Sustainable Packaging and Cosmetics: A Bibliometric and Systematic Literature Review of Environmental Developments and Trends

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Abstract

We witness pollution, and waste from packaging deteriorating air, soil, and water quality. Finally, green consumerism has become a global trend in the 21st century, which pushes cosmetic companies to be more environmentally conscious. The study examines papers that were taken from the "Scopus" database between 2013 and 2024. Additionally, Biblioshiny and VOSviewer were utilised as research instruments. This research article's goal is to identify and analyse the scientific literature with a bibliometric analysis (SPAR-4-SLR) of 229 articles to find the main topics, keywords, sources, most cited countries, and affiliations in the literature on sustainable packaging and cosmetics. An additional goal is to display a few condensed systematic literature reviews with the authors, years, variables, sample size, publishers, and conclusions highlighted. The publishing volume has demonstrated a noteworthy 8.01% yearly average growth rate. With 56 publications, 2023 was the most productive year, while Spain was the most productive country, respectively. "Polymers" is the journal with the highest production volume in articles and local indexes. While, 'Sustainable development', 'Packaging material', 'Circular economy', and 'Cosmetics' are the various frequently used keywords. The analytical findings suggest that research collaboration can close the knowledge gap and offer new insights into sustainable packaging and cosmetics by bridging the gaps between developed and developing nations as well as between the subject of marketing and environmental science.

Keywords: Bibliometric analysis, Biblioshiny, Sustainable, Packaging, Cosmetics, Scopus, VOSviewer

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1.   Introduction

Packaging has existed since ancient times when humans began storing and transporting goods. The first forms of packaging were made of natural materials such as leaves, bark, and animal skins. Later, humans started to use materials like ceramics, glass, and metal for packaging. Packaging facilitates a product's journey from its place of origin to its site of consumption and has a direct or indirect impact on every other industry. Packaging is a system that allows commodities to be handled, stored, transported, and marketed in a safe, economical, and efficient manner along the supply chain. It is more than just a box or carton (Dixon-Hardy and Curran, 2009). In consumer-packaged goods industries, where product quality preservation, loss prevention, ease of storage and transportation, and competitive advantage are frequently heavily dependent on packaging components, packaging plays undoubtedly the most significant role.

Unfortunately, packaging makes up 15–25% of total municipal solid waste in several countries (Tencati et al., 2016). Plastic packaging alone accounts for 50% of the world's total plastic waste production (UNEP, 2018). However, data from FedEx, UPS, and USPS indicates that 165 billion things are shipped within the US each year using cardboard packaging made from around 1 billion trees (Peters, 2018). Given the influence that packaging has on various eco-systems, it is feasible to investigate its role within the circular economy, which is essentially restorative and regenerative by design and seeks to extract as much value as possible from products, components, and materials over time (Batista et al., 2018).

The philosophical background of sustainable packaging is rooted in the idea of environmental responsibility and the sustainable use of resources. As per Gustavo et al. (2018), the concept of sustainability in packaging involves utilizing sustainable raw materials (like bio-materials and recycled materials), clean production processes, optimising the use of packaging materials, and renewable energy in all phases and energy efficiency, as well as developing closed loops through waste management, reuse and reprocessing. Throughout the product life cycle, this type of packaging promotes a healthy environment and poses no health hazards (Zhang and Zhao, 2012). The traditional hierarchy of waste management (reduction, reuse, recycling, and recovery) is the foundation for the majority of these programs. The evaluation and improvement of products and their packaging techniques are now considered their entire lifetime (Shinn, 2004).

According to the Sustainable Packaging Coalition (SPC), sustainable packaging is defined as: "Purposely developed, designed, and made to be sustainable throughout its life cycle. Sustainable packaging effectively integrates environmental, social, and economic aspects into its design."

Sustainable Packaging and Cosmetics

It has been claimed that ancient Egypt is where the history of cosmetics began. They were mostly used for hygiene purposes and had beneficial health advantages (Chaudhri and Jain et al., 2009; Vollmer et al., 2018). Today's cosmetics market is very different from the previously described area of the economy as a whole. Quality, efficiency, and safety are now of utmost importance in this highly competitive and global environment (Amberg and Fogarassy, 2019).

In addition, the worldwide cosmetics market has a 2018 value of USD 507.8 billion. By 2025, it will be expected that the market will be worth roughly 758.4 billion dollars (Ridinger, 2020). Cosmetics packaging has a significantly damaging influence on the environment. The extra layers, or first and second layers, as well as the materials utilised, such as glass, paper and paperboard, aluminium, wood, plastic/polymeric materials, and hybrid buildings, are both of the primary problems with packing.

Finally, green consumerism has become a global trend in the 21st century, it encourages cosmetic firms to expand their range of green products and become more ecologically mindful to appeal to these new customers. The consumer's understanding of the environmental and social issues pushing the beauty industry to become "greener" is one of the most significant drivers driving sustainability in the sector (Pop et al., 2020).

Using materials and processes that have no adverse effects on the environment is what is referred to as "sustainable packaging" in cosmetics items. It involves employing packaging made of recyclable, biodegradable, or compostable materials, using less plastic, and selecting environmentally favourable options. As a result, waste and pollution decrease, supporting the use of beauty products that are more environmentally friendly and sustainable.

Let's take the example of The Body Shop from Europe. This business is known as one of the forerunners of the second wave as it adopted the Caswell-Massey concept to create and market a whole line of bath products and scents in extremely straightforward and environmentally friendly packaging (Csorba and Boglea, 2011). Furthermore, several companies are

implementing refilling policies, including Shu Uemura, INGLOT, Tarte, and DHC (Feng, 2016; Inglot).

An attempt has been made to detect this phenomenon of sustainable packaging in the context of the cosmetic business by bibliometric evaluation of the majority of pertinent journals, nations, organizations, and keywords as a result of the fast-expanding body of research. It will offer fresh perspectives on the dynamics of the literature and current research trends in the area of environmentally friendly cosmetic packaging.

2. Objectives of the study

The specific aims or purposes that a researcher seeks to achieve through a research study are known as research objectives. As a result, the study's numerous objectives are as follows:

Research Questions	Objectives and Significance's
Which elements and common factors determine the adoption of sustainable packaging in cosmetics?	To determine the elements and the most common factors of sustainable packaging in cosmetics.
What is the annual growth rate for publications in this field?	Determining an annual growth rate for publications in this field would help forecast the future trend.
What are the most popular Journals, the most productive countries, and institutions publishing in this field?	To determining the productivity of journal, country, and, institutions as it would make it easier for researchers to locate relevant techniques, studies, and materials for conducting high-quality research and to understand the most productive countries and institutions for future publications.
What are the most significant research keywords and topics related to this field?	It would make it easier for researchers to examine and uncover researcher gaps.

