplay between environmental responsibility, social ethics, and economic viability, this comprehensive review aims to contribute to the ongoing discourse surrounding the sustainable transformation of the cosmetic industry.
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Introduction

Sustainability is a growing concern in the cosmetics industry, which addresses the economic, social, and environmental impacts of its products throughout their life cycles. There are numerous possible meanings and interpretations of the term "sustainability," but the 1987 report "Our Common Future" offers the most prevalent. The term "sustainability" has its origins in the concept of "sustainable development," which Bruntland (1987) defines as "development capable of satisfying the needs of the current generation while safeguarding the ability of future generations to provide for their own requirements." The concept of "sustainability," which is presently adopted by an overwhelming majority of sectors, has incited changes in the approaches of consumers and businesses towards matters such as energy efficiency, resource management, product innovation, and refuse disposal. Companies are placing

Environmental, social, and economic sustainability evaluation is crucial in the cosmetics industry. This facilitates a holistic comprehension of the ramifications

the design stage [1].

facilitates a holistic comprehension of the ramifications that the industry has on society, the economy, and the environment. It facilitates the determination of measurement and structural properties between these dimensions as well as the identification of direct and indirect effects between them [2]. Furthermore, the integration of these dimensions and the monitoring of sustainable development status facilitates the evaluation of sustainable development at the national level [3]. The social and environmental aspects of sustainability are impacted by the economic dimension, and in addition to short-term metrics, long-term economic performance is also taken into account. Furthermore, for organizations

increasing emphasis on sustainability across the complete life cycle of their products, commencing with

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to attain transparent and ethical economic outcomes, economic sustainability is an indispensable component [4]. In order to ensure sustainability, the circular economy, which balances economic performance, social inclusion, and environmental resilience, is acquiring prominence [5].

Local cosmetic companies encounter obstacles stemming from resource constraints and a dearth of sustainability incorporation into their fundamental operations, whereas multinational cosmetic companies are at the forefront of instituting sustainability initiatives [6]. In the cosmetics industry, the incorporation of sustainable development objectives also encompasses the utilization of natural raw materials in formulations, such as digestate extract that is abundant in surfactants [7]. Supplier selection is a critical component of sustainability that has been subject to objective evaluation and selection through the implementation of the Cosmetics Sustainable Supplier Selection (C-SSS) model [8]. Industry events emphasized sustainability extensively, placing particular emphasis on biobased composition, biodegradability, minimal aquatic toxicity, and net greenhouse gas emissions [9].

The evaluation of sustainability in the cosmetics industry goes beyond a singular focus, encompassing environmental, social, and economic dimensions. This holistic evaluation facilitates a nuanced understanding of the industry's impact on society, the economy, and the environment. By scrutinizing the interplay between these dimensions, measuring their structural properties, and identifying direct and indirect effects, the cosmetics industry seeks a sustainable path forward. This paper aims to explore and synthesize these multifaceted aspects of sustainability in the cosmetic industry, the challenges, innovations, examining and opportunities that define its current trajectory. Through an in-depth analysis, this paper aims to contribute to the ongoing dialogue surrounding the sustainable transformation of the cosmetics sector, offering insights that inform future practices and policies.

Environmental Sustainability in Cosmetic Products

A. Life cycle analysis of cosmetic products

cycle analysis (LCA) helps enhance Life the sustainability of cosmetic items by assessing the ecological consequences at every stage of the product's life cycle. This encompasses the stages of design, procurement of raw materials, production procedures, packaging, distribution, and the post-consumer phase. LCA aids in identifying opportunities for enhancing sustainability, such as replacing traditional ingredients with sustainable alternatives, establishing cutting-edge factories that recycle water and energy, and advocating for the recycling and reutilization of packaging materials. LCA facilitates the evaluation of various packaging technologies, such as dip-tube pumps, airless pumps, and bag-in-bottle formats, in order to assess their environmental impacts. By integrating LCA into their decision-making processes, cosmetic firms may make more informed and strategic choices to minimize their environmental impact and enhance the overall sustainability of their goods [1,6,10].

