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Systematic Review

Advancing Toward Sustainability: A Systematic Review of Circular Economy Strategies in the Textile Industry

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Abstract: The textile industry, fueled by the "fast fashion" phenomenon, contributes significantly to environmental, social, and economic degradation through the rapid turnover of styles, leading to substantial waste as consumers frequently discard garments. This cycle of consumption and production is linked to the social demand added to purchase income, demonstrating the urgent need for sustainable interventions. The main objective of this study is to carry out a systematic review of the literature to identify and critically evaluate circular economy strategies implemented in the textile industry. This study conducted a systematic review of circular economy strategies in the textile industry using the PRISMA methodology. Our search spanned a ten-year period, examining 88 articles, from which 55 were selected as pertinent. The primary strategies identified include reuse, recycling, repair, and reduction, each of which is assessed through environmental, social, and economic lenses. Reuse is crucial for reducing impacts and waste, yet it is hampered by insufficient consumer incentives. Recycling shows promise but is hindered by technological and awareness barriers. Repair contributes to extending the lifespan of garments, thereby reducing the need for new production, although it encounters challenges in terms of service accessibility and consumer knowledge. The reduction involves the search for better and more sustainable materials, with the main barrier being the fast fashion. The findings suggest that reuse is not only economically viable but also capable of lessening social inequality. Recycling, however, necessitates substantial investments and the development of supportive policies. Repair, on the other hand, significantly lessens the environmental impact and can spur new economic opportunities and employment. Despite these hurdles, these strategies present viable pathways toward a more sustainable textile industry. However, achieving this requires a paradigm shift in both consumer behavior and corporate practices to embrace and optimize circular economy practices within the sector.

Keywords: circular economy; textile industry; sustainable fashion; sustainability

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1. Introduction

The textile industry, widely recognized as a major source of environmental impact, is at a critical juncture due to the phenomenon of "fast fashion". This concept refers to the rapid turnover of product designs and materials aimed at influencing consumer preferences and increasing short-term sales. This trend accelerates the product life cycle, often reducing the useful life of garments and contributing to an unprecedented accumulation of textile waste [1,2]. Some estimates suggest that over 100 million new garments are produced globally, of which 92 million end up in landfills mixed with other waste [3]. Furthermore, according to 2020 data from the European Environment Agency [4], textile consumption in the European Union generated the third largest demand for water and land and was responsible for the fifth largest use of raw materials and greenhouse gas emissions.

This practice, driven by the constant demand for new styles, not only increases excessive production and consumption but also poses significant challenges to waste management and environmental sustainability, as highlighted in the Brundtland Report [5]. In this context, the adoption of circular economy strategies has emerged as a promising approach to mitigate these impacts, focusing on alternatives to extend the lifespan of garments and reduce waste.

Research on alternative management options for garments and waste from textile production is encouraging. For instance, Shirvanimoghaddam et al. [6] suggest that waste reduction amidst dynamic trend changes can be achieved through the creation of second-hand markets. On the other hand, Arnold et al. [7] emphasize that achieving a circular economy should not be limited to the final stages of a product's life cycle but requires the involvement of textile companies to implement effective and sustainable business models based on circular economy strategies. Hinkka et al. [8] explored the textile-to-textile recycling process, which focuses on transforming discarded fibers into new materials for creating new garments. However, recycling requires constant investment and updates in fiber recovery technologies [9]. The applicability of these options is not always replicable in all countries. It is essential to understand people's opinions, spaces, and attitudes, as well as their perceptions of establishing second-hand clothing businesses, and to encourage communities to participate in actions involving the donation and reuse of such items [10]. Even at the international level, there are regulations that seek to embody these waste management options, such as the new EU circular economy action plan, which seeks to promote durable, reusable, and recyclable materials in clothing manufacturing [11].

Thus, the relevance of conducting a systematic review to collect, analyze, and discuss information from other studies lies in recognizing the options for applying circular economy strategies in the textile industry and identifying the phase in which they occur. These strategies are analyzed from the three pillars of sustainability—economic, social, and environmental—generating valuable information for decision-making and policy formulation while also highlighting the barriers that still exist to the replicability of each strategy. The challenges associated with the textile industry are not limited to end-of-life waste management. There are still areas that need to be explored to promote the application of strategies for the use of textile waste. Currently, pre-consumer waste, which includes all pieces of fabric and threads generated during the cutting and making of garments [12], has already been studied for its use in new products, such as cleaning cloths or spinning new materials [13].

This aspect has received limited attention in the scientific literature over the past decade. Haq & Alam [14] identify a notable gap in existing knowledge, highlighting the lack of a detailed assessment that contemplates the variety, dimensions, total volume, quality, and potential for reuse of these pre-consumer wastes. Consequently, they propose that these materials could be directed toward the production of smaller items, such as children's clothing, optimizing their use, and contributing to environmental sustainability.

Taking the above into account, there is a highlighted need for deep inquiry into the realm of the circular economy within the textile industry. From the literature review conducted, there is a notable absence of systematic reviews specifically dedicated to examining circular economy strategies with sustainable development goals or that limit their scope to assessing particular management techniques for reuse and recycling [15]. However, there is a lack of research on the predominant circular practices in the textile industry and their impact on the economic, social, and environmental dimensions. As stated by Kirchherr et al. [15], "the circular economy has emerged as a concept to support sustainable development, yet empirical research and systematic reviews are still in their infancy, particularly in specific sectors such as textiles" [16]. However, there is insufficient research on the main circular practices in the textile industry and how they affect the economic, social, and environmental dimensions.

Identifying this research gap underscores the pressing need to conduct a systematic review that not only compiles and synthesizes circular economy strategies applied in the textile industry but also critically evaluates their effectiveness and repercussions [14]. Such a review could establish a solid foundation for understanding how these strategies contribute to the sustainability of the sector, thereby filling a significant gap in existing knowledge. In this context, the purpose of this study is to provide a comprehensive view of the implementation of circular economy principles in the textile industry, emphasizing the positive aspects that promote more sustainable practices.

Therefore, the main objective of this study is to carry out a systematic review of the literature to identify, manage, and extract data on circular economy strategies implemented in the textile industry, followed by a selection of studies, data analysis and interpretation, and presentation of results. To achieve this purpose, the following research question is formulated:

RQ1: *What are the main circular economy strategies applied in the textile industry? What do these strategies mean in the context of the transition toward a circular textile sector?*

2. Methodology

To ensure a clear and structured methodology that reflects the rigor of this study, the research process is organized as follows (Figure 1):

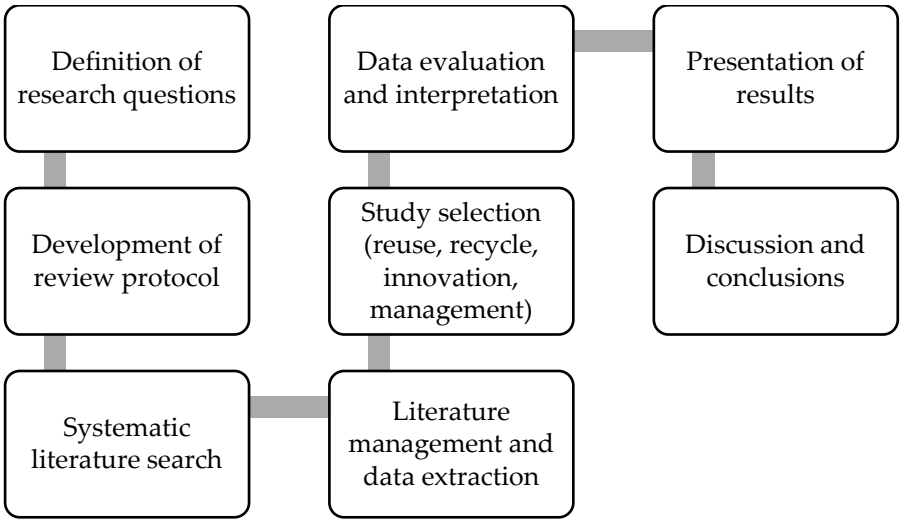

Figure 1. Applied Methodology. Own elaboration.

This research employs a systematic review of the literature using the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), ensuring reproducibility according to the described methodology and allowing for a rigorous analysis of scientific studies that exclusively address the research question posed.

Thus, this study uses the PRISMA methodology for a systematic literature review (Figure 2) of circular economy strategies applied in the textile industry as a tool to answer the posed research question.

2.1. Inclusion Criteria and Article Selection

The databases used for the literature search were Scopus and Web of Science, which were selected due to their broad coverage of the most relevant and indexed journals in the field. Studies have shown that Scopus and Web of Science provide comprehensive and high-quality literature suitable for systematic reviews [17–21]. The search employed the following keywords and Boolean operators: "circular economy" AND "textile industry". Additionally, the search was limited to ten years, from 2014 to 2024, yielding 437 potential articles. This timeframe was chosen because the concept of a circular economy has gained

significant momentum and widespread recognition in the past decade. Notably, the circular economy began to emerge as a significant focus in sustainability studies and policies in the early 2010s [16,20], making this period highly relevant for our review.

First Stage of Selection: This initial stage focused on establishing criteria for language and type of publication. Studies were exclusively in English and were strictly articles. With this criterion, the number of articles was reduced to 256.

Second Stage of Selection: The aim of this stage was to ensure that the selected articles addressed the central theme and research question and that they were case studies rather than reviews. To achieve this, a thorough examination of each article's title, abstract, and conclusions was conducted. This evaluation process reduced the number of articles to 71.