3. Methodology

In this study, A systematic literature review analysis is done in the first part of the study and, later on the selected dataset is analysed using a quantitative exploration with a bibliometric study.

Bibliometric Analysis Methods and Research Software

The study used bibliometric analysis, which is a quantitative tool, to evaluate the dynamics of published literature on sustainable packaging by identifying the most pertinent articles, journals, countries, and rankings (Jalal et al., 2021). To do the bibliometric study, we followed the most recent trends and utilised the R programming language software's Biblioshiny package (Secinaro et al., 2020).

The applications VOSviewer and Biblioshiny were used to analyse the definitive collection of 229 articles. A thorough cartographic study of scientific literature is made easier with the help of the open-source program Biblioshiny. The R programming environment was used in its design and development because of its great versatility and easy interface with other statistical and graphical applications. Because of the tool's great adaptability, new features and upgrades may be added quickly (Aria and Cuccurullo, 2017).

Data Collection

The "Scopus" database has the largest abstract database (Santos et al., 2021) and the most comprehensive collection of indexed journals (Kumar et al., 2021; Mahecha Núñez et al., 2021). Filtering options include year, affiliation, document type, source type, country, and language. Scopus was selected to carry out this analysis because it is the largest abstract and citation-based database of peer-reviewed literature in the disciplines of science, social science, the arts, and humanities. To conduct the research, data were taken from 2013 to 2024(July). Using the search parameters, the study data that were found were exported in a CSV format. (keywords string: ("Sustainable" OR "Green" OR "Ecological") AND ("Packaging") AND ("Cosmetics" OR "Skincare "OR "Beauty Products" OR "Makeup") in title and abstract (publications); a Limit year from 2013 to 2024 (267 publications) on July 2024. In addition, restrictions were made on document types (Articles, Reviews, and Conference papers), language (English only), and 9 subject areas are included. Finally, 229 articles are selected for data analysis and evaluated by following SPAR-4-SLR given by "Paul et al., 2021".

Assembling

Identification

Domain: Sustainable packaging of cosmetics

Research Questions:

What was the change over time in the quantity of publications in this field?

Which were the most popular Journals, Countries, Institutions and Keywords publishing in this field?

Acquisition

Database: Scopus

Search Period: 2013-2024(July)

Search Keywords: "Sustainable" OR "Green" OR "Ecological" AND "Packaging" AND "Cosmetics" OR "Skincare" OR "Beauty Products" OR "Makeup"

Total No. of Articles: 267

Arranging

Organisation

Organizing Codes: Article Title, Journal title, Author Name, Author's Keywords, Cite Scores etc.,

Organizing Framework: Not applicable

Purification

Article Type Excluded: Article Excluded other than Time framework(N=26), Document Types(N=7) and English language(N=5)

Article Type Included: 229 Articles

Assessing

Evaluation

Analysis Method: Bibliometric and VOSviewer

Agenda Proposal Method: Future Research Directions

Reporting

Reporting convention: Figures (Networks), Table Metrics and Words.

Limitations: Data exclusive to Scopus, only bibliometric data was reviewed

Source of Support: No funding agency

Figure 1: The SPAR-4-SLR Protocol introduced by Paul et al., (2021).

Table 1: Main information regarding the data source analysing *Scopus* data using Biblioshiny

Timespan	2013:2024	Document contents	
Sources (Journals, Books, etc)	177	Keywords Plus (ID)	2307
Documents	229	Author's Keywords (DE)	827
Annual Growth Rate %	8.01	*Authors*	
Document Average Age	3.16	Authors	948
Average citations per doc	22.65	Authors of single-authored docs	12
References	18950	*Authors collaboration*	
Document types		Single-authored docs	13
Article	99	Co-Authors per Doc	4.41
Book chapter	44	International co-authorships %	26.2
Conference paper	19		
Review	67		

4. Results

4.1 An outline of the proposed research

Out of the 229 documents, 15 articles are presented in Tables 2 and 3 to show some summarized systematic literature reviews (SLR) on sustainable packaging and cosmetics. There has recently been an increase in the number of documents highlighting the continued expansion of research projects and the industry's interest in environmentally friendly packaging in the beauty industry. The 15 papers on sustainable packaging and cosmetics that were selected for this SLR were published in various academic publications between 2013 and 2024 and listed in the Scopus database.

The outcomes are summarized in Table 2. It reveals the names of the authors, the year the research was published, the nation the authors are associated with, the kind of study, and the size of the sample. The main variables of the study are also covered.

Table: 2 List of literature (15 articles)

Sr.	Author's & Years	Country	Type of Study	Variables	Sample size
1.	Martins and Marto (2023)	Portugal	Review study	Design and development, Ingredient selection, Production, Packaging, Distribution, Consumer use, Post use.	NA
2.	Lin et al., (2018)	UK	Empirical study	Cognitive components, Affective components, Cognitive components, Personal experience and lifestyle, Media and Marketing techniques, Social surrounding.	30 British females
3.	Lomartire et al., (2022)		Review study	Seaweed, Bioactive compounds, Bioplastic, Sustainability, Biodegradable packaging.	NA
4.	Prakash et al., (2024)	India	Empirical study	Cosmetic packaging, Para-social interaction, Altruistic motivation, Pro-environmental belief, Purchase intentions, Zero waste buying behaviour.	378 Respondents
5.	Moharam, (2023)	Bahrain	Empirical study	Attitudes, Subjective norms, Perceived behavioral control, Environmental beliefs, a key ependent variable of green purchasing behavior.	400 Bahraini females
6.	Amberg and Fogarassy (2019)	Hungary	Empirical study	New brands, Healthy way of life, Environmentally conscious consumer behaviour, Natural ingredients,	197 Respondents

				Natural packaging, Less effective natural cosmetics	
7.	Siddiqui et al., (2023)	Germany	Empirical study	Environmental attitudes, Personal norms, Social norms, Socioeconomic, Demographic characteristics, Consumers' intention	299 German families
8.	Malik et al., (2023)	France	Review study	Antioxidant properties, Bioactive compounds, Boraginaceae, packaging, Herbal products, Natural colorants, Nutraceuticals, Pigments, plant natural products	NA
9.	Cubas et al., (2022)	Brazil	Review study	Biodegradable polymers, Natural preservatives, Microalgae, Cosmetics without water, Clear technology and Production process, Life cycle analysis, Sustainable development goals.	NA
10.	Gatt and Refalo (2022)	Malta	Review study	Life cycle assessment, Recyclability Reusability, Dematerialisation Cosmetic packaging, Sustainability	NA
11.	Vázquez et al., (2023)	Spain	Empirical study	Environmental concern, Socio-demographic variables, Label awareness, Label attitudes, Label use in purchase behaviour.	3000 Spanish consumers
12.	L'Haridon et al., (2023)	France	Case Study	SPOT methodology, System boundaries and Functional units, Collection of Life Cycle Inventory	2 Case studies

