Key Drivers and Barriers to Circular Economy Practices in the Global Textile and Fashion Industries: Sustainable Strategies for the Indonesian Batik Industry

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ABSTRACT

The global textile and fashion industries, including Indonesia's batik sector, significantly contribute to environmental pollution and resource depletion, particularly water waste. This makes adopting circular economy and sustainability practices in the batik industry crucial. The study identifies key drivers, barriers, and strategies for sustainability in the global textile, fashion, and batik industries to recommend strategies for Indonesia's batik industry. Using a combination of SLR with PRISMA, Pareto analysis, and SWOT analysis, four strategic models were developed and validated through in-depth interviews with relevant stakeholders. The strongest, S-O strategy (based on internal and external drivers), emphasizes leveraging knowledge of circular economy principles and utilizing government policies and subsidies for technological investments and improving production efficiency. The weakest, W-T strategy (based on internal and external barriers), calls for internal training and collaboration with the government to enhance skills and secure financial access, aiding the transition to more sustainable practices. Compared to the S-O and W-T strategies, the S-T and W-O strategies are at an intermediate level in terms of strengths and weaknesses. Implementing these strategies will help the batik industry improve sustainability, align with global trends, and overcome existing challenges.

1. INTRODUCTION

The global textile and fashion industry is one of the sectors that significantly impacts the environment [1-5]. The production processes, which involve extensive use of natural resources and generate large amounts of waste, make this sector a major contributor to environmental degradation [6-9]. The fashion industries generate significant pollution, making them among the least environmentally friendly sectors globally due to the growing adoption of a linear fashion system that continues to exploit scarce natural resources and energy. This highlights the need for a shift toward a circular economy to achieve sustainable production and consumption [10, 11]. Amid growing global awareness of the importance of sustainability, the circular economy concept has been proposed as a solution to mitigate the negative impacts of this industry [12-14].

Globally, the concept of a circular economy is rapidly evolving as an alternative to the linear economy, which follows a "take-make-dispose" model [10, 14-17]. Circular economy aims to reduce waste, extend product life cycles, and optimize resource use, including repurposing waste as new resources [18-20]. Research within the global textile and fashion industry context has focused on various aspects, such as textile recycling, upcycling, and innovations in design that extend product lifespan [1, 21, 22]. However, the application of circular economy principles in the textile and fashion industry remains scarce and faces many challenges [3, 23-25], especially in developing countries like Indonesia [26, 27].

The textile, fashion, and batik industries are closely interlinked through supply chains, production, and global and local market dynamics. All three contribute to economic and cultural dynamics and hold great potential for future sustainable practices [7, 8, 11, 28]. Batik is an integral part of the textile industry but has distinct characteristics as a traditional art form that reflects Indonesia's rich cultural heritage. The batik-making process involves special dyeing techniques, such as wax-resist dyeing applied to textile fabrics. Batik is not only a textile product but also a symbol of the cultural identity and history of Indonesian society [27, 29].

These three industries-textile, fashion, and batik-are also increasingly interconnected in efforts toward sustainability [7, 8, 28]. The textile industry is striving to develop more durable and environmentally friendly fabrics, the fashion industry

seeks to create reusable or recyclable products, and the batik industry, with its traditional processes, is exploring ways to reduce environmental impacts, especially from the use of chemical dyes that can be pollutive [3, 30, 31].

Amid the global concern over environmental issues caused by the textile and fashion industries, the batik industry, as part of the textile sector, is also under scrutiny regarding its ecological impact, particularly in traditional production methods that often still use chemicals and synthetic dyes [3, 7, 8, 23]. However, research on the circular economy in the batik industry remains limited globally. Most studies have focused on the textile industry in general and how developed countries adopt circular economy models [32]. Batik, which is considered a specialized sector with cultural value, has not yet become a central focus in global discussions on the circular economy. Nevertheless, with growing interest in sustainable practices, batik-producing countries like Indonesia are beginning to be seen as part of a global strategy to reduce the environmental footprint of the textile sector [3].