Third Stage of Selection: This phase involved a meticulous assessment of the methodology, results, and findings presented in each article to ensure that they provided substantial insights into circular economy strategies and innovations applied in circular business models within the textile industry. This rigorous evaluation yielded 55 articles (Scopus: n = 45; Web of Science: n = 10).

2.2. Quality Appraisal and Data Extraction

To ensure the quality of the studies, the articles were evaluated using the Critical Appraisal Skills Programme (CASP), whose purpose is to elevate the level of analysis in three aspects: quality, reliability, and study design. CASP provides an evaluation of the research methodology, sampling, data analysis, and presentation of results [22].

Each article was evaluated based on the following parameters described in the CASP criteria: methodological rigor, validity of the results, appropriateness of the statistical methods, and clarity. This analysis allowed the classification of the 55 reviewed articles into three quality groups: low, moderate, and high, as has been carried out in studies of this type [22]. Through this exhaustive evaluation process, the credibility, applicability, and replicability of the included studies were ensured, while also validating the methodology of the present systematic review.

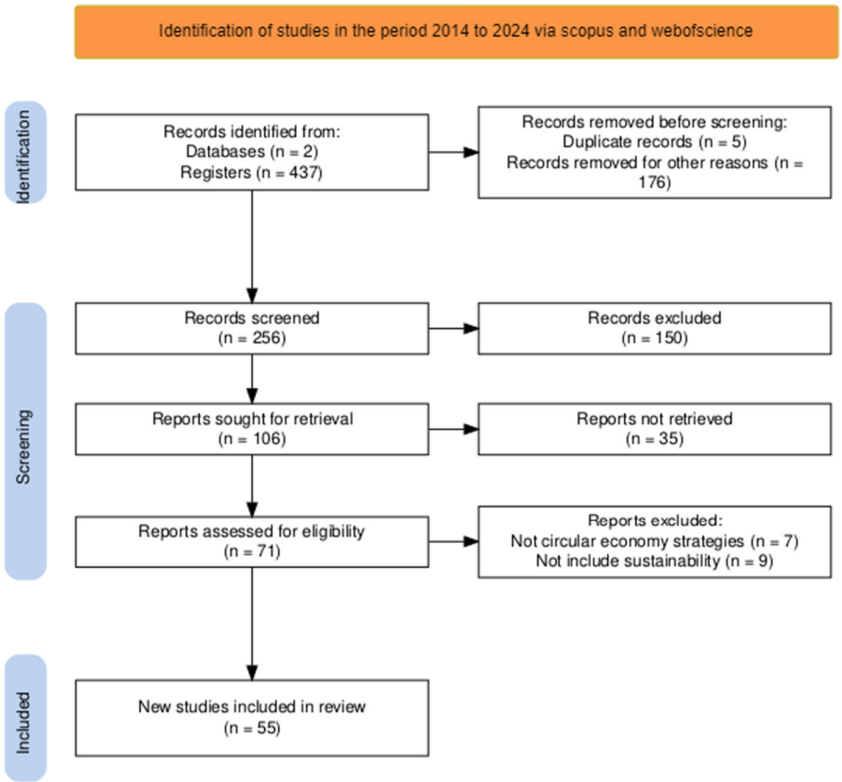

Figure 2. PRISMA Flow Diagram for Systematic Literature Review (adapted from Haddaway et al. [23]). Own elaboration.

2.3. Analysis of Data

The data retrieved from the review of the articles were analyzed in two main ways:

First, the VOSviewer software 1.6.19 was used. To conduct a qualitative analysis of the final selection of articles (n = 55), the VOSviewer tool was used to visualize and analyze information networks, such as keyword networks, to understand the connection between the proposed base keywords (circular economy, textile industry, strategies) and various related themes. An analysis of keyword co-occurrence within the software was performed, which allowed the relationships between key terms to be identified and visualized on a network map. After obtaining the map, it was analyzed and broken down into groups to identify and justify which circular economy strategies are applied to the textile industry.

Second, once the information was compiled, an analysis and interpretation of the data were conducted. This involved identifying the productivity of articles by country, focusing on the application of circular economy strategies. Due to the exclusive use of Scopus, the assessment of their environmental, social, and economic impacts is limited by the scope of the indexed literature within this database. The results were presented graphically, and a detailed discussion was conducted to provide the context and explanation of the data extracted from the 55 selected articles. Finally, pertinent conclusions derived from the presented information are included.

3. Results

In this section, we delineate key strategies such as reuse, recycling, and repair, among others, and delve into their practical application, scope, and purpose from environmental, social, and economic viewpoints. Based on a systematic review of relevant studies, these findings provide a comprehensive overview of the effectiveness of practices such as reuse, recycling, and repair, highlighting how these strategies contribute in certain aspects to sustainability in this sector.

Through this analysis, we aim to bridge the gap in the literature concerning the comprehensive evaluation of circular economy strategies in the textile context. We present a detailed overview that highlights the main circular economy strategies applied in the textile industry, focusing on their potential to reduce adverse environmental effects and generate social and economic benefits. This overview provides significant insights into the effectiveness of these strategies within the scope of the research question.

Table A1 compiles the 55 articles selected for this review, providing a summary of their contributions to the study of the circular economy in the textile industry. It details the circular economy strategies explored, the research methodology employed, and the environmental, social, and economic impacts and considerations addressed in each study.

The analysis of the selected bibliometric data was based on a detailed selection in the CAPS checklist, with three assessment points to mark the robustness and validity of the most relevant findings produced by the Scopus and Web of Science databases. The classification of the studies shown in the last column (Table A1) was based on an evaluation of the methodologies and results, strictly following a checklist. The studies were classified as moderate quality since the methodology design met an adequate design, which involved retrieving information from the context and designing a model for data collection. The only reason it is not classified as a high-quality article is that the method description may not be entirely replicable and may serve as a basis for other research. Additionally, high-quality studies that presented comparative results focused on validating the presented data.

3.1. Geographic Context

The significance of the geographic context in researching circular economy strategies in the textile industry is crucial for understanding the variability and effectiveness of practices adopted in different regions. Figure 3 offers a clear overview of the contribution by country in this field of study, allowing us to recognize some of the countries in which the study of the implementation of circular economy practices in the textile industry has focused.

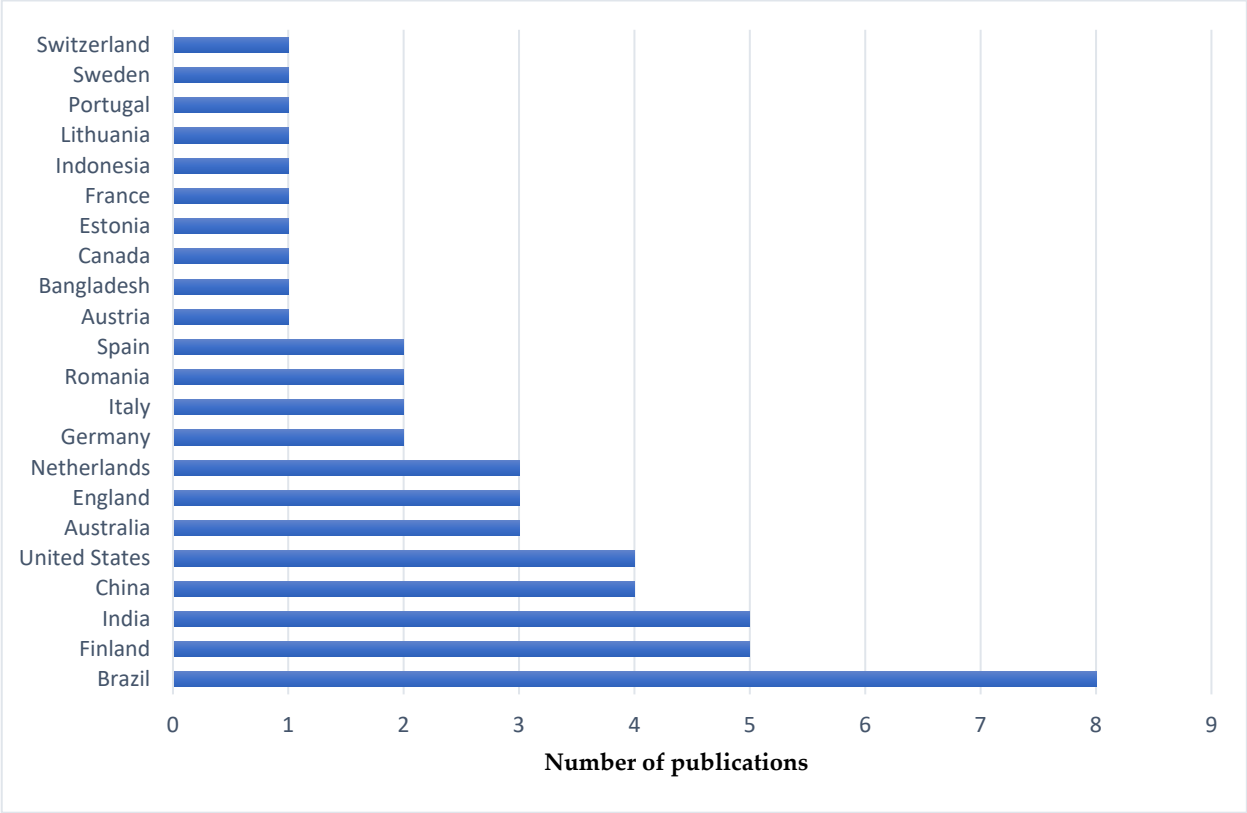

Figure 3. Contributions by country in studies of circular economy strategies applied to the textile industry. Own elaboration.