				(LCI) Data, Environmental ratings, Sustainability index.	
13.	Bom et al., (2020)	Portugal	Empirical study	Product life cycle, Selection of raw materials, Production, Packaging, Distribution, Post-Consumer Use.	32 Cosmetic professionals
14.	Brodnjak and Jestratijevi (2023)	Slovenia	Review study	Cosmetic brands, Environmental impact, Packaging materials, Packaging waste, Sustainable packaging.	NA
15.	Dube and Dube (2023)	Turkey	Review study	Sustainable cosmetics, Sustainable packaging, Sustainability strategies Consumer behavior, Corporate social responsibility Technological developments.	NA

Table: 3 List of publishers, journals, and findings (15 articles)

Sr.	Author/ Year	Publisher	Sources	Findings
1.	Martins and Marto (2023)	Elsevier	*"Sustainable Chemistry and Pharmacy"*	Many cosmetic firms are already incorporating sustainability techniques into their goods, particularly in the environmental venue, as a result of growing concerns about sustainability. By implementing sustainability practices not just at this level but also at the social and economic levels, cosmetic enterprises may help create a more sustainable

				future on a global scale.
2.	Lin et al., (2018)	MDPI	*"Administrative Sciences"*	The main conclusions of this study were that, as a result of ignorance and unclear market requirements, there are generally indifferent opinions on green cosmetics. When selecting cosmetics, most respondents considered price and performance more significant than environmental considerations. However, the majority of respondents acknowledged that their neutral opinions now could shift to more favourable ones in the future due to increased understanding of natural and organic products as well as green manufacturing.
3.	Lomartire et al., (2022)	MDPI	*"Applied Science"*	Numerous studies show that the spread of plastics and microplastics in the waters causes major environmental problems that affect aquatic life and ecosystems. In order to conserve the environment and replace plasticisers with biodegradable materials, it is now essential to employ seaweed-derived biopolymers sustainably.
4.	Prakash et al., (2024)	Heliyon	"*Science Direct*"	According to the findings, customers' altruistic motive and purchase intention are positively impacted by eco-friendly packaging, pro-environmental beliefs, and parasocial interaction. In the end, these elements work together to influence the decision to choose zero-waste cosmetics.
5.	Moharam, (2023)	Natural Sciences	*"Information Sciences*	Since eco-friendly cosmetics were beneficial to both the environment and human health,

		Publishing Corporation	*Letters An International Journal"*	most people had favourable attitudes about them and purchased large quantities of them. The study included four independent variables—attitudes, subjective norms, perceived behavioural control, and environmental beliefs—and a critical dependent variable, green purchase behaviour, which validated all of the conceptual model's assumptions.
6.	Amberg and Fogarassy (2019)	MDPI	*"Resources"*	The results suggest that health and environmental concern will continue to have a major impact on the behaviour of producers and consumers in the cosmetics industry. Additionally, because cosmetics have a far smaller spectrum of health impacts than food, it won't necessarily follow the trends set by the food sector. In the future, the selection of natural cosmetics will grow considerably. The main force behind this will be the development of environmentally friendly cosmetics chemicals and manufacturing processes (primarily for packaging).
7.	Siddiqui et al., (2023)	MDPI	*"Sustainability"*	Only a small number of product categories show statistically significant variations based on social norms, gender, or age; nevertheless, in practically all of the product groups studied, environmental attitudes in particular can differentiate between consumer groups with high and low intents to remove plastic packaging. None of the FMCG groups under investigation showed any signs of group

				distinctiveness being impacted by personal norms.
8.	Malik et al., (2023)	MDPI	*"Materials"*	The most recent research on the various properties of shikonin derivatives in connection to food and cosmetics is examined in this paper. Numerous studies have shown that these natural bioactive chemicals might be used in a wide range of applications, including food additives, skin care, functional foods, and the treatment of different ailments.
9.	Cubas et al., (2022)	MDPI	*"Polymers"*	Every stage of the product's life cycle, from the conception of raw materials to the final disposal by the user, must be thoroughly studied in order to ascertain the socioeconomic and environmental impacts generated. In an attempt to be in line with sustainable development, several industries are changing their viewpoints and looking for more ecologically friendly ways to produce their goods.
10.	Gatt and Refalo (2022)	Elsevier	*"Resources, Conservation & Recycling Advances"*	The removal of inventive materials that make the package reusable results in a 74% reduction in environmental impacts only when the packaging materials are entirely recycled. The benefits of reusability outweigh the drawbacks of dematerialisation by 171%. Reuse should be prioritised in these situations, according to the study's findings, as recycling would only rely on the user and the available infrastructure.

11.	Vázquez et al., (2023)	Elsevier	*"Sustainable Production and Consumption"*	Paper and wood, computing, and electrical were the industries that valued the usage of labels the most. When it came to utilising certificates, young women who were better educated and environmentally conscious were the most successful buyers. In any event, it is determined that approximately half of Spanish consumers do not find added value in sustainability labels.
12.	L'Haridon et al., (2023)	MDPI	*"Sustainability"*	There is discussion on the use of SPOT, which is predicated on certain management and strategic metrics (business and brand aims, KPIs, and financial incentives). By 2022, 97% of L'Oréal's goods will be marketed as eco-designed thanks to these efforts. SPOT demonstrates how eco-design may be widely used without sacrificing the integrity of science. The intricacy of the LCA and the simplicity of interpreting the findings must be properly balanced in eco-design tools.
13.	Bom et al., (2020)	MDPI	*"Sustainability"*	The findings indicate that there are no packaging materials, raw resources, or methods that can be regarded as completely sustainable. However, the effects of any kind of cosmetic product on sustainability may be significantly reduced with the right tactics. This is a promising application that gives the user access to the three aspects of sustainability in an easy, quick, objective, and interactive manner. Its use will speed up

				analysis and decision-making while also making formulators' jobs easier.
14.	Brodnjak and Jestratijevi (2023)	Wiley	*"Sustainable Development"*	The results show that 61% of brands use recyclable, refillable, or bio-based alternatives, whilst 39% of brands leave out information on the packaging material. This change highlights a rising interest in sustainability, yet unidentified packaging components point to gaps in transparency, calling for stricter laws. Surprisingly, of the brands examined, only 14 use a variety of certifications and criteria for infant cosmetics.
15.	Dube and Dube (2023)	MDPI	*"Cosmetics"*	According to the findings, there might not be much benefit to trying to persuade consumers to alter their behaviour, waiting for a major expansion of the global recycling infrastructure, or anticipating that regulatory restrictions will make up for the absence of commercial and technological alternatives. A study plan is outlined for the creation of sustainable packaging that might reduce externalities and offer mass-produced packaging that is favoured by both producers and consumers with the right kind of regulatory backing.