At the national level, attention to circular economy practices in the batik industry is increasing, in line with efforts to preserve environmental sustainability and enhance product competitiveness in global markets. The Indonesian batik industry, a national cultural heritage symbol [33], faces similar challenges in terms of sustainability. Although batik is recognized as a premier product with high cultural value, its production process often generates chemical and solid waste that adversely affects the environment [29, 31, 34-40].

On the other hand, international market pressures to adopt sustainable practices in the textile and fashion supply chains add urgency to the need to implement circular economy concepts in the batik industry [3, 7, 8]. However, the application of these practices remains minimal due to various obstacles, such as a lack of understanding of long-term benefits, technological limitations, and resistance from industry players [34-36].

Water and soil pollution resulting from batik industry waste can harm the health of local communities living near production areas. Communities that rely on rivers for clean water and agricultural irrigation are directly affected by the pollution from batik waste. Furthermore, these environmental impacts can trigger social conflicts between batik industry players and local communities who depend on the preservation of their environment. Additionally, a lack of education and awareness about sustainability among batik workers and entrepreneurs makes it harder for them to compete in markets that demand sustainability standards [29, 31, 34-36, 40, 41].

The traditional batik industry heavily impacts ecosystems, primarily through water pollution, harmful chemicals, and excessive energy and water use. Untreated liquid waste discharged into rivers degrades water quality, harming biodiversity [33, 39, 40, 42, 43]. The use of fossil fuels for energy in the production process also increases carbon emissions, contributing to climate change [2].

Several studies in Indonesia have examined the environmental impacts of the batik industry, particularly regarding the use of chemical dyes and toxic waste generated by batik production. This waste can pollute rivers and soil around production areas, negatively affecting local community health and ecosystem balance. Therefore, some research has begun exploring alternative environmentally friendly natural dyes and cleaner production practices [29-31, 33, 34, 36-38, 40, 44, 45]. These studies also propose the need for stricter regulations regarding waste management in batik

production centers and increased awareness among entrepreneurs of the importance of sustainability. This highlights the need for a shift toward a circular economy to achieve sustainable production and consumption. However, many challenges arise in introducing circular economy principles, which hinder the system's transition [10, 11].

While the circular economy has been widely discussed in the context of the global textile and fashion industries, there is a lack of specific studies addressing the application of this concept within the Indonesian batik industry. Most previous research has focused on developed countries or modern textile industries [26, 32], while local contexts like batik-which has different production characteristics and supply chains-have not been sufficiently explored [29, 40]. Several research findings related to the drivers, barriers, and strategies of circular economy practices in the global textile and fashion industries can be reviewed as a reference basis for identifying and analyzing the drivers, barriers, and strategies of circular economy practices in Indonesia's batik industry:

Research findings in Europe reveal that the main drivers are relevant European regulations, appropriate technologies and digitalization, increasing consumer social and environmental awareness, and managerial capabilities. The barriers include supply chain complexity, large-scale supply chain collaboration, information gaps, and readiness to take market risks [1]. Research findings in the Global South emphasize that funding is the main driving force for sustainable manufacturing practices, while the lack of education on remanufacturing and recycling is identified as the main barrier [14]. Research in India reveals five major challenges to circular economy practices in the fashion industry: expensive raw materials, lack of certification, issues in collection and sorting, weak technical knowledge, and the absence of a shared vision [12].

In Brazil, research findings highlight that internal drivers (market strategies, business principles, commitment, production processes, innovation) are more prominent than external factors (government regulations) in implementing the circular economy [46]. Research in Taiwan identifies six dominant barriers: low customer demand for recycled textile products, the lack of successful circular business models, challenges in collaborative innovation among supply chain partners, the lack of high-quality recycled materials, and high costs with low short-term economic benefits [25]. In Indonesia, research shows that a lack of customer knowledge, along with socio-cultural and regulatory factors, is a barrier to the sustainability of batik SMEs [29].