Analyzing the case studies of the 55 articles reviewed, Figure 3 was developed, where it was found that most studies related to the application of circular economy strategies in the textile industry were from Brazil. This is explained by data from the Brazilian Association of Textiles and Apparel, which considers the Brazilian textile industry to be one of the main suppliers of inputs and fabrics. Therefore, its contribution to the application of strategies, such as reuse and recycling, is mainly for the same reason. National agreements have begun to address the excessive use of inputs demanded by this industry [24].

In 2023, BVRio, in collaboration with the Circular Plastics in the Americas Program (CPAP), published a report entitled "Sustainable Textile and Apparel Industry: Main Challenges of Circularity in Brazil", with the aim of generating a progressive change in the Brazilian textile sector. This report motivates local industries to provide, first, official and transparent data on their production; second, to invest in textile management technologies for their recovery and subsequent recycling; and third, to promote business models that support sustainability, such as the sale of used items and repair, resale, and rental [25].

Another country that was found to contribute significantly to research on circular economy strategies is Finland, despite its limited resources and small geographical area. This commitment is exemplified by the adoption of specific policies and programs such as "Bio & Circular Finland" by Business Finland, reflecting a proactive and conscious approach toward the circular economy [26].

Other countries, such as India, China, and the United States, have also demonstrated substantial research activity, indicating a growing global interest in exploring and implementing sustainable practices in the textile industry.

The variability in the number of studies across these countries may be influenced by economic factors, resource availability, government policies, and levels of social awareness. Korsunova et al. [27] mention that CE in underdeveloped countries is reflected as a need to address a problem, exemplifying it with the case of reuse and repair of a product, with the

purpose of prolonging its value, so this statement could reflect those developing countries and the presence of an informal sector, are interested in looking for options to extend the useful life of a product.

This geographical distribution underscores the importance of tailoring circular economy strategies to local and regional contexts, taking into account the unique characteristics and challenges of each country. Additionally, it highlights the potential for knowledge transfer and sharing of best practices among countries.

3.2. Circular Economy Strategies

Figure 4 presents a co-occurrence map of keywords that illustrates the interconnection of themes within the research on the circular economy in the textile industry. The analysis identifies three main clusters that represent focus areas in the compiled studies. The blue cluster, the densest, symbolizes "circular economy", a central hub closely linked with "sustainability", highlighting how these concepts intertwine with "reuse" and "recycling". These latter themes emerge as crucial pillars within the cluster, emphasizing their importance in the current literature, which is why they are perceptible in the figure, unlike other strategies. The green cluster, centered on the "textile industry", shows that this is the field of application where these circular economy strategies are implemented in concrete case studies. This visual map highlights the two main strategies, reuse and recycling, as fundamental pathways in the transition toward a sustainable production and consumption model in the textile sector.

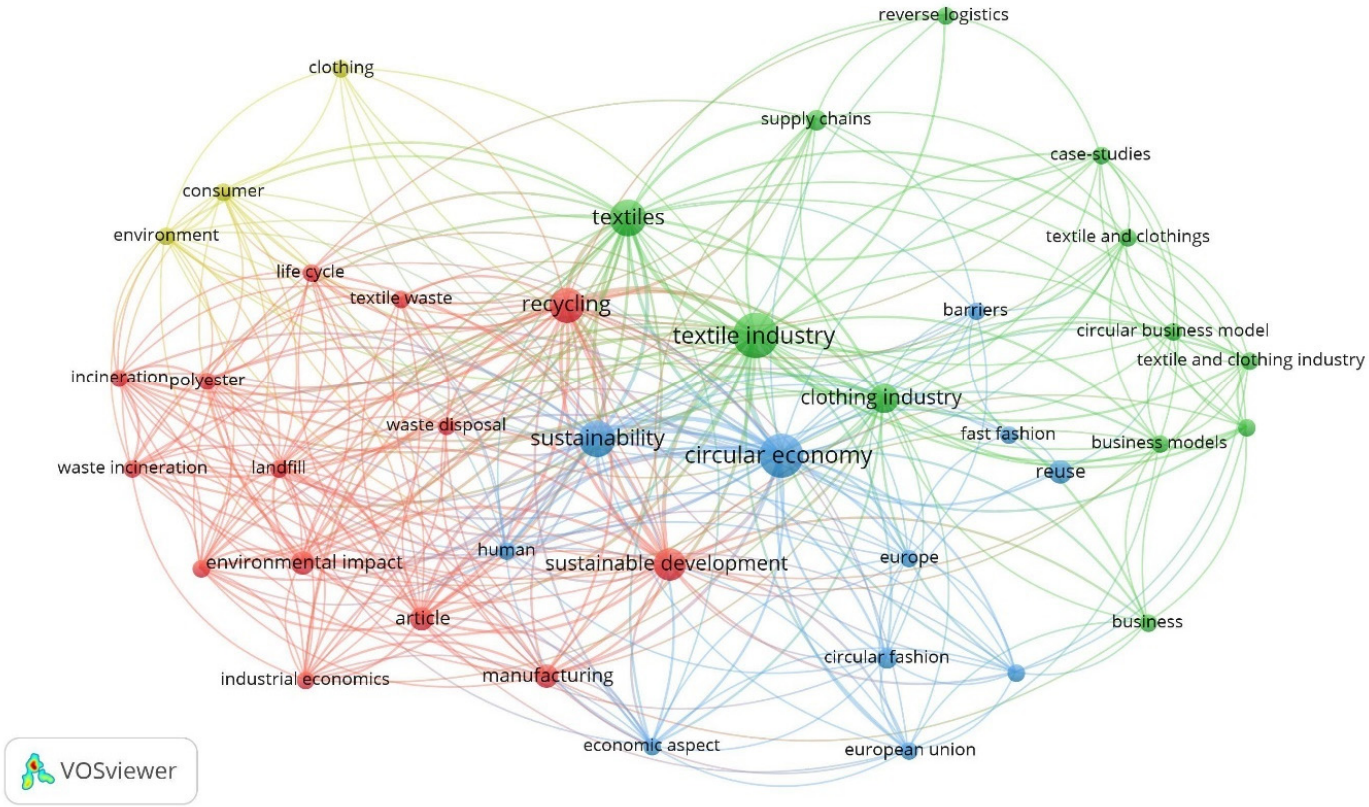

Figure 4. Co-occurrence map of keywords corresponding to the reviewed articles. Own elaboration using VOSviewer.

Figure 5 shows that the circular economy strategies examined in the literature focus predominantly on recycling, representing 45% of the studies' emphasis. Reuse also holds a prominent position at 35%, indicating its fundamental role in transforming textile waste into useful resources. Repair, although to a lesser extent, is considered in 7% of the articles, underlining its importance in extending the lifecycle of textiles. With 5%, the reduction highlights the need to decrease resource use from the beginning of the production

process. Finally, strategies such as reprocessing at 3% and redistribution, return, recovering, upcycling, and eco-design, although less common at 1% each, indicate an emerging area of interest that could lead to new pathways for enhancing sustainability in the textile industry.

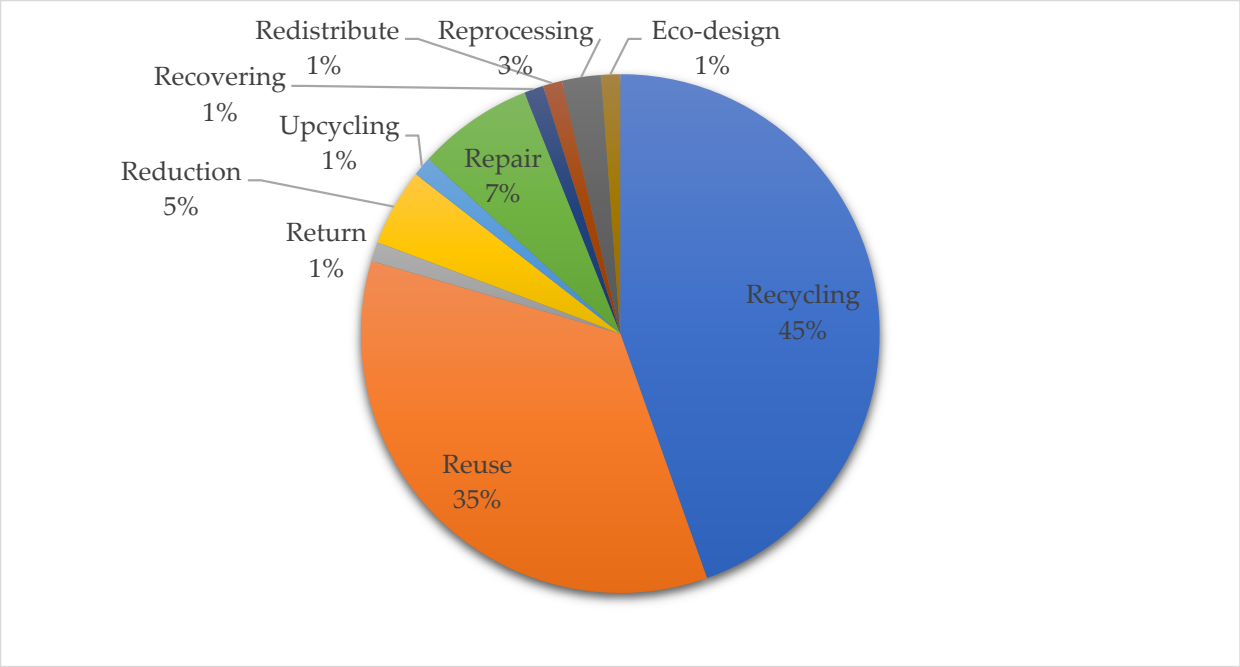

Figure 5. Circular economy strategies addressed in the reviewed articles. Own elaboration.