4.2 Analysis of Overall Growth Trend

Throughout the observation period 2013–2024(July), there is a noticeable growth in documentation for sustainable packaging in cosmetics, according to the study of production trends (see also Figure 2). The number of articles published between year 2013 and 2017 ranged

from 3 to 7. It is comparable to the commencement of the research phase. Next, 11 and 12 articles were published annually, things got going in 2018 and 2019. 2020 marked the year of a great hike, by double the number of articles compared to the previous years, that is 33 articles. The trend continues with further significant growth in 2021 (38 articles) and 2022 (41 articles), indicating sustained momentum in research and advancement in this field. The number of publications rise to 56 by 2023, highlighting the continued expansion of research projects and the industry's interest in environmentally friendly packaging in the beauty industry.

The publishing volume has demonstrated a noteworthy 8.01% yearly average growth rate. There has been a remarkable increase from just 6 articles in 2013 to 56 by the end of 2023. The number of articles published in this field increased in 2020. After that, it gained momentum in the last four years between 2020 and 2023. 2023 was found to be the most productive year with 56 published articles, indicating that there is potential for more research in this area.
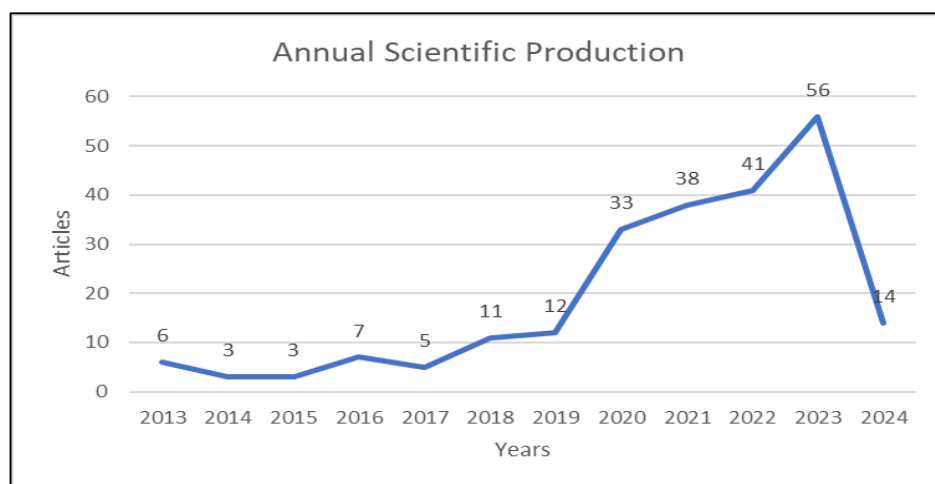
Figure 2: Annual scientific production *Source* Scopus data analysed by Authors

It is important to highlight that while the search period concluded in the first week of July 2024, the data for this year is incomplete, but the predictions for 2024 look good. It appears from the trend that a large number of other scholars may join shortly and advance the field.
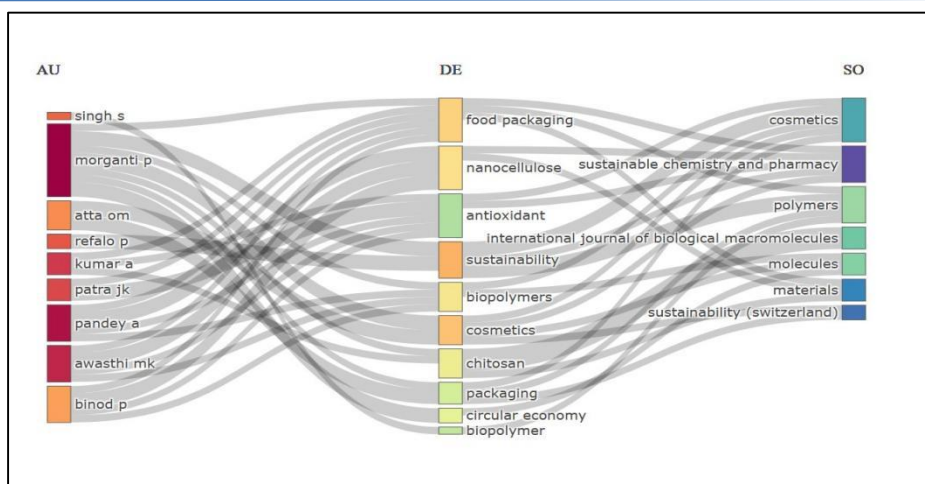
Figure 3: Three field plots for Authors, Keywords, and Journal Source *Scopus* data analyse through Biblioshiny

To display the link between the top authors, keywords, and journals, a three-field plot is created using the data that was obtained. The centre field in the three-field diagram (Figure 3) displays the authors' keywords, while the left displays the most prolific authors and the right displays the most productive journals. Relative frequency or the quantity of articles in each of the three areas that fit into a specific range or category is represented by the thickness of the rectangle.

It explains that "Morganti P.", one of the best writers, employed keywords associated with his name in Figure 3 and published his papers in the most prolific journal, "*Cosmetics*". Furthermore, the five keywords that were utilised in the most productive journal, "*Cosmetics*", includes antioxidants, sustainability, biopolymers, cosmetics, and packaging. Morganti P. and Refalo P. specifically address the topic of sustainability, whereas Morganti P. and Atta OM. specifically address the keywords packaging and cosmetics.