Regarding circular economy practice strategies in the global textile, fashion, and batik industries, research in Germany has shown that only a small number of companies have adopted the following circular business model strategies: upcycling and recycling, clothing rental, repair, reuse, and material innovation [21]. Research in Italy has developed a theory/concept to address challenges and barriers in circular economy adoption through a circular supply chain orchestration approach [6]. Research in Sweden reveals that motivation for eco-friendly innovation is necessary to address environmental issues in the fashion industry. Multi-stakeholder collaboration provides the knowledge, scale, and resources required, which a single actor may not possess [32]. Findings from Pakistan indicate that enhancing research and development capacity is the most important strategy for implementing green supply chain management [47].

This research aims to fill that gap by providing an in-depth

analysis of the specific challenges and opportunities in the batik industry. Key research gaps to be addressed include: 1) The scarcity of studies specifically on the full application of circular economy in the batik industry, particularly in recycling and material reuse. 2) The lack of empirical data on the success of circular economy-based business models in small and medium-sized batik centers. 3) The technological limitations and awareness among traditional batik industry players, especially in adopting environmentally friendly new technologies.

This research is expected to provide a tangible contribution to supporting the transition of Indonesia's batik industry toward circular and sustainable practices. Thus, the primary goal of this research is to: 1) Identify the key factors driving and inhibiting circular economy and sustainability practices in the global textile, fashion, and batik industries, including in Indonesia. 2) Develop sustainable strategy recommendations based on global best practices that can be applied by the Indonesian batik industry to enhance sustainability and competitiveness in global markets.

A deeper understanding of the factors driving and hindering the implementation of the circular economy, particularly in the batik industry, is needed. With sufficient knowledge, stakeholders can formulate policies and strategies adopted from global best practices to promote sustainable practices. This research is crucial to help Indonesia's batik industry not only compete in global markets but also meet sustainability standards, which are becoming increasingly important in the future.

2. METHODS

The method used to analyze the key drivers, barriers, and strategies to circular economy practices and sustainability in the textile, fashion, and batik industries at the global level, particularly in Indonesia, is an approach that combines a Systematic Literature Review (SLR) with the PRISMA framework, Pareto analysis, and SWOT analysis. These three methods are applied synergistically to gain deep and relevant

insights into the key factors driving and hindering the adoption of the circular economy in the batik industry, while also formulating sustainable strategies for relevant stakeholders. The SLR with PRISMA ensures a comprehensive and objective review of the literature, Pareto analysis helps prioritize the most significant factors, and SWOT analysis provides guidance in formulating appropriate and relevant strategies. The findings of this study are expected to contribute significantly to supporting the transition of Indonesia's batik industry toward more environmentally friendly and sustainable circular economy practices. While these methods provide a robust framework for identifying and analyzing drivers, barriers, and strategies, their limitations lie in their reliance on secondary data, potential biases, and lack of dynamic or quantitative perspectives. To address these gaps, studies have been validated through case studies or in-depth interviews with relevant stakeholders.

2.1 SLR with the PRISMA framework

The SLR method is used to comprehensively identify and review previous studies related to circular economy practices and sustainability in the textile, fashion, and batik industries. This approach is designed to reduce bias by following a systematic procedure in collecting, selecting, and evaluating relevant literature. The method employs the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure orderliness and transparency in the process of searching, selecting, and analyzing the literature. The SLR process using the PRISMA framework involves four main stages [48, 49]:

As shown in Figure 1, the SLR process using the PRISMA framework illustrates the stages of identifying, selecting, and determining the most relevant references related to the research. SLR provides a systematic and reliable approach to exploring existing findings and mapping research gaps related to the implementation of the circular economy in the batik industry. PRISMA, as a tool in the SLR, ensures transparency and reproducibility in the literature review process, making the results more credible and accountable.
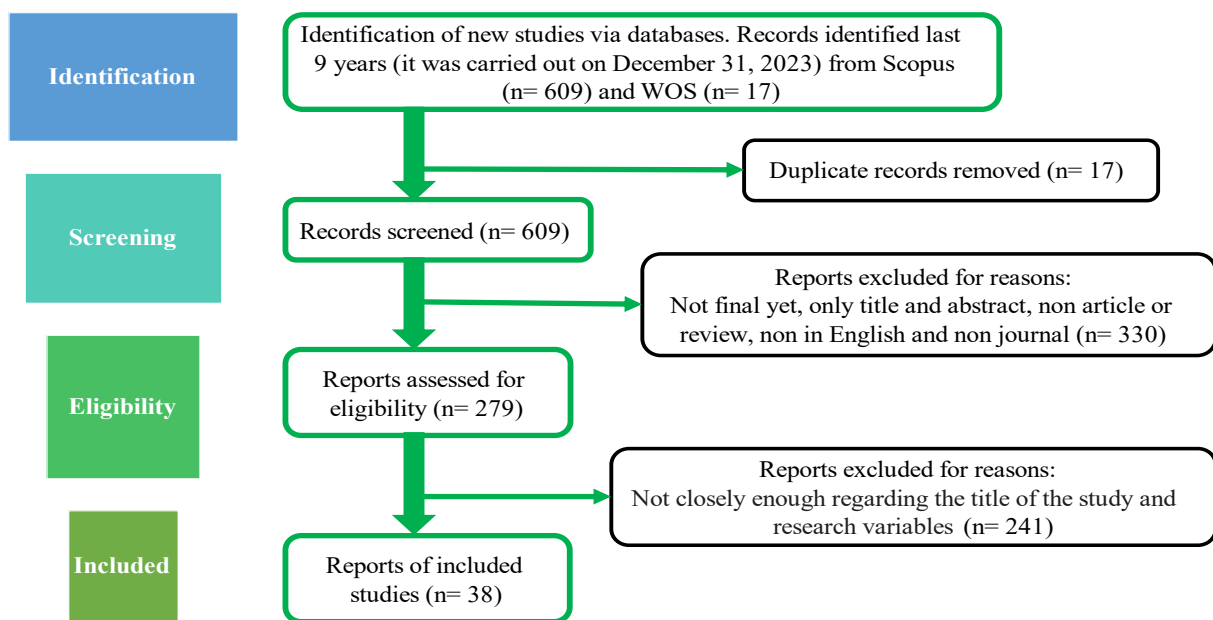

Figure 1. The SLR process using the PRISMA framework

Table 1. Details of inclusion and exclusion criteria

No.	Inclusion	Exclusion
1	Limited to final and full text article or review	Excluded not final yet, only title and abstract, non article and review
2	Limited to English	Excluded non in English
3	Limited to journal	Excluded non journal
4	Limited to very closely regarding the title of the study and research variables	Excluded not closely enough regarding the title of the study and research variables

The first stage is identifying the number and trend of publications (2015-2023) selected by article title, abstract, keywords retrieved from Scopus database using search keywords: "Circular Economy" OR "Sustainable Manufacturing" AND "Strategy" OR "Intervention" OR "Implementation" OR "Practice" OR "Enablers" OR "Drivers" OR "Barriers" OR "Challenges" AND "Batik" OR "Textile" OR "Fashion". The identified literature is screened based on inclusion and exclusion criteria. The inclusion criteria include literature focused on circular economy practices and sustainability in the textile and fashion industries over the past 9 years. Meanwhile, the exclusion criteria are literature that is irrelevant to the research context or lacks adequate empirical data.

Table 1 shows the details of the inclusion and exclusion criteria used in this SLR method with the PRISMA framework. The literature that passes the selection process is further evaluated to determine its eligibility based on the quality of the methodology, contribution to the topic of the circular economy, and relevance to the Indonesian batik industry. Studies that meet these standards will be selected as primary data sources. The data obtained from the literature that meets the criteria are then synthesized to gain a deeper understanding of the drivers and barriers to the circular economy in both global and local contexts. This synthesis also provides a foundation for further analysis of the challenges faced by the batik industry in adopting sustainability practices.