3.2.1. Recycling

Regarding recycling, the reviewed studies by Arnold et al. [7], Coppola et al. [28], Furferi et al. [29], Ta et al. [30], Repp et al. [31], Degenstein et al. [32], and Kamble & Behera [33], demonstrate that this strategy is predominantly implemented in garments that have reached the end of their lifecycle. The purpose is to transform discarded textiles into new raw materials that can re-enter the garment production cycle. To achieve this, significant adjustments and costly investments in the production infrastructure are necessary, which may include advanced recycling technology and process reengineering to accommodate recycled materials.

Several European countries, particularly Finland, Italy, Germany, and Switzerland, have adopted recycling as a cornerstone of their circular economy policies. Their leadership in implementing these strategies can be attributed to their early recognition of the importance of a sustainable economy, as demonstrated by their commitment to initiatives like the "Circular Economy Action Plan" proposed by the European Parliament in 2020 [34].

These nations have laid the groundwork for comprehensive policies that not only advocate the recycling and reutilization of textiles, but also promote innovation and long-term sustainability in the textile industry.

3.2.2. Reuse

Reuse stands out as a central strategy in the circular economy in the studies analyzed, including those by Shirvanimoghaddam et al. [6], Haq & Alam [14], Fiori et al. [35], Horn et al. [36], Persson & Hinton [37], Reike et al. [38], Schmutz & Som [39], Jain et al. [40] and Lombardi Netto et al. [41]. This approach is prioritized due to its efficiency in leveraging existing materials in the textile industry, allowing for their direct reintegration into productive cycles. Unlike recycling, reutilization typically requires lower technological investments and does not demand significant changes in existing production processes, facilitating the transformation of discarded or unused products into valuable resources for the creation of new products.

The evidence found in the reviewed studies points to a broad application of reutilization, not only concerning pre-consumption materials, which are remnants generated during garment manufacturing, but also post-consumption products, such as clothing that has reached the end of its life cycle and fashions that have become obsolete. This strategy not only contributes to waste reduction and resource savings but also encourages more conscious and responsible consumption, prompting both the industry and consumers to consider the full lifecycle of textile products.

3.2.3. Repair

Repair emerges as an integral strategy in the circular economy paradigm within the textile industry, not only extending the lifespan of garments but also fostering a culture of care and appreciation for clothing. The consumers' decisions to opt for repair instead of disposal are crucial in this process, turning them into active agents of sustainable change. Often, these repair services are provided by specialized third parties, opening up a field of specialized employment that extends beyond original manufacturing. This dynamic has the potential to revitalize traditional and artisanal techniques, adapting them to the modern context, and creating a more robust community around sustainable fashion. Repair not only revalues garments but can also inspire donation practices and the flourishing of second-hand markets, which play a vital role in the circular economy [37].

3.2.4. Reduction or Rental

As for reduction, this strategy goes beyond merely decreasing production; it is a commitment to quality over quantity, encouraging practices of conscious consumption, and the selection of more durable and repairable materials. Reduction can manifest in the adoption of design practices that facilitate the recyclability or repairability of garments, as well as in innovative business models such as clothing rental, which offers consumers access to fashion without the need for permanent ownership. This approach not only saves resources like water and energy but also challenges the fast fashion mindset, promoting a shift toward a textile industry that prioritizes sustainability at every stage of the product lifecycle [36].

3.3. Scale and Scope of Studies

Of the studies reviewed, two levels of application were identified: macro- and microscale. Although, among the previous levels, it is important to highlight what some studies address as the meso level that involves the relationships and alliances between companies to achieve circular economy strategies, for this review, it was classified only in micro and macro according to the application of the strategy, only to dimension in which area of the textile industry the importance of the circular economy is most analyzed. Of the 55 articles analyzed, the majority had a large-scale approach; that is, the solution and application of strategies were oriented toward a case study within the textile industry in a country. Figure 6 shows the distribution of the level of the industries to which the strategies are applied. The reason why 67% of the studies focus on this dimension is because regulations are strict for this type of producer, and in most of the case studies, they focus on industrialized countries, which have the necessary infrastructure for large-scale production, even for the export of this type of item.

The remaining 33% corresponds to studies focused on a micro dimension, which includes municipal production and small-scale manufacturing, among others. The justification for there being fewer studies on small productions is that, in most of these producers, their services are linked to the production demand of their consumers, and in other cases, they focus on creating business opportunities that take advantage of waste from other businesses for the production of smaller items. Therefore, their strategy is linked to reuse due to the volume of waste generated compared to a large-scale producer.

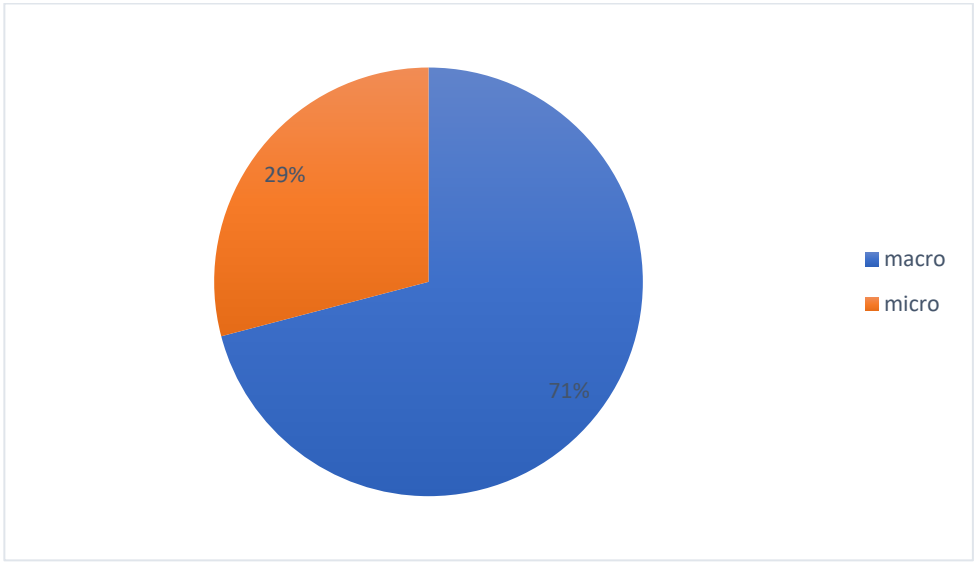

Figure 6. Distribution of the level of the textile industry to which the reviewed articles are applied. Own elaboration.

3.4. Environmental, Economic, and Social Perspective

Sustainability in the Circular Economy (CE) is a multidimensional theme reflected in the specialized literature, focusing on the environmental, social, and economic benefits these strategies can provide. Figure 7 shows the percentage of articles reviewed that address the three previously mentioned benefits. In the environmental realm, 38% of the reviewed articles highlight the contribution of the CE to resource conservation and the reduction of waste volume generated, as well as the mitigation of environmental pollution. These studies delve into how CE strategies can reduce the ecological footprint of the textile industry by optimizing the use of raw materials and valuing waste, and assessing their impact on greenhouse gas emissions and soil and water pollution.

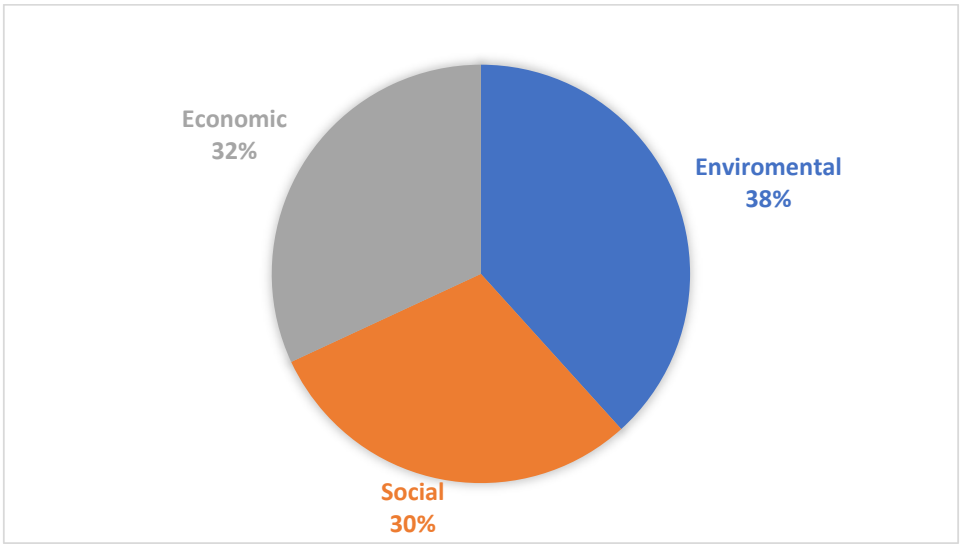

Figure 7. Percentage of economic, social, and environmental benefits addressed in circular economy strategies in the reviewed articles. Own elaboration.