4.3 Most Relevant Sources

The journals that are most popular for publishing articles about environment-friendly packaging for cosmetics are displayed in Figure 4. The top 10 journals are displayed in this graph according to the number of papers they have published.
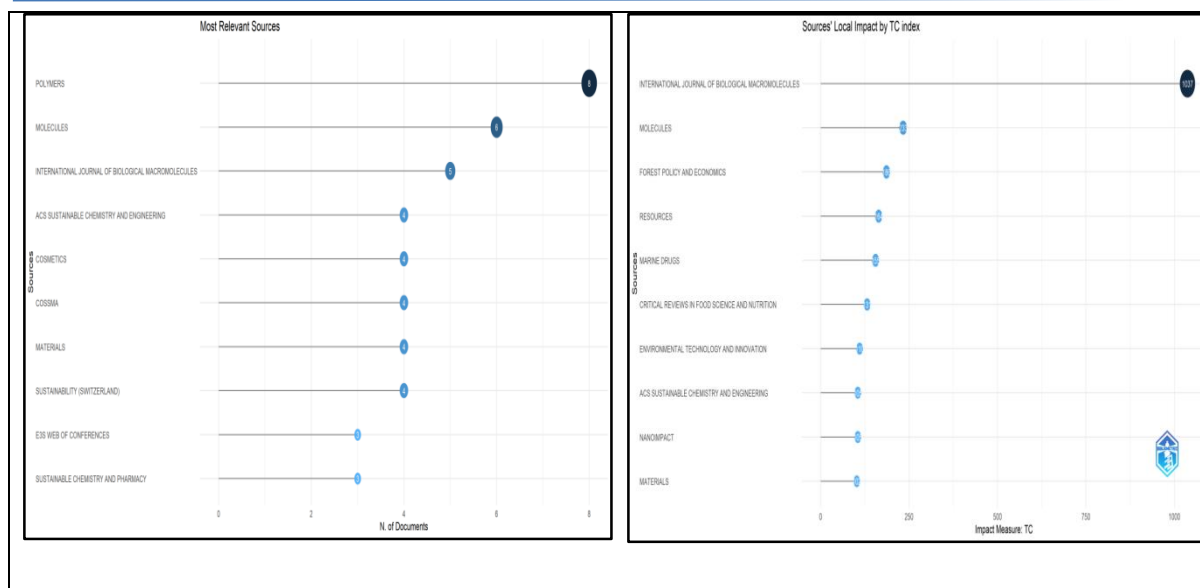
Figure 4: Top 10 journals according to total publications and total citations Biblioshiny is used to analyse *Scopus* data.

With the highest publications having eight scientific literatures, "*Polymers*" is the most productive journal. The top five journals in terms of overall production are "*Molecules*", "*International Journal of Biological Macromolecules*", "*ACS Sustainable Chemistry* and *Engineering*", *and* "*Cosmetics*", with 6, 5, 4, and 4 papers in each of those categories respectively. However, a journal's article count alone is insufficient to determine which one is the most pertinent journal. Therefore, in addition to the number of papers published, the analysis also included the total amount of citations that each publication obtained.

The influence and recognition that each journal has received within its relevant domain are depicted in the plot chart of total citations. Leading the pack with the total citations (1037), the "*International Journal of Biological Macromolecules*" is widely recognised for its contributions to the study of big biological molecules. The next top two journals are "*Molecules*" and "*Forest Policy and Economics*", with a total citation count of 186 and 233, respectively (Figure 4). In terms of citation count, "*Resources and Marine Drugs*" continues to be one of the top five journals.
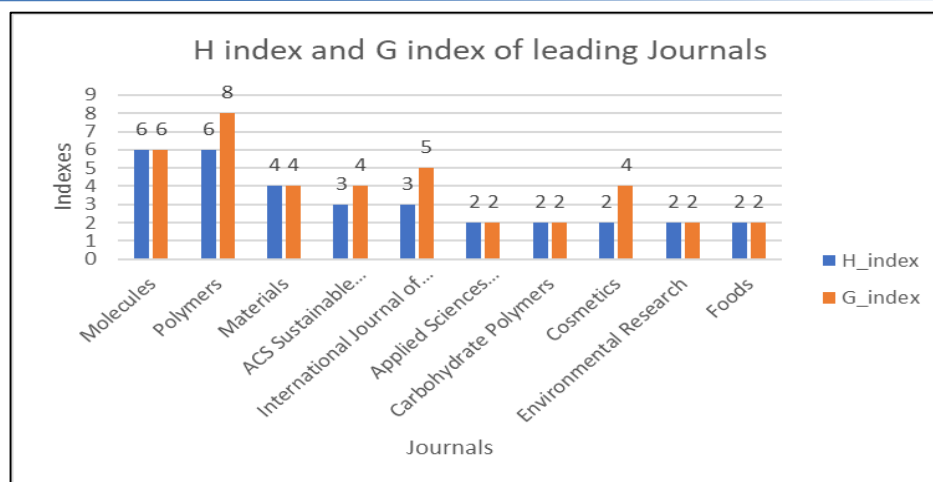
Figure 5: Top 10 journals by G index and H index Sources Scopus data analysis through Excel

The effect of the top 10 journals is evaluated using Excel to create a clustered column chart of the G index and H index (Figure 5). With H-index ratings of 6, which indicate that they have each produced at least six papers that have been referenced at least six times, '*Molecules*' and '*Polymers*' stand out as leading sources. Furthermore, '*Polymers*' has a higher G-index score of 8, which suggests that it has had more citation impact than '*Molecules*'. Similarly, '*Materials*' exhibits a modest influence and productivity in this sector, with an H-index and G-index of 4. With somewhat lower but still impressive grades, '*ACS Sustainable Chemistry and Engineering*' and the '*International Journal of Biological Macromolecules*' demonstrate their contributions to sustainable packaging research. While having lower H-index and G-index ratings, other sources including '*Applied Sciences*', '*Carbohydrate Polymers*', '*Cosmetics*', '*Environmental Research*', and '*Foods*' show varied degrees of effect and production.

In summary, "Polymers" is the journal with the highest production volume in terms of both articles and local indexes, such as the H and G indexes. The '*International Journal of Biological Macromolecules*', on the other hand, has received the most citations overall.