2.2 Pareto analysis

After the key drivers and barriers of the circular economy were identified through the SLR, Pareto analysis was used to prioritize these factors. The Pareto principle, also known as the 80/20 rule, suggests that approximately 80% of results are caused by 20% of the primary factors. The process begins by identifying the drivers, barriers, and strategies of circular economy practices in the textile, fashion, and batik industries at the global level, followed by assigning weights based on the frequency of their mention. The final step is visualizing the data in a Pareto diagram, which reveals the priority drivers, barriers, and key strategies that can be acted upon by relevant stakeholders [50-54]. In the context of this research, Pareto analysis helps identify the key drivers and barriers that contribute the most to the implementation of the circular economy in the batik industry. Pareto analysis functions to filter and focus attention on a few key factors that have the greatest impact, ensuring that the proposed strategies are more focused and effective. By using Pareto analysis, this study is able to place greater emphasis on the main factors that need to be addressed or optimized to advance the adoption of the circular economy in the batik industry.

2.3 SWOT analysis

The Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis is used to formulate strategies for circular economy practices in the batik industry by analyzing the strengths (internal driving factors), weaknesses (internal inhibiting factors), opportunities (external driving factors), and threats (external inhibiting factors) within the internal and external context of Indonesia's batik industry. This method helps identify the internal and external potentials that affect the implementation of the circular economy, ensuring that the resulting strategies are more targeted, especially in adopting sustainability principles [55-58]. SWOT analysis assists researchers in formulating strategies that leverage strengths and opportunities while addressing weaknesses and threats. These strategies are designed to enhance the competitiveness of the batik industry in the global market, while ensuring that sustainability practices and circular economy principles are widely adopted across the sector.

3. RESULTS AND DISCUSSION

3.1 Bibliometric analysis

This research began by identifying data and documents published in the Scopus database in accordance with the scope of this research to find out updates on the number and trends of related research results at the global level. The next step is to screen the published documents obtained, to carry out an eligibility analysis to determine the number of most relevant journal articles used as the basis for the study in this research. The publications were identified on December 31, 2023 based on the search keywords: "Circular Economy" OR "Sustainable Manufacturing" AND "Strategy" OR "Intervention" OR "Implementation" OR "Practice" OR "Enablers" OR "Drivers" OR "Barriers" OR "Challenges" AND "Batik" OR "Textile" OR "Fashion".
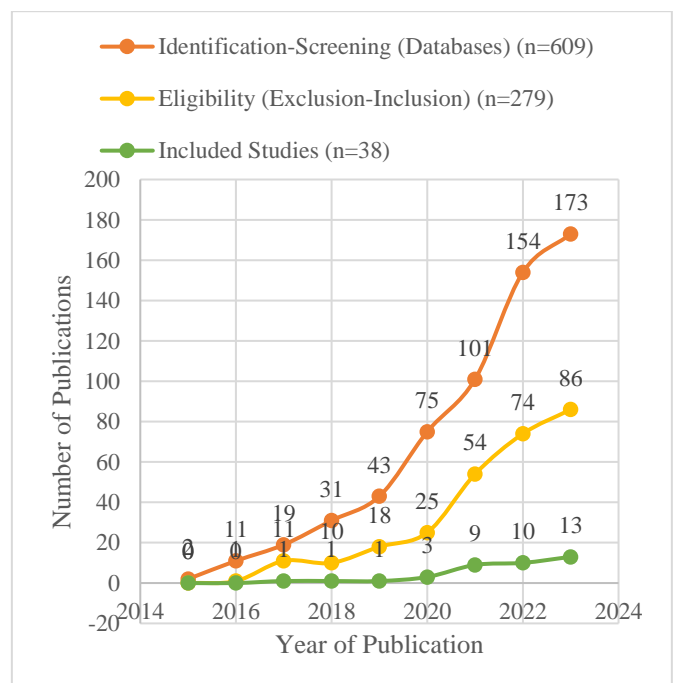