B. Assessment of raw material sourcing

Enhancing the sustainability of cosmetic goods may be achieved by evaluating the supply of raw materials. An effective method involves assessing the regional biomass and native plant species to identify viable sources of bio-derived raw materials. An alternative approach involves the creation and verification of a framework for choosing environmentally friendly suppliers using unbiased and fair standards, such as the C-SSS model [8]. Furthermore, the utilization of underutilized medicinal plants, food industry by-products, and agricultural waste might offer a diverse array of bioactive substances for the development of cosmetics [11]. In addition, by measuring variables pertaining to the availability of raw materials, such as the total risk of supply, environmental repercussions, and challenges to environmental justice, decision-making may be informed, and more sustainable energy solutions can be prioritized [12].

C. Evaluation of manufacturing processes

Assessing manufacturing processes may enhance the sustainability of cosmetic items in many means. To begin with, firms may establish cutting-edge

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manufacturing facilities that recycle water and energy, therefore diminishing their ecological footprint [1]. Furthermore. the implementation of ongoing enhancements to manufacturing processes, cost reduction strategies, and quality assurance protocols may effectively optimize profitability and ensure competitiveness [13]. Furthermore, the careful choice of sustainable suppliers significantly contributes to the overall improvement of the sustainability of cosmetic goods. Through the assessment of suppliers using unbiased and equitable standards, firms may guarantee that their supply chain adheres to ecologically sustainable practices [8]. Additionally, including raw materials derived from the environment and formulating cosmetics with sustainable alternatives can help enhance the sustainability of cosmetic goods [7]. In general, the assessment of production procedures allows organizations to pinpoint areas for enhancement and apply strategies that decrease environmental effects and promote sustainability across the complete life cycle of cosmetic goods.

D. Exploration of eco-friendly packaging materials

The cosmetic business is actively researching environmentally sustainable packaging materials in order to minimize its ecological footprint. A research conducted a comparison of the advantages of transitioning to biodegradable and biobased polymers in cosmetic packaging. Polylactic acid and wood plastic composites were determined to be feasible choices, with polylactic acid demonstrating promise in mitigating the overall environmental effect throughout its lifespan and at the conclusion of its useful life. Nevertheless, it was discovered that these substitutes were more costly compared to the standard material, acrylonitrile butadiene styrene. A separate investigation examined the ecological consequences of various dispensing mechanisms used in cosmetic packaging. According to research, the airless pump system was determined to have the lowest environmental impact when compared to the dip-tube pump and bag-in-bottle style. In addition, the use of agro-waste materials, such as fruit peels and natural fibres, might offer a sustainable packaging solution in the beauty sector. This would help reduce waste and carbon emissions while also providing cost-effective alternatives [14].

E. Examination of disposal methods

Various research has analyzed the disposal strategies utilized by the cosmetic sector. The research was conducted on the wastewater disposal system of cosmetics manufacture, which involved many processes including homogenization, coagulating sedimentation, and anaerobic biodegradation. Separate research emphasized the problem of microplastics in the cosmetics sector, originating from either packaging materials or directly from the goods themselves. The study underscored the necessity of employing more advanced technology and treatment methods to mitigate environmental consequences. Furthermore, an analysis was conducted on the waste production of the cosmetic product plastic packaging business, specifically examining both hazardous and non-hazardous waste. The research investigated potential avenues for waste encompassing recycling management, and the transformation of garbage into usable goods [15]. the study examined the Moreover, possible environmental hazards associated with cosmetic items and the necessity for proficient regulation of chemicals of emerging concern (CECs). The report proposed the implementation of regulation, namely the REACH Act, to evaluate and mitigate the risk of environmental pollution. Conclusively, research scrutinized the notion of the circular economy within the cosmetics sector and discovered that although enterprises engage in recycling, the majority do not engage in the practice of reusing their resources [16].