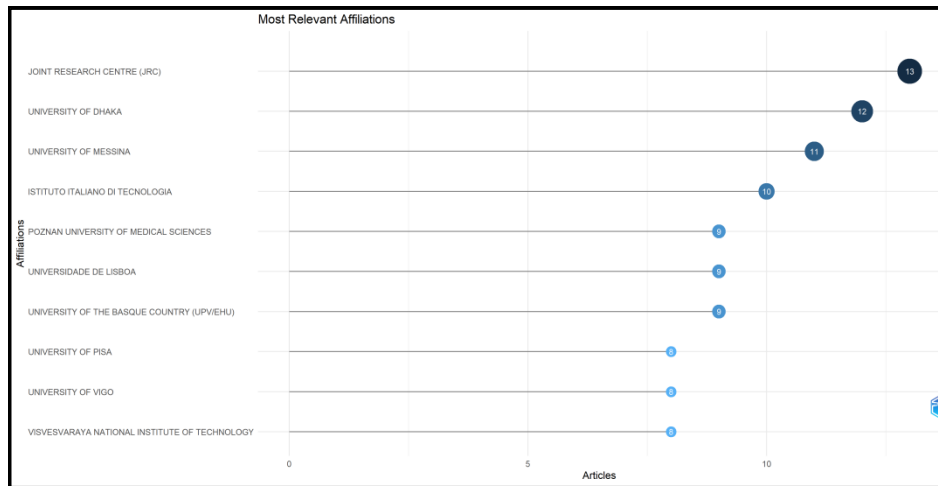**4.4 Most Relevant Affiliations**

Figure 6: Top ten organisation by the largest number of publications Source *Scopus* data analyse using Biblioshiny

Regarding research output and academic contributions, the plot chart illustrates the number of publications produced by various affiliations. At the top with 13 publications, the Joint Research Centre (JRC) demonstrates its wide-ranging involvement in cooperative research projects. Universities like the University of Dhaka, University of Messina, and Istituto Italiano di Tecnologia are showing notable engagement in the Scopus database, with 12, 11, and 10 articles, respectively (Figure 6). These universities are in close pursuit of the lead position.

4.5 Most Relevant Countries

Table 4 provides an overview of the scientific impact of the top 10 countries, presenting the total citations (TC) alongside the average article citations. Spain emerges as a front-runner with a TC of 939 and an impressive average of 117.4 citations per article, indicating a strong influence in producing highly cited research. Italy and China follow, both with total citations of 618 and 342, although their average article citations are 26.9 and 26.3 respectively. India ranks fifth overall in terms of citations, but its average citation per article is rather low at just 10.

Table 4: Majority cited Nations Source *Scopus* data analyse using Biblioshiny

Country	Total Citations	Average Citations
Spain	939	117.4
Italy	618	26.90
China	342	26.30
USA	282	35.20
India	280	10.00
Korea	274	54.80
Pakistan	254	127.0
Finland	214	107.0
Hungary	165	82.50
Poland	137	17.10

4.6 Most Relevant Keywords

One of the most popular techniques for producing keywords that indicate concepts is keyword analysis (Bordet, 2017; Scott, 1997). Finding research trends, research gaps, and promising areas for future study depends on this methodology.

By limiting the criteria for VOSviewer analysis to a minimum of five times the occurrence of a term, a co-occurrence network analysis of all 827 keywords using the full counting approach has been completed. Out of 827 keywords, only 21 appeared five or more times.

With 52 linkages and a total link strength of 73, there are four clusters (colours) including 21 items. Cluster 1 has seven of the author's twenty-one keywords; Clusters 2, 3, and 4 follow with seven, five, and two entries, respectively. Similar idea words are clustered together, and each word's relative importance is shown by the size of the nodes in each cluster. The strength of the relationship between the author's keywords and the nodes is indicated by the thickness of the lines connecting them, which is based on how frequently the keywords appeared together in published articles. The most popular author keywords, as seen in Figure 9, are "Circular economy," "Sustainability," "Packaging," "Cosmetics," "Bioactive compounds,"

"Biopolymers," and "Chitosan". Author's keywords like Sustainability, Packaging, and Cosmetics have a frequency of 23, 9, and 13, respectively.
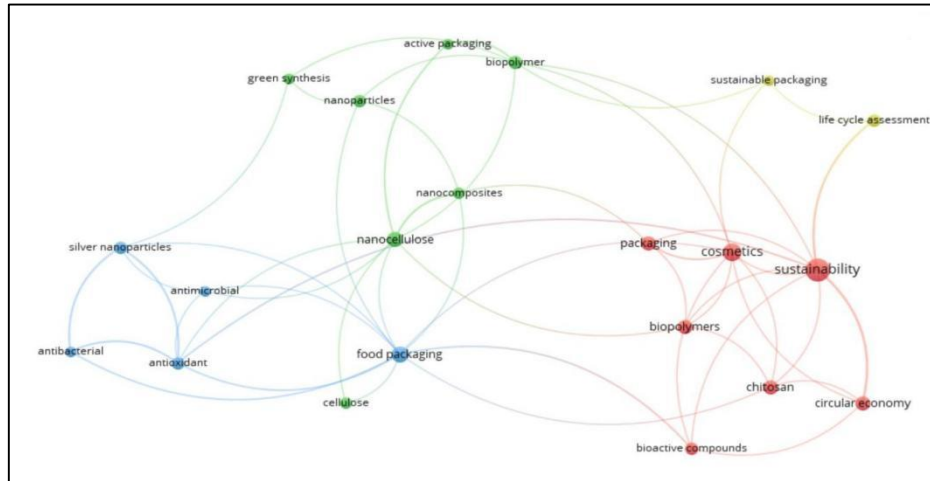

Figure 7: Co-occurrence of author's keywords Source *Scopus* data analyse by VOSviewer

The frequency of keywords discovered in the article's titles is seen in this plot Figure 8. The most common keywords, "Packaging," "Green," and "Sustainable," indicate an emphasis on ecologically friendly methods. "Food" and "Cosmetics" are likewise among the top 10, with frequencies of 21 and 22, respectively.
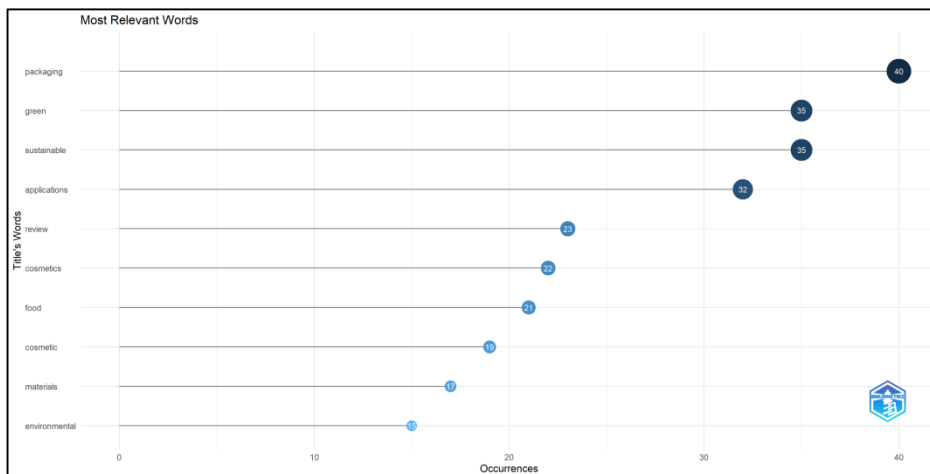
Figure 8: Highest frequent title keywords Source *Scopus* data analyseby Biblioshiny