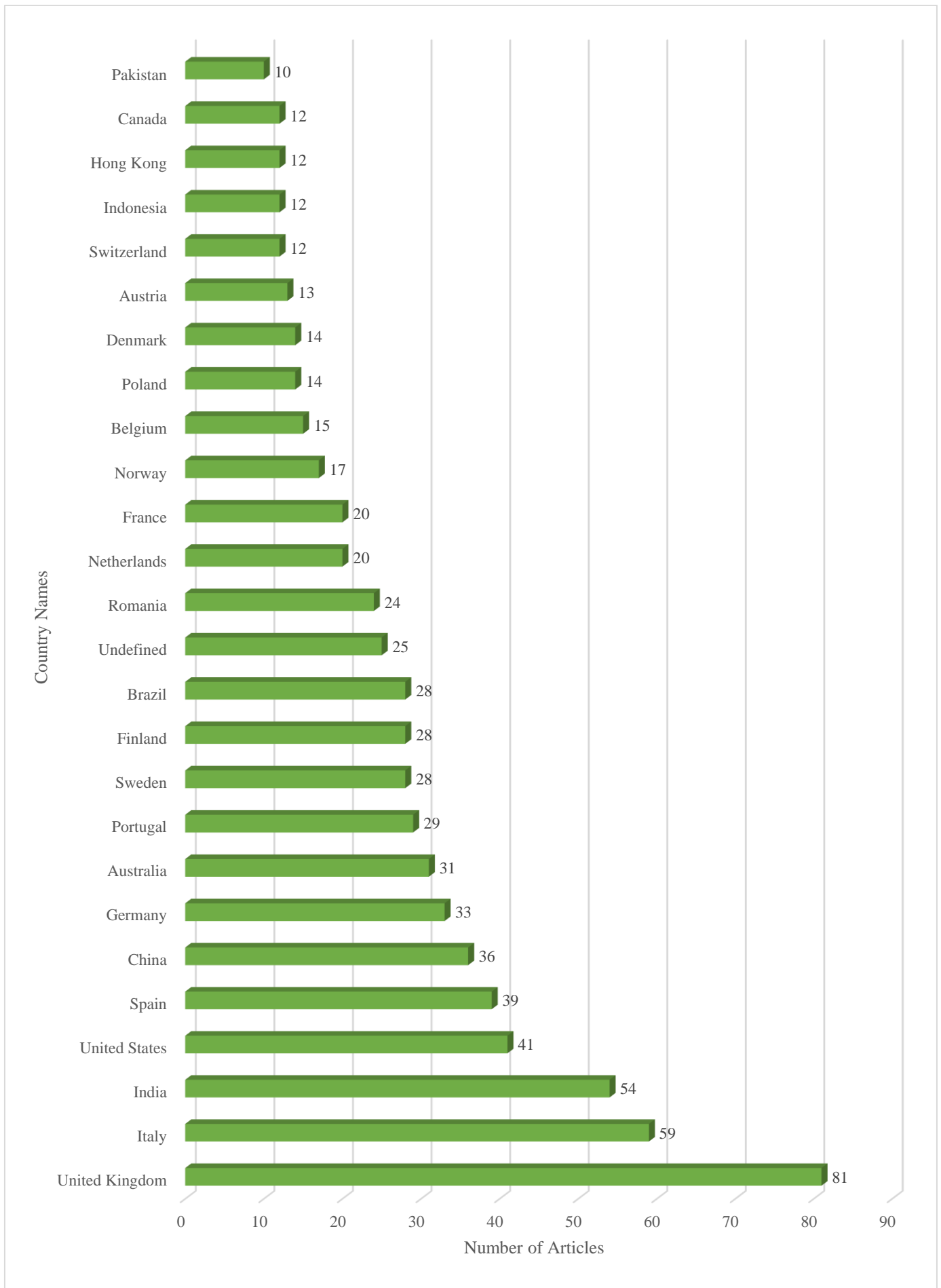**Figure 2.** Publication trends and volume in a specific field of research (2015-2023)