Regarding the economic dimension, which constitutes 32% of the research body, the ability of the CE to promote greater economic equity is highlighted. Studies like those by Persson & Hinton [37] suggest that the implementation of practices such as second-hand clothing markets can be particularly beneficial for vulnerable communities, promoting job

creation and offering goods at more affordable prices. Concurrently, Majumdar et al. [42] point out that the economic advantages of CE can also be manifested in the form of financial incentives that reward sustainable practices, such as the recovery and reuse of textiles.

The social aspect, covered in 30% of the articles, emphasizes the generation of social value as a direct result of implementing the CE. Here, the literature indicates that the CE can significantly contribute to community well-being by supporting job creation, promoting equality and transparency, and improving working conditions, as reported by Jain et al. [40]. Additionally, the importance of consumer engagement in revaluing garments that, although considered obsolete, can re-enter the cycle of use, thus strengthening community and social awareness regarding responsible consumption, is emphasized.

4. Discussion

This analysis aims to offer a renewed and complete perspective on circular economy practices in the sector, especially regarding the application of the identified strategies and their impact on the three dimensions of sustainability. Therefore, it must be clarified that the circular economy does not fully imply influencing each of the three dimensions since it depends on other factors. Although it can comply in the environmental aspect with the conscious use of materials and the recovery of waste, or in the economic aspect with the creation of markets, it can be more difficult in the social aspect since it depends on issues that involve cultures, social justice, and issues of labor equity since sometimes these points of social behavior are not directly addressed during the approach of the circular economy. Thus, this analysis will be carried out in a detailed manner and will be based on the analyzed documents, together with a critical opinion on the information.

From the above results, corresponding to the analysis of the 55 articles retrieved, it was found that there are some similar studies that carried out reviews, but the approach is as follows: Jia et al. [43] conducted a literature review focused on the circular economy in the textile industry. This study suggests that the main drivers for the adoption of a circular economy include increasing environmental awareness, regulatory pressure, consumer demand for sustainable products, and the search for long-term economic efficiency. In the context of the textile industry, these drivers can be translated into the search for sustainable alternatives to address the problems of textile waste and environmental pollution.

Another study by Leal Filho et al. [44] describes within its review the socioeconomic benefits of reusing and recycling textiles, recognizing successful initiatives and technological advances. It also highlights that the adoption of circular economy practices can foster innovation in products and processes, which in turn can improve the competitiveness of companies in the market.

Unlike previous studies, in this study, when reviewing the body of literature on circular economy strategies in the textile industry, several key trends emerge. First, there is an increasing focus on recycling and reuse as the most applied strategies, particularly in developed regions. However, despite their potential, these strategies are often constrained by technological limitations and consumer behavior, indicating a gap between policy initiatives and practical implementation.

Furthermore, the literature tends to concentrate on environmental impacts, with less emphasis on the social and economic dimensions of circular economy practices. This gap suggests that future research should broaden its scope to assess the holistic impacts of circular economy strategies by integrating social sustainability metrics with economic viability.

To this end, the discussion of the findings found in this review for the three main strategies identified (reuse, recycling, and repair) is presented below.

4.1. Recycling: Challenges and Opportunities

For case studies related to the recycling strategy, the focus is on converting clothing to recover components for the production of new raw materials, employing methods such as mechanical and chemical recycling.

The study by Coppola et al. [28] describes how the textile production industry can improve its processes by making minor adjustments, such as substituting certain raw materials with those of lower environmental impact to address the problem of excessive use of pesticides and water for crops like cotton, and replacing them with eco-friendly fibers designed for easier recovery for recycling. In this case, it is proposed to adapt the sourcing of raw materials to those that are easily recoverable, although this type of option is more expensive due to organic materials [30]. On the other hand, among the benefits found with this strategy is consumer approval of the company in search of products with a lower environmental impact throughout its production, in addition to categorizing the company as socially responsible and expanding its alliances with other companies that at the same time increase occupying new markets [45–48].

Complementing this, the study by Furferi et al. [29] showcases how an Italian company uses regenerated wool and lyocell, where the majority of the regenerated wool is sourced from an external company. Ecologically, this process minimizes the use of virgin raw materials for fabric production and results in lower CO_2 emissions and reduced water use. Economically, the production of these recycled materials requires advanced infrastructure that a few companies possess, and most of them are third parties specifically dedicated to regenerating textile fibers from waste. Socially, more manual labor is required for the manual classification of textile materials based on their composition and quality [31].

Analyzing recycling alternatives, the challenges or barriers to this strategy were primarily identified as the need for technologies to recover fibers and the separation of components, since most garments are composed of more than one material [33]. Another challenge is collection, as identified by Degenstein et al. [32] in their study in Canada, which recognizes that community participation in facilitating the disposal of their textile waste is due to a lack of access to recycling collection services, and furthermore, few people are aware that clothing has the potential to be recycled, becoming a cultural issue in which the population does not have access to information on the proper disposal of textile products, creating a lack of shared responsibility between the consumer and the producer. [49,50]. Leal Filho et al. [44] add other barriers to this strategy, such as the lack of technology and poor coordination, policies, and standards, meaning there is a gap in frameworks and policies that manage textile waste and its recycling.

In addition, some companies do not agree to use recycled materials because, first, they consider that they are of lower quality; second, they can be more expensive since they require their combination with virgin materials; and third, when they agree to use recycled materials, they seek to maintain price competition by manufacturing abroad [51–53]. This situation, as well as the lack of partners between recycling service providers and producing companies, creates a gap that becomes even larger with the absence of policies; the lack of knowledge about recycling, collection, and final disposal; and the low investment in technologies are the main barriers that affect all textile industry markets to continue with the linear production model and continue seeking short-term competitiveness [54,55]. Therefore, gradual changes in fiber recycling can provide better results, either for new products (closed recycling) or for new products from other industries (open recycling).

Some of the options that can be a solution are policies and regulations that involve economic incentives or tax subsidies that motivate companies to create transitions in their production, the generation of knowledge about recycling options, and the exchange of knowledge about these options with entrepreneurs; these two together will promote the creation of new markets. Meanwhile, in the case of consumers, prizes and discounts can be given to products, with the aim of causing people to participate in clothing recycling initiatives [56,57].

4.2. Reuse: Challenges and Opportunities

In the reviewed case studies, reuse is considered the second option to counteract the environmental impacts caused by the textile industry, consumer purchasing, trends, and the so-called fast fashion. It is primarily addressed from the perspective that tons of clothing

are sent to final disposal sites globally without having reached their optimal lifespan. Thus, authors like Fiori et al. [35] promote different ideas, study consumer participation to carry out actions that promote the reuse of second-hand clothing, and identify that consumer collaboration is diminished by the search for recognition or valuation of their effort to participate in actions such as donation and clothing delivery [58]. Also, Wang et al. [59] identify that the main motivations for which people use second-hand clothing are three: economic, recreational, and critical. The first is the search for an attractive and fair-priced product. The second refers to the actions of consumer satisfaction in discovering products with low prices that produce pleasure. The third refers to the question of morality, in which one seeks to fight against the waste caused by consumerism.

Therefore, to address the contribution of individuals in part, there can be proposals from the same distributing company to incentivize their clients to contribute to the return of their items identified as obsolete fashion [60].

Other studies, such as that of Reike et al. [38], conducted national tracking and analysis in the Netherlands on the stance regarding textile circularity, finding that while there is political support on the issue, the textile sector is not considered by the country as one of the main sectors of development opportunity; thus, the local government leaves open the participation of involved actors for the execution of circular activities such as mechanical recovery or chemical recycling within textile production. Identified as the only probable option is the second-hand market through online or retail resale models, online rental systems, or establishments, and although this action is not promoted by the government, it gains relevance due to the economic remuneration it can bring for those interested in selling their items or even remnants from manufacturing processes [39].

In addition to the two previous options, some studies, like that of Lombardi Netto et al. [41], analyze energy recovery from the incineration of waste. However, this type of management is considered one of the penultimate options for the reuse of textile waste, as it contributes to greenhouse gas emissions in addition to burned waste.

Thus, the first two studies represent a sample of reuse as one of the circular economy strategies that can create opportunity areas that benefit both the industrial sector and the same seller. The most viable options among those that allow reuse are clothing resale markets, which exchange clothing for discounts or money because these options promote the reuse of these items and avoid the purchase of new products [61,62].

Challenges or barriers to the implementation of reuse include the selfishness of brand companies to allow their products to be resold or even used to manufacture a different one. This can be seen as an exclusivity that large clothing markets seek to give to their items to be reused only by the same brand or by one with permissions, as analyzed by Antón Juárez [1] in his study, where he emphasizes that the problem arises when a third party uses parts of products protected by a trademark right and, without the owner's consent, adds them to other products, which can lead to a lawsuit by the original producer. This is a clear example of a barrier to the circular transition of the textile industry.

Additionally, one of the obstacles faced by reuse is the perception of the value of second-hand garments. In some cultures, there is a stigma associated with used clothing, where people prefer to acquire new products instead of second-hand garments. This may be due to deep-seated beliefs about hygiene, social status, or simply aesthetic preferences. This cultural difference can hinder the acceptance and adoption of garment reuse practices, as it influences consumer attitudes and behaviors toward used clothing [63].