Figure 9 depicts the various keywords that are used in the articles related to sustainable packaging in cosmetics. This treemap shows different keywords along with their frequency of occurrence and the percentage of the occurrence. According to this tree map, "Sustainable development" is the most frequently used keyword and contributes 5 % in total. Whereas,

"Packaging Material" contributed 5% of the total keywords used. Cosmetic, Food Packaging, and Packaging are the next frequently occurring words which are contributing 4% followed by words like chemistry, articles, and cosmetics behavior are contributing only 3%.
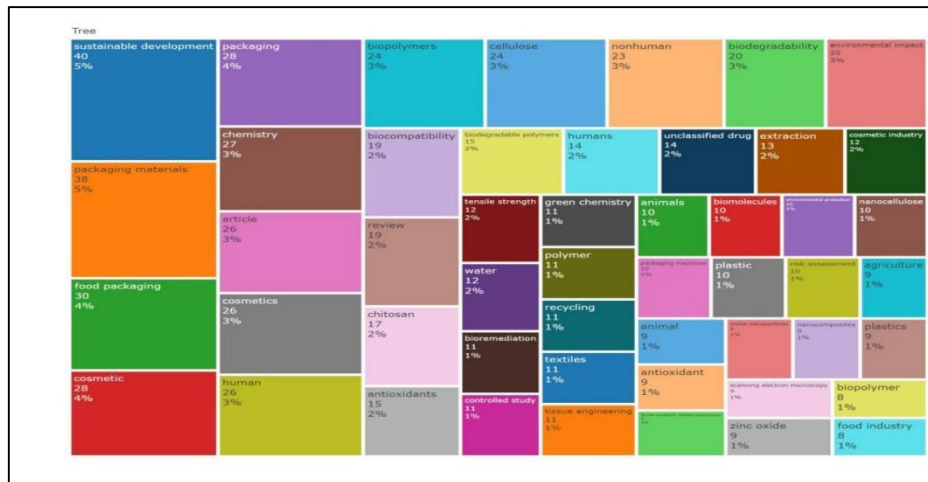

Figure 9: Highest frequently used keywords Source *Scopus* data analyse by biblioshiny

5. Discussion

5.1 Common factors from literature review related sustainable packaging in cosmetics

A. Sustainable Development

Global well-being and social, environmental, and economic sustainability are the goals of the 17 Sustainable Development Goals (SDGs) that the UN has proposed. SDGs 3, 6, 7, 8, 9, 12, 14, and 13 are specifically focused on reducing the effects of waste management, water pollution, and climate change. These goals are pertinent to the growth of a more ecologically conscious and sustainable cosmetics sector (Chen et al., 2020) Cosmetics packaging disposal is a topic covered in SDG 12. Notably, goal 12.5 seeks to significantly lower trash creation by 2030 through reuse, recycling, reduction, and avoidance. Waste production and the preservation of marine habitats and terrestrial biodiversity are the main topics of SDGs 14 and 15. Since both SDG 3 and the cosmetics sector prioritise human health and well-being, with an emphasis on personal care, body maintenance, and cleanliness, they are closely related (Lyrio et al., 2011). Additionally, new water-efficient methods for making cosmetics have surfaced,

advancing the industry and helping to achieve SDGs 6, 12, and 13. The SDG 9 "Industry, innovation, and infrastructure" seems to be in the greatest position to connect to the other goals that include combining efforts related to the cosmetics sector. SDGs 7, 8, 9, 12, 13, and 14 have been addressed by the cosmetics industry's growing investments in clean technology and innovative production techniques. It is also possible to bring up SDG 8, which specifically aims to support equitable, sustainable, and long-term economic growth. In order to raise awareness, encourage innovation, and spread best practices, a number of additional activities are geared towards businesses and consumers (Almeida et al., 2017).

B. Life cycle assessment:

Environmental, social, and economic sustainability are all impacted by the creation of manufactured goods (Bom et al., 2019; Cosmetics Europe, 2012). The product is created during the development and design phase, which is followed by the raw material and ingredient selection, manufacturing, packaging, transportation, distribution, retail, consumer usage, and post-use phases. A cosmetic product's sustainability is determined during the design phase, which is the first stage of its life cycle and has an impact on all others (Cosmetics Europe, 2012). Nowadays, hundreds of cosmetic businesses include sustainability into one or more stages of their products' life cycles. For instance, major players in the cosmetics industry like Garnier and L'Oréal implement sustainability throughout the product's whole life cycle. However, the sustainability of their goods is not just being addressed by large beauty corporations.

C. Consumer Attitude

When forming consumer attitudes, knowledge was seen as a crucial component (Ajzen and Fishbein, 1977). Individuals with strong pro-green views had a deeper understanding of green cosmetics, including precise measuring criteria and integrated consumer definitions. Stronger supportive attitudes would result from increased desire for environmental advocacy and green consumer behaviour (Aria and Cuccurullo, 2017). 48% of the survey sample strongly agreed that green cosmetics are more environmentally friendly than conventional cosmetics, indicating that Bahraini women generally have a good attitude towards using them (Csorba and Boglea, 2011).

Australia's environmental attitude towards plastics was also examined by Dilkes-Hoffman et al., 2019. Understanding the negative environmental impacts of plastics is linked to the desire expressed by 80% of respondents to use fewer of these materials. Customers are increasingly viewing the improper use and disposal of plastic bags and packaging as an environmental issue (Filho et al., 2021). Overall, it is frequently discovered that the most crucial element in avoiding plastic is having a frugal attitude towards the environment (Elgaaïed-Gambier, 2016).

D. Cosmetic Packaging

Packaging decisions might affect how customers behave depending on their ethical and environmental beliefs. Martinho et al. (2015) emphasise how important the packaging sector is to protecting the environment and how eco-friendly packaging innovation may help strike a balance between environmental advancement and economic growth. According to Van Birgelen et al., consumers' perceptions of brands and propensity to buy are influenced by ecologically friendly packaging. Consumers today are becoming more conscious of the environmental effects of the packaging used for commonplace goods (Magnier and Schoormans, 2015).