Social Sustainability in Cosmetic Products

The cosmetic sector derives several advantages from the implementation of social sustainability. To begin with, it fosters the development of a sophisticated consumer culture by promoting an environmentally conscious mindset among customers, which in turn cultivates a discerning approach towards enterprises that market eco-friendly products [17]. Furthermore, it improves the connection and appeal of the brand, leading to favourable recommendations, a heightened desire to make a purchase, and the inclination to participate in online brand communities [18]. Furthermore, it serves to enhance consumer consciousness regarding social responsibility and fosters the advancement of the cosmetic sector [19].

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The primary social sustainability concerns confronting the cosmetic business encompass the detrimental influence of advertising content on the sector's standing and the imperative for conscientious advertising methods [1]. Moreover, the sector suffers from a dearth of empirical knowledge and comprehensive approaches to sustainability, resulting in challenges when it comes to completely adopting sustainable practices [20]. Moreover, the industry has difficulties in integrating sustainability into the fundamental operations, especially for domestic cosmetic enterprises that have limited resources and limited comprehension of the environmental effects throughout the product's life cycle [19]. Furthermore, it is imperative to establish rules and policies that promote openness in company operations and enhance the level of confidence between producers and customers. This may be achieved through implementation of obligatory sustainability the reporting and the enforcement of extended producer responsibility legislation specifically targeting packaging [6]. In order to improve its social sustainability performance and contribute to a more sustainable future, the cosmetic business must confront these difficulties [21].

Economic Sustainability in Cosmetic Products

Business models for sustainability (BMfS) allow organizations to generate social and environmental value for stakeholders. Implementing **BMfS** necessitates significant organizational transformation to remove entrenched dependency on old business models [22]. Sustainable business models (SBMs) refer to the strategies employed by organizations to generate, distribute, and retain value within economic, social, and environmental frameworks. SBMs tackle challenges such as limited resources, responsible management of supply chains, and effective waste disposal [23]. Both start-ups and established companies must undergo digital and sustainable business model changes in order to attain both ecological and economic sustainability. Digitally sustainable business models have the ability to provide sustainable value from ecological, economic, and technical standpoints [24]. Merging economic, environmental, and social business model patterns alone is inadequate for attaining genuine sustainability. To determine if a business model is genuinely sustainable, one must examine it as a whole system, taking into account its interconnected components, the broader system it is a part of, and any external variables that may affect it [25]. Technological advancements are the main catalyst for developing new business models that promote sustainability in industries with high carbon emissions. However, the adoption of these models by corporations is currently happening at a sluggish pace. Subsequent investigations have to employ a series of case studies to monitor the evolution and effects of business model improvements across a certain period [26].

The cosmetic industry is progressively prioritizing the incorporation of sustainability into its business strategies. Businesses are increasingly acknowledging the significance of choosing sustainable suppliers and are creating frameworks to impartially assess and choose them [8]. Both local and international cosmetic industries are actively addressing environmental, social, and governance (ESG) concerns and striving to establish a consumer culture that is environmentally friendly [17]. Research has examined the influence of economic, social, and environmental sustainability on brand attachment and attractiveness. The findings have shown favourable effects on word-of-mouth, purchase intention, and consumers' inclination to participate in online brand communities [18]. Furthermore, the viability of using raw materials derived from nature, such as surfactin-rich digestate extract, in washing cosmetics has been assessed, demonstrating satisfactory functional characteristics and enhanced safety during application [27]. These findings enhance the progress of creating sustainable business models in the cosmetics sector by highlighting the significance of choosing suppliers, implementing ESG practices, fostering brand attachment, and using natural raw materials.