One way to break these barriers is to incentivize consumers to return their garments through options proposed by the same provider or through the creation of policies that reward companies for recovering their products and subsequently applying a circular economy strategy. These include reward programs, where customers receive points or discounts for garment returns; trade-in credits that allow customers to obtain value for their used garments when purchasing new products; discounts on future purchases for returns; donation programs in collaboration with local charities; and educational campaigns that highlight the environmental and social benefits of returning garments [58].

Likewise, companies can improve their designs for durability by using unblended and recyclable materials.

If these barriers can be broken, this strategy can have benefits in all three aspects of sustainability: socially as an opportunity for economic recovery and business for people who may not necessarily be the holder of the item but a third party through donation, economically in addition to the remuneration for the sale, these options represent an affordable opportunity for lower-income people which can help reduce inequality [37], and finally environmentally several important points can be listed such as the minimization of clothing waste ending up in landfills, the maximization of product use, the recovery of raw materials for the production of other items, sustainable fashions, among others [30].

4.3. Repair: Challenges and Opportunities

Repair plays a crucial role in the textile industry due to its ability to extend the lifespan of garments, reduce waste, and foster more sustainable practices through the creativity of the repairer to maintain the aesthetics of an item [64]. Among the studies reviewed, it was found that there are repair workshops dedicated to fixing garments with minimal defects, such as zippers, buttons, and tears [65].

Among the challenges identified are the shift in consumer mindset toward a more conscious and sustainable consumption model [66], limited access to repair services, especially in rural areas or marginalized communities, and the cost and time associated with garment repair. Additionally, the quality of garments and the lack of education and awareness about repair techniques are significant obstacles that must be addressed to promote a culture of appreciation and care for garments and maximize the impact of repair in the textile industry.

Repair contributes to the reduction of the environmental impact by prolonging the lifespan of clothing. In addition to this repair strategy, improvements could be obtained in production markets since they would focus on design and retail sales, leaving aside the overproductions that lead to obsolete fashion [67]. This, in turn, reduces the need to produce new garments, which implies less consumption of natural resources, water, and energy, as well as a decrease in carbon emissions associated with textile production. Repair as a strategy promotes a value proposition linked to a service that allows the extended value of garments, in addition to the creation of partners between interested parties [47,68].

From an economic perspective, repair can generate new business opportunities and employment. The creation of garment repair services can lead to the emergence of small businesses and local startups dedicated to this activity. However, studies like that of McQueen et al. [65] have shown that young people are the main ones interested in carrying out repairs and opt for cost-free repair options that involve help from family or friends.

Thus, repair, along with reuse, are options that do not demand large investments but do require consumer participation to achieve circularity. Additionally, a repair can offer a more economical alternative for consumers compared to buying new garments, which can contribute to greater social inclusion by making sustainable fashion more accessible to a broader audience; although not only is citizen participation necessary, the proposal for a repair service must also come from the product provider itself [69,70].

4.4. Other Circular Economy Strategies in the Textile Industry

In addition to the primary strategies of recycling, reuse, and repair, there are other innovative approaches within the circular economy that have significant potential to transform the textile industry, which may be given greater importance in the future; some of these strategies can be related to the strategies presented in Figure 8. These include reduction or rental, which relates to reduce (R2); eco-design with remanufacturing (R6); and functional economy with rethinking (R1), each of which uniquely contributes to sustainability.

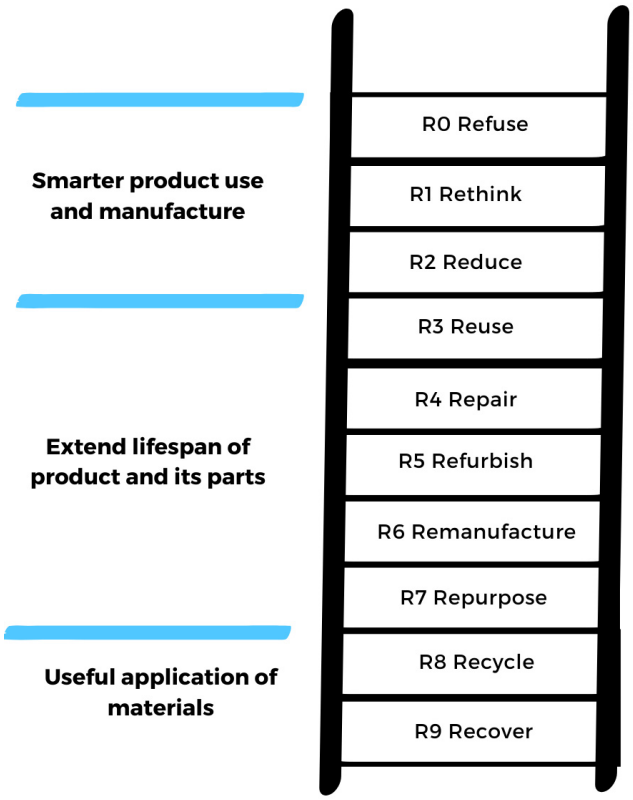

Figure 8. The different stages of R strategies (adapted from Larae, Malooly & Daphne Tian [71]). Own elaboration.

Reduction or Rental: The concept of renting offers a practical solution to the problem of fashion waste. By allowing consumers to rent clothing instead of purchasing it, this strategy significantly extends the functional life of garments and reduces the volume of clothing that ends up in landfills. This model not only satisfies consumers' desire for variety but also decreases the overall demand for new garment production [72,73]. Companies like Rent the Runway have popularized this model, showing that it is not only viable but also profitable [74]. However, the challenge remains to scale this model while maintaining logistical and hygienic standards.

Eco-Design: Eco-design involves integrating environmental considerations into product design to minimize environmental impacts throughout the product lifecycle [75,76]. In the textile industry, eco-design can significantly reduce waste and resource consumption by using materials that are more sustainable and easier to recycle [20]. Moreover, designing products that consider disassembly would facilitate future recycling or reuse. Although promising, the widespread adoption of eco-design requires designers to have a deep understanding of environmental impacts and lifecycle assessment, which can be enhanced through education and training programs [77].

Functional Economy: The functional economy focuses on selling services rather than products, encouraging businesses to retain ownership of their goods and consumers to lease or share them. This shift from ownership to access and function can profoundly reduce the environmental footprint by promoting the efficient use of resources [40,78]. For instance, a company could offer a subscription service for jeans where the consumer pays for the performance (usage) of the jeans rather than owning them outright. The challenge here is cultural, as it requires a shift in consumer mentality from ownership to access, which may require time and targeted awareness campaigns.

It is clear from our analysis that although there are many promising practices, the scalability of these strategies remains a critical challenge. This assessment highlights the need for innovative solutions that address supply chain complexities and consumer

engagement through circular initiatives. Based on these insights, we propose a more integrated approach to implementing circular economy strategies, focusing on fostering collaboration between stakeholders and promoting consumer engagement, identifying the involvement of each being key to achieving implementation, and transitioning to a circular textile sector.

5. Conclusions

A systematic literature review of circular economy strategies applied to the textile industry highlights the importance of addressing the rapid disposal of garments from multiple perspectives. Recycling, reuse, and repair have emerged as the three key tools for reducing the environmental and social impact of the textile industry. Recycling was identified as the main strategy, as the articles analyzed discussed the potential to recover and create new materials at an affordable price. However, this has not yet been fully realized, as most studies highlight the significant potential to convert garments into new raw materials, but emphasize the need for investments in technology and supportive policies.

Reuse is identified as the second strategy and one of the most viable strategies for counteracting environmental impacts and reducing garment waste, although it faces challenges related to the lack of incentives for consumers to promote the use of second-hand products over new ones.

As for repair, while it is not addressed in the analyzed studies, it remains a viable option, like reuse, as it extends the lifespan of garments and promotes a culture of conscious consumption. However, it faces obstacles such as limited access to repair services and a lack of education on repair techniques.

Regarding reduction, this is a strategy that depends on consumer actions and their recognition of the intended usage period for an item. Therefore, reduction through rental businesses is an option to avoid unnecessary consumption of items, thereby extending their lifespans for different users.

As final comments and recommendations for future research to establish a circular economy in the textile industry, it is crucial to implement a transition plan that involves changes in production processes and measures to return products to producers to find the most applicable strategy. To achieve this, collaboration between stakeholders and between companies is necessary. This implies adopting design practices that enhance the circularity of textile products by using sustainable and easily recyclable materials and creating eco-designs with the future of the garment in mind for repair or recycling. Additionally, reuse initiatives should be promoted, such as creating second-hand markets and clothing exchange programs, to extend the lifespan of garments and reduce the amount of waste in landfills.

Furthermore, it is essential to foster greater awareness and education about circular economy principles at all levels of the textile value chain, from consumers to manufacturers and designers. This includes raising awareness of the importance of reducing overconsumption, optimizing resource use, and adopting more sustainable practices in the production and consumption of textiles. Moreover, closer collaboration between companies, governments, and non-governmental organizations is needed to develop and implement policies and regulations that promote the circular economy, specifically in selective material separation, and even requiring the textile industry to disclose the current composition of their products. These actions lead to innovation and the adoption of best practices throughout the value chain.

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Appendix A

Table A1. Summary of information from the selected articles in the review.