Studies are looking at whether there is an urgent need for herbal cosmetics rather than chemical ones, as part of the growing green consumer trend of purchasing zero-waste items like cosmetics (Muralidhar et al., 2023). Consumers now want green cosmetics or zero waste goods, which are regarded as an individual's environmentally conscientious decision (Kautish et al., 2022). The goal of zero-waste cosmetics is to produce as little trash as possible over their entire existence. This entails using compostable or biodegradable materials, reducing or doing away with packaging, and implementing environmentally friendly production techniques. Therefore, it's likely that product packaging might encourage young people to purchase cosmetics.

E. Socio-demographics

Purchase decisions for plastic may be influenced by a variety of sociodemographic characteristics. For instance, those with higher levels of education tend to refrain from buying plastics (Madigele et al., 2017; Zambrano-Monserrate and Alejandra Ruano, 2020). The greater significance of environmental sentiments in this group may be linked to this (Heidbreder et al., 2019). Numerous studies have revealed that women are also less likely to purchase plastic

packaging or bags (Heidbreder et al., 2019), highlighting the influence of gender on decisions about environmentally friendly purchasing (Borg et al., 2020). Another contradicting element is age; some research suggest that older individuals are more inclined to use less plastic (Afroz et al., 2017), while other studies find that younger people are more dedicated to making environmentally responsible purchases (Heidbreder et al., 2019; Elgaaïed-Gambier, 2016). The study's findings only partially supported the idea that family size, education level, gender, and age all contribute to lower use of plastic-packaged goods (Gustavo et al., 2017). Since sociodemographic traits are typically seen as key contributors to variation in terms of preferences and choices, they are commonly employed to characterise sustainable customers.

5.2 Discussion as per Bibliometric Analysis

When it comes to solving present and upcoming sustainability issues, the field of sustainable packaging is crucial. Within this framework, the subject of environmentally friendly packaging in the cosmetics sector is presently receiving increasing attention. This bibliometric analysis examined how the area of cosmetics has evolved over the last ten years (2013–2024), identifying trends as well as authors, working groups, nations, and publications that are particularly noteworthy in this regard.

Research on sustainable packaging for cosmetics increased throughout the course of this publication, particularly in 2020, which led to increased publishing activity. From 2013 to 2024, the average annual growth rate is 8.01%.

In terms of the number of papers published, "Polymers," "Molecules," "International Journal of Biological Macromolecules," "ACS Sustainable Chemistry and Engineering," and "Cosmetics" were the top five journals. Ranking adjustments may be discernible based on key performance measures such as evaluated publication and citation statistics. Accordingly, "Polymers" seems to be the most active journal in terms of the quantity of articles as well as local indices, such as the G index (8) and H index (6). Conversely, the "International Journal of Biological Macromolecules" has accumulated the greatest number of citations (1037) in total.

About the contributing authors and documents, it was shown that the document "Chitosan as a bioactive polymer: Processing, Properties and Applications" by (Muxika et al., 2017) has the highest total citations (736).

Spain was found to have the most citations geographically, followed by Italy, China, the United States of America, and India. Nonetheless, these are the top-ranked universities with the greatest number of publications in the area of environmentally friendly cosmetic packaging, the Joint Research Centre, University of Dhaka, University of Messina, and Istituto Italiano di Tecnologia have demonstrated significant activity in the Scopus database.

Examining the study subjects, namely the most commonly used author and title keywords, it is evident that the focus was on the circular economy, sustainability, packaging, cosmetics, bioactive chemicals, biopolymers, and chitosan. Only 21 out of 827 author keywords appeared five or more times, according to the results of the VOSviewer overlay visualisation of the co-occurrence of author keywords. "Sustainable development" is the most utilised term, contributing 5% overall, based on this tree map.

6. Suggestions on future research and gaps

The study discovered a strong correlation between environmental science and marketing, as well as sustainable packaging. As a result, future studies should be done in conjunction with environmental science and marketing. There is a lot of research focusing on nations like China and fewer studies on emerging nations. Thus, research in the future will focus on developing nations like India and other Asian nations.

While there are collaborative works in literature, the majority of them are produced by wealthy nations in partnership with developing ones. In order to narrow the knowledge gap, industrialised and developing nations should collaborate on future research projects.
The influence of sustainable packaging in the food business has been extensively studied by researchers; however, other industries, such as cosmetics, are moving towards green marketing and are less well-researched. Thus, the adoption of eco-friendly cosmetic packaging solutions should be the main focus of future study.

Numerous product-related factors and statements found in published literature have been identified by the study; yet, there is still a need to find additional consumer-related variables to increase the acceptance of sustainable packaging.
Subsequent investigations in this field will enhance comprehension of the intricate relationships between environmentally friendly packaging and customer behaviour in the

cosmetics sector, thereby informing strategies for promoting the adoption of environmentally friendly packaging solutions especially in India, as a result of the need for a better understanding of consumer knowledge and intent to buy sustainable packaging.

7. Implication of the study

Sustainability concerns are given more weight in the United Nations Sustainable Development Goals (Yasin et al., 2023), which nations must accomplish by 2030. As a result, in the future, sustainability could emerge as the primary area of research for scientists. This research addresses one of the most significant concerns that environmental issues are now confronting. This study adds to the corpus of knowledge of sustainable packaging and cosmetics by analyzing the pattern of the published articles and highlighting the key findings on this theme. This study will be beneficial for marketers, academicians, and researchers as the study reveals various insights that will help to find out the research gap and conduct study to fill this gap. They should get overall knowledge about existing studies in this area. The results of the most relevant Journals will help researchers to target the most cited journals for publication of their articles as well as the findings of top institutions and top authors will help the researchers to make collaborations with the Institutes and the authors who are doing wonderful work in this domain. The result of the top articles published in this domain will help the researchers in making the base for further research.

8. Conclusion

The application of bibliometric analysis can provide insights into the creation of collections, characterise the citation patterns and strengths of institutional scholarship, and identify observable networks of schools of thought that are co-cited. The research trends, theme development, and significant studies on sustainable packaging for cosmetics have all been visualised in the current study. The largest database of biographies, Scopus, was used for data extraction and analysis. The research methodology and themes of sustainable packaging in cosmetics for various periods have been provided in the paper. The path of sustainable packaging in cosmetics has been explored in this paper, along with potential paths for further research for academics. Academics might research the newly emerging field of sustainable packaging, which could give practitioners and policymakers more insightful information. In this sense, the current study has aided in the knowledge of the direction, growth, and advancement of research. The bibliometric examination of biographical information retrieved

just from the Scopus database is the extent of this work. Since many high-caliber articles are only included in one or the other of these databases, combined bibliographic data from Scopus and Web of Science may be used in future research. Furthermore, to comprehend the research paradigm from publications of high quality, future studies may use bibliometric analysis on publications published on SCI, SSCI, and ABDC lists.

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