Analysis of the Cosmetic Industry's Long Term Sustainability

Particularly in the cosmetics sector, the need for defining indicators and using specialized methods to measure, monitor, and assess sustainable standards and, ultimately, to support target attainment is driving an increase in the importance of sustainability metrics to business. It is essential, in the beginning with the design and procurement of raw materials and continuing through the manufacturing, packaging, distribution,

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consumer use, and disposal or post-consumer use phase. This is true from the beginning of the process, when raw materials are designed, to the end, when cosmetics are disposed of or used after they have been used by consumers. Life Cycle Thinking (LCT) ought to be the jumping off point for any sustainability assessment that is looking for an all-encompassing method of striking a balance between the three pillars of sustainable development. The cosmetic sector is increasingly acknowledging the value of LCT as a strategy. LCT encompasses the comprehensive evaluation of a product's environmental, economic, and social effects across its entire lifespan, spanning from manufacture to end-of-life (Figure 1). It aids in the identification and resolution of environmental concerns linked to the many phases and operations encompassed in the manufacturing of cosmetic goods [28]. Utilizing LCT in the cosmetic sector can enhance sustainable production and consumption, hence enhancing environmental and socio-economic performance [10]. Nevertheless, there has been a scarcity of studies on the use of Product Lifecycle Management (PLM), a crucial element of LCT, in the beauty sector. Additional progress is required in the advancement of PLM systems tailored to the cosmetic and fragrance sectors. Furthermore, the use of LCT concepts and tools is necessary to accomplish sustainability objectives in this industry [29].



Figure 1: Cosmetic product life cycle with a sustainable approach LCT

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Evaluation of certifications, labels, and marketing strategies

Certifications, labelling, and marketing tactics are essential for ensuring the long-term viability of the cosmetic Colombia, industry. In cosmetic manufacturers can choose to obtain certification for their goods from either the health authority INVIMA or a certifying agency specializing in Good Manufacturing Practices (GMP) [30]. Within Europe, cosmetics are required to adhere to Regulation (EC) 1223/2009, which establishes the "Golden Standard" for safety and is applicable to both European and non-European nations [31]. The legislation specifically targets the constituents, their levels of concentration, toxicological characteristics, and the extent to which consumers are exposed. Since 2009, animal testing has been banned, which has posed difficulties in evaluating novel compounds [32]. Furthermore, a technique, device, and computer storage media have been devised to provide a repository of cosmetic product information and a system for evaluating and assigning ratings to cosmetic items based on their chemical composition.

Companies in the cosmetics sector are progressively embracing green marketing as a novel market orientation, propelled by the growing need for ecologically sustainable goods. The Cosmetics Sustainable Supplier Selection (C-SSS) approach has been established to impartially and equitably evaluate suppliers according to sustainability criteria, which is an area of increasing focus [8]. When buying sustainable cosmetics, consumers take into account many factors, such as their attitude towards environmental consumption, well-being, health, reference groups, and perceived qualities. Companies are creating national ecolabel requirements for personal care and cosmetic items to demonstrate the environmentally friendly character of their products. These criteria assess the environmental and socio-economic elements of the products using sustainable production and consumption principles. The presence of certifications, such as the COSMOS-Standard organic certification, has а favourable influence on the perceived value and intention to purchase environmentally friendly cosmetic goods [33]. The presence of these certifications, labelling, and marketing techniques enhances the overall sustainability of the cosmetic industry.

Importance of Fostering an Informed and Responsible Beauty Consumer Culture

Cultivating a knowledgeable and accountable beauty consumer culture is crucial for several reasons. Initially, there is an increasing recognition of the possible hazards and perils linked to the utilization of specific cosmetic goods, both for consumers and the ecosystem. It is essential for consumers to have access to information on the constituents and possible health ramifications of the products they utilize so that they can make well-informed decisions that prioritize their overall health and wellness. Furthermore, there is a growing trend towards ethical consumerism, where customers are increasingly seeking items that are in line with their beliefs and contribute to the promotion of sustainability. Companies may fulfil these needs and showcase their dedication to corporate social responsibility by promoting a responsible beauty consumer culture. Furthermore, advocating for ethical consumption may effectively diminish waste and foster the preservation of resources. By promoting the selection of refillable or environmentally friendly cosmetics, the beauty sector may actively contribute to a more sustainable future.