Source/Strategies	Method	Environmental	Social	Economic	Appraised Quality
[6] Reuse and reprocessing	Enhanced understanding of circular economy approaches in the textile and fashion industry toward sustainability.	Energy and water consumption, as well as causing toxic chemical pollution of water, soil degradation, greenhouse gas emissions, and waste.	Health issues, repetitive, monotonous processes in workers, and ethical issues such as low pay rates, lack of basic facilities, and forced labor.	Prevention of waste overproduction and obtaining full value from products.	Moderate
[7] Reuse and recycling	Surveys conducted between December 2022 and January 2023. Survey research and correlational study. Data evaluation.	Use of raw materials and greenhouse gas emissions. Use of pesticides in large quantities, which end up in wastewater.	Social innovations address changes in social components, such as innovations in customer offerings that change customer behavior, and organizational change within the company, such as changes in responsibilities.	In sustainable business models, value is also created in environmental and/or social aspects. The latter encompasses value capture, i.e., how the company generates income and what its strategy is.	Moderate
[8] Recycling	(1) Literature review. (2) Case selection. (3) Instrumentation and data collection. (4) Data analysis. (5) Report writing.	Utilization of large quantities of water and chemicals and generation of waste.	Minimize inventories and improve customer service.	A well-designed RSC (Reverse Supply Chain) could be economically viable and cost-efficient.	High
[12] Reuse and recycling	Holistic summary of types, sizes, total quantity, quality, and reusability capacity of pre-consumer waste.	Increasing material efficiency (minimizing waste and manufacturing in an organized manner).	Specific business strategic plan, giving to the environment and society.	A higher priority than revenue and creating eco-friendly products through waste reuse or recycling.	High
[28] Reuse and recycling	Case study to investigate contemporary phenomena.	Efficient use of resources, such as minimizing losses. Selection of materials (i.e., eco-friendly fibers and recyclable/recycled technical materials).	Integrated and regenerative models that prioritize material selection, collaborative product design, supply chains integrated with distributors, and commitment to customers.	Implementing circularity through dynamic capabilities based on the Resource-Based View.	High
[35] Reuse	Focus group method. Use of Qualitative Data Analysis (QDA) Miner software.	Strategies for organizations to promote a more environmentally friendly position in society.	Consumer participation in the return of post-consumer clothing products.	Strategies to encourage product returns focused on the consumer's role.	High
[36] Reuse, Recycling, Reduction	Life cycle assessment is complemented by the evaluation of environmental and health risks associated with different options.	It is possible to significantly reduce (37%) environmental impact by reducing washing frequency.	Actions are needed from the consumer, such as design solutions and transparent data sharing.		Moderate

Table A1. *Cont.*

Source/Strategies	Method	Environmental	Social	Economic	Appraised Quality
[37] Reuse and repair	Qualitative comparison of cases. Relationship between a constantly changing second-hand market and a socially just circular economy.	Environmental impacts associated with the consumption of new clothing: CO_2 emissions, chemical pollution, and the use of water and land.	Providing affordable housing and protecting an ecosystem.	Higher levels of economic equality compared to the linear economy.	High
[38] Reuse, recycling, reduction, repair	Qualitative study using multiple methods, with a focus on the Netherlands as a case study.	The environmental impacts of production and consumption (e.g., waste).	Including ethical and economic equity in textile supply chains in the mission.	Moving from maximizing the number of items sold to maximizing and retaining the value per item.	High
[42] Collection and recovery	Using gray numbers, the initial relationship matrix of the DEMATEL method was applied.	Air and water pollution, climate change, depletion of the ozone layer, and natural resource depletion.	Economic prosperity and social equity for the benefit of current and future generations.	Regulatory measures or economic incentives as procurement criteria and rewards in tax rates.	High
[29] Recycling	Definition and drafting of a Sustainability Report; Optimization of materials (raw and recycled) provided. Implementation of supply chain traceability, integrating the blockchain paradigm.	Leveraging efficient use of natural resources, use of renewable energies, waste reduction or elimination, and end-of-life product management.	Increased investment in education, knowledge, research, and innovation (smart).	A green and resource-efficient economic system (sustainable). Increasing employment rates, social and territorial cohesion, and addressing poverty (inclusive).	High
[39] Reuse	Quantitative data collection on industrial waste from Swiss companies.	Environmental impacts such as the release of methane and carbon dioxide into the atmosphere and the leaching of contaminants into soils.		Economically attractive.	High
[30] Reuse and recycle	Qualitative interview study to explore how consumers experience recycled textiles and reused clothing.	Creating cognitive experiences, learning about the manufacturing process and the ecological and ethical impacts of sustainable clothing.	Social responses refer to how customers relate to others and their social environment.	Positive emotions regarding economic benefits and the good price/quality/impact relationship.	High
[40] Reuse and recycle	The RESOLVE framework serves as a basis for being a comprehensive circular economy framework. Additionally, the MIPS (Material Input per Unit of Service) approach adapted to the standard business approach.	Utility and material quality or product durability, lifespan extension, recirculation rate, and percentage of recycled resource usage.	Labor contribution, equality, transparency, healthy working conditions.	Gross/net profit margin, hourly wages per individual, retail price competitiveness, and generated incentives.	Moderate

Table A1. *Cont.*

Source/Strategies	Method	Environmental	Social	Economic	Appraised Quality
[31] Recycle and reuse	Initial employment in value chains of apparel sold in the European Union was determined. Then, two transition scenarios toward a circular economy were developed.	High energy consumption throughout the life cycle, excessive water and chemical consumption, waste generation, and direct CO_2 emissions resulting from global supply chain logistics.	Issues of indecent work, such as low wages, long working hours, unhealthy work environments, and safety issues.	The positive effects of economic growth and employment.	High
[32] Reuse and recycling	Quantitative and qualitative data obtained through online survey distribution to consumers, available from September 2016 to February 2017.	Intensive use of resources and clothing waste generation.	Consumer willingness to participate in sustainable clothing disposal practices.	Extending the lifespan of clothing or generating value-added products from unwanted garments through existing infrastructure.	Moderate
[41] Reuse	Application of methods such as: Multicriteria Decision Analysis, Analytic Hierarchy Process, and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS).	Sustainability programs of six leading companies in the Brazilian textile industry.			High
[33] Recycling and reuse	Research was conducted on the generation of textile waste, its classification, the global textile market, and environmental impacts.	Steady growth in the production and consumption of non-biodegradable synthetic fibers.			Moderate
[79] Reuse	We developed a framework based on factors that identify the delineating aspects of a Closed loop supply chain and performed a content analysis of the publicly available sustainability reports of companies.	The complexity of the supply chain and the high volume of natural resources and toxic chemicals used during manufacturing.			High
[45] Recycling	An assessment of the apparel fiber market has been conducted in cooperation with stakeholders from the European clothing industry.	Textiles and clothing manufacturing today plays a key role with regard to global climate change, water scarcity, and environmental pollution in general.	Stakeholders agree that the collection and sorting stage for material recycling is very important and introduced a significant criterion: the location of textile waste collection.	During the discussion round, stakeholders aimed to point out legislative requirements for the European textile industry to achieve sustainability goals and keep up its competitiveness in the market.	High

Table A1. *Cont.*

Source/Strategies	Method	Environmental	Social	Economic	Appraised Quality
[80] Redesigned	The study was carried out in Brazil, and it includes Fashion Design courses at the undergraduate level.	Practices are capable of generating new meaning in the fashion sector, circulating materials, and retaining value in resources.			High
[46] Recycling	The study was conducted by interviewing 27 companies in Finland, a country that aspires to be a forerunner in the CE.	Struggling niche companies call for strict regulations to create a supportive operating environment for sustainable business, whereas regime companies expect regulations only on waste collection and recycling.	Accelerating the transition toward circularity requires new ways of collaboration between companies and the government as well as between companies.	According to most of the interviewees, innovative and circular solutions, such as recycling technology and building new facilities, require the government's economic support.	High
[49] recycling, eco-design	This study mainly focuses on surveys of French textile and clothing SMEs.	Reducing waste, minimizing greenhouse gas (GHG) emissions, energy, and water consumption.	Lack of sustainability performance, a lack of regulation, and a lack of mandatory responsibilities of SC actors.		Moderate
[69] Recycling	Characterization methods included scanning electron microscopy (SEM), optical microscopy, fiber quality analysis, degree of polymerization (DP), X-ray diffraction, Fourier-transform infrared spectroscopy, and thermogravimetric analysis.	This analysis of the properties of partially degraded cotton fibers provides a necessary technical foundation for promoting cotton fiber fragment recycling for use in applications such as composites and regenerated fiber.			Moderate
[47] Recycling, Reuse	Propose a methodology from Design Thinking (DT) to insert circular thinking in NPD.	Companies can work on reuse, recycling, and manufacturing issues so that CE occurs.	The success of closed-chain actions strongly depends on the strategic business plan, product portfolio planning, and sustainability-oriented project draft.	Customer relationships and increased competitive advantage.	Moderate
[51] Recycling, Reuse	The model uses the "play card" from Simos' procedure and the Normalize software that provide a comprehensive, consistent, and transparent approach to decision-making.	Study of processes and eco-efficient materials.	Thus, it is required that, socially, there is a fundamental rethinking of consumption practices.	The study points out that it is urgent to raise investments from private financial institutions and investors.	Moderate
[52] Recycling, Reuse	Qualitative exploratory study included in-depth interviews with three Australian fashion SMEs engaged in circular design practice.	A high-quality new material may, in fact, be less detrimental to the environment.	Human-centered design is a participatory social process involving a network of user stakeholders and the community.	Several participants had to manufacture offshore to keep their price point acceptable to their customers.	High

Table A1. *Cont.*

Source/Strategies	Method	Environmental	Social	Economic	Appraised Quality
[54] Reuse, Recycling	Identification and analysis of barriers in the textile industry, applying the "weighted influence non-linear gauge system (WINGS)" method.	Strategies to improve the long-term waste management practices of the industry and to achieve sustainable development goals (SDGs).	Lack of consumer awareness.	Lack of trust among supply chain partners, lack of financial incentives from the government.	High
[81] Recycling, Reduction	Explored U.S. retailers' unique merchandising strategies for recycled clothing based on a logistic regression analysis of 16,000 Stock.		U.S. Retailers adopt distinct product assortment strategies for clothing made from recycled materials in terms of colors, design patterns, and product categories.	U.S. Retailers were statistically more likely to price recycled clothing lower than the market average.	High
[55] Reuse	Examine the current Brazilian textile scenario using the multi-level perspective through three methodological approaches: desk research, workshops, and interviews.		Collaboration among stakeholders, education, investment, market forces, and public policies.	The Brazilian textile industry still operates mainly in a linear way, focusing on competitiveness and short-term opportunities.	High
[56] Recycling, Reuse	This paper discusses the necessity of building a recycling system for post-consumer textile waste.	Whether recycled textiles are truly safe, environmental protection is also an important factor affecting consumers' acceptance of recycled products.	Awards can be presented to participants in this activity to encourage people to participate in this type of social initiative.	Shared consumption can efficiently use resources and can generate strong economic mutual benefits.	High
[82] Recycling	The main technical challenges of this recycling methodology	The cellulose present in cotton textiles is much purer.			Moderate
[83] Recycling, Reuse	Reviews the current progress of recycling and reuse of waste silk from the aspects of energy, yarn and fabric, reinforcement of composites, silk fibroin, biological tissue engineering, filtration of air and water, and electrode.	Moreover, most of the textile wastes are either incinerated or landfilled due to the low cost of recycling, which inevitably causes pollution to the environment.			Moderate
[84] Recycling	Recycled textile waste fabric-reinforced cement board as a facade-cladding material for building. envelopes is the focus of this research.	Environmental requirement considers the overall environmental impact of the life cycles of the panels through Global warming potential, Resource consumption, and Waste management.	The quality of human life and health of the users embraces three criteria: Comfort, Safety, and Urban landscape.	Economic requirement represents the whole expenditure required to implement the facade cladding for the estimated life cycle, with Cost serving.	High

Table A1. *Cont.*

Source/Strategies	Method	Environmental	Social	Economic	Appraised Quality
[85] Recycling	Key experts from a sample of textile organizations were interviewed to understand their collection practices and possible future solutions, and a data analysis model was constructed to provide an accurate prediction of end-of-life textile volumes.	Textile features such as low and varying volumes, quality, and contamination affect the management of the first mile.	Textile volumes are predicted with demographic and socioeconomic variables.		High
[60] Reuse	A questionnaire was developed to collect information on the goal achievement of the products in terms of both success and success factors.	Conventional as well as sustainable textiles.	Customer expectation fulfillment.	Financial or information support from the government. Compliance with laws and regulations and economic aspects.	High
[58] Reuse, Repair, Recycling	Challenges and opportunities with the current textile recovery system in the United States.	high usage of energy, water, and chemicals; the leakage of pollutants to environmental sinks.	Textile circularity also has social benefits, particularly through the donation of used products to charities for resale.	Economic assessment is also necessary to evaluate the development of textile recovery and recycling infrastructure.	Moderate
[61] Reuse, Repair, and Recycling	A non-probabilistic sampling of 311 validated surveys was carried out, analyzing recycling behavior, collection system, and sociodemographic characteristics.	Location of the container limits the participation of people in the selective collection.	Respondents exchange their clothes in exchange for incentives such as discounts or money in stores.		High
[48] Recycling	Data collected were analyzed using the structural equation model (SEM). The respondent's level of agreement and disagreement on each item was described using a five-point Likert scale.	Environmental concerns are often seen as major motivators for recycling.	Social influence, attitude, perceived risk, environmental concern, and utility influence conscious fashion.		High
[86] Recycling	A questionnaire was used to collect information; 208 company managers contributed as respondents to this research.	Generation of solid waste.	Law for the conditions for the management of solid waste.		High
[67] Reuse, Recycling	Proposes the alternative of customized clothes using textile waste in order to rethink, reuse, or recycle waste in the production stage.	The development of business practices based on environmental concerns. Technological innovation to improve efficiency.	Save energy, create local jobs for all skill levels, and opportunities for cohesion and social integration.	Design and retail can lead to a more flexible design process and, therefore, to high product performance.	High

Table A1. *Cont.*

Source/Strategies	Method	Environmental	Social	Economic	Appraised Quality
[87] Recycling	The study was based on five years of comprehensive field research in four factories in Bangladesh, India, and Estonia.	Some of the best-known upcycling designers who use pre-consumer textile waste and leftovers are, for example, Reet Aus from Estonia, British designer Christopher Raeburn, and Zero Waste Daniel from New York.	Upcycling is a growing trend among fashion designers, helping to save resources andkeep tons of textile waste out of the waste stream.	Businesses are beginning to understand the financial benefits of highlighting a circular approach.	High
[63] Reuse	Research approach based on design science methodology hat can be used to design solutions to complex and relevant field problems.	The value proposition regards both products (i.e., products based on recycled materials or recycled production inputs) and services (i.e., take-back management and waste handling and processing).	The value creation consists of the partners and stakeholders, and the value creation process.	(1) Sustainability orientation, (2) Extended value creation, (3) Systemic thinking, and (4) Stakeholder integration.	Moderate
[88] Recycling	Develop a sustainable green technology for the recovery of cotton fibers and polyester from textile waste.	Reduction of carbon footprint by −1440 kg of CO_2-eq/t of waste.		Possibility of reaching economic returns up to 1629$/ton of waste.	Moderate
[89] Recycling, Reuse	Identifies the key differences between standard fashion design and production processes and upcycled fashion design and production processes.	Three key metrics of carbon, water and waste, UK government agency WRAP (Waste and Resources Action Programme) has identified textile products as priority materials for reuse and recycling.		Creating a sustainable and innovative business model for UK-led fashion production.	Moderate
[90] Reuse, Recycling, Repair	A total of 22 semi-structured interviews were conducted with consultants and senior corporate managers.	Reducing the environmental footprints associated with wastewater generation, excessive energy and water consumption, and usage of hazardous chemicals.	Development sector, Non-governmental organizations.	Customer requirements, Company image, Unsustainable consumption patterns.	High
[91] Reuse	Extensive nationwide survey of Indian textile organizations. the modified fuzzy Stepwise weight assessment ratio analysis (SWARA) method has been used.			Misalignment between the project aim, the main goals of the company, and the customer demand.	High
[92] Reuse	Data analysis structural equation modeling was used to test the hypotheses and Pearson correlation between variables.	Low impact on increasing resource consumption efficiency, reusing waste as input in other processes, and increasing access to commodities.			High

Table A1. *Cont.*

Source/Strategies	Method	Environmental	Social	Economic	Appraised Quality
[53] Recycling	Review of the available academic literature, evidence from corporate sustainability reports and websites, and feedback from an online survey of industry professionals.	Use and treatment of natural resources.	Human well-being, society, inter-societal relations, and fairness.	The efficient use of tangible and intangible resources to ensure the long-term survival and competitiveness of the company and the resultant benefits delivery.	Moderate
[68] Recycling, Reuse	The Situations Actors Processes and Learnings Actions Performances (SAP–LAP) technique analyses the problem.	Reducing waste, such as CO_2 emissions, dimension focuses on the natural environment and concerns the availability, use, and treatment of natural resources.	Focuses on human well-being, society, inter-societal relations, and fairness.	The efficient use of tangible and intangible resources.	Moderate
[70] Reduce, Recycling	A preliminary list of challenges and strategies were made from discussions and an extensive literature review.	Efficiently collect, monitor, separate, and dispose of waste for value recovery.	Governmental policies, management decisions, and business practices.	Design process, procurement and sourcing, production, distribution, usage, and restoration.	Moderate
[57] Recycling	Fuzzy-based multicriteria decision-making approaches comprised of the Analytical Hierarchy Process (FAHP) and the Technique for Order of Preference by Similarity to Ideal Solution (FTOPSIS).	Technology boost.	Policymakers, organizations, and other stakeholders interested in promoting sustainable development.	Financial investment.	High
[93] Recycling	Valorization strategies, the value-added products obtained, and their applications.	Developments in effective textile valorization via upcycling.			High
[50] Recycling	Analyzing the barriers associated with circular textile innovation in Taiwan. Literature review.		Lack of trustworthy public information, lack of social awareness.	Lack of funding for circular business models, environmental cost, tremendous upfront investment costs, high costs but low economic benefits in the short-term.	Moderate
[94] Recycling	Snowball sampling, different relevant experts and stakeholders in the textile industry.	Value creation logic is designed to improve resource efficiency by contributing to extending the useful life of products and parts.		Economic incentives, maximization, and economic externalities.	High

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