In order to cultivate a well-informed and conscientious beauty consumer culture, a number of very successful tactics may be put into practice. It is essential to enhance openness and facilitate access to data on chemical hazards. The Know Better, Do Better Collaborative, spearheaded by ChemFORWARD, seeks to gather and disseminate chemical hazard data pertaining to the substances employed in the personal care sector. Moreover, it is crucial to offer educational materials and platforms that enable customers to obtain knowledge on dangerous components and make wellinformed choices. By integrating these methods, a culture of knowledgeable and accountable beauty consumption may be nurtured, resulting in advantages for both consumers and the environment.

Conclusion

Sustainability, as we've seen in the preceding discussions, is a key issue in the world of the cosmetic sector. The cosmetic industry is undergoing a transformative shift towards sustainability, driven by the growing awareness of its impact on society, the

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economy, and the environment. This paper has delved into various aspects of sustainability in cosmetic products, from life cycle analysis and raw material sourcing to manufacturing processes, packaging materials, disposal methods, and the broader social and economic implications. The adoption of sustainability practices is evident in the increasing emphasis placed by companies on the complete life cycle of their products, starting from the design stage. The integration of sustainability dimensions allows for a nuanced understanding of the industry's impact, facilitating the identification of direct and indirect effects and the measurement of structural properties. This holistic evaluation is crucial for establishing a sustainable path forward.

Environmental sustainability, analyzed through life cycle analysis, raw material sourcing, manufacturing processes, packaging materials, and disposal methods, plays a central role in the industry's transformation. The use of sustainable alternatives, evaluation of suppliers through models like C-SSS, and exploration of ecofriendly packaging materials are steps towards minimizing the environmental footprint of cosmetic products. Social sustainability is gaining prominence, with a focus on fostering an environmentally conscious consumer culture, improving brand connection, and increasing consumer awareness of social responsibility. However, challenges such as the impact of advertising content and the need for comprehensive sustainability approaches persist, particularly for local cosmetic enterprises. Economic sustainability is being addressed through the adoption of business models for sustainability and sustainable business models, with a recognition of the interconnectedness of economic, environmental, and social dimensions. The importance of choosing sustainable suppliers, implementing ESG practices, fostering brand attachment, and using natural raw materials is highlighted as essential for progress in creating sustainable business models in the cosmetics sector. Long-term sustainability in the cosmetics industry requires a comprehensive approach, including life cycle thinking, product lifecycle management, and continuous evaluation of sustainability metrics. The industry's response to certifications, labels, and marketing strategies, coupled with a focus on green

marketing, contributes to the long-term viability and overall sustainability of cosmetic products.

Substituting more environmentally friendly synthetic components is a major obstacle. The inclusion of natural, organic, or green chemistry-derived ingredients in cosmetics formulations necessitates additional research and evaluation on the functionality and safety of each ingredient, its stability in the formulation, and its performance with respect to the aesthetic preferences of consumers. There also needs to be research done comparing conventional cosmetic components to sustainable alternatives to help with the transition. The cosmetics sector may make strides toward sustainability by adopting more natural ingredients, greener methods and packaging, and focusing on changing consumers' behaviour in addition to the way its goods are made. The fact is that more sustainable practises are necessary for the beauty industry to thrive in the future. This paper contributes valuable insights into the challenges, innovations, and opportunities shaping the sustainable transformation of the cosmetics sector. The multifaceted analysis presented here serves as a foundation for ongoing dialogue, informing future practices and policies that can lead the cosmetics industry towards a more sustainable and responsible future.

Declaration

I would like to emphasize that the views expressed in this work are solely the personal opinions of the writer and do not in any way reflect the official stance or views of Reckitt or its affiliates.

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