Figure 3. The most active countries in a specific field of research
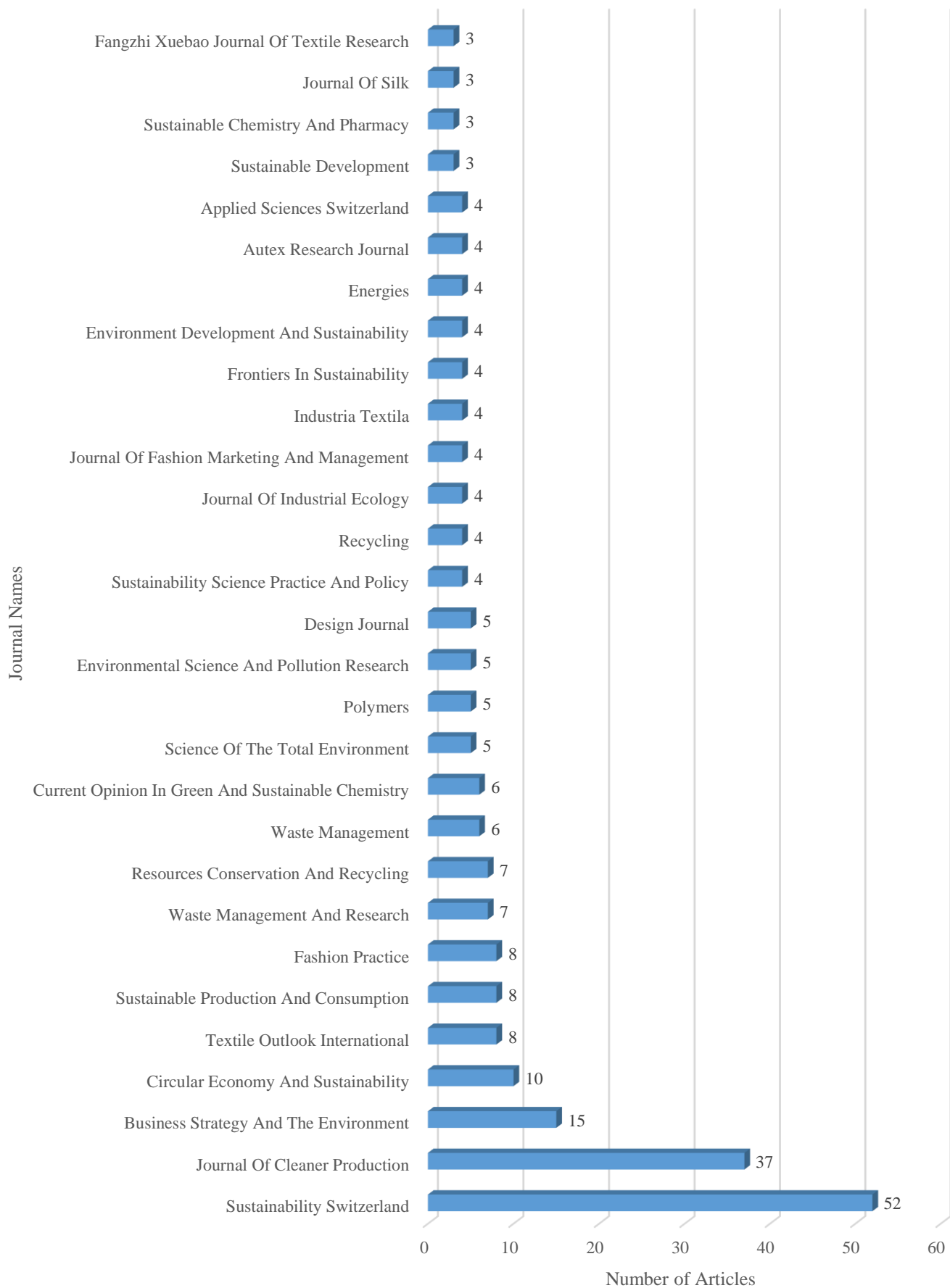
Figure 4. The leading journals in a specific field of research

As shown in Figure 2, there has been a significant increase in publication trends and volume from 2015 to 2023 at the global level related to this research in the Scopus database. During the selection and eligibility stages, the publication volume gradually decreased, but the trend continued to rise, resulting in a total of 38 journal articles being selected as the most relevant focus for this study. Based on publication trends and volume, it can be seen that this research is highly relevant and has attracted significant attention at the global level. Publication trends and volume related to this research topic have significantly increased, especially over the past three years. This indicates that the research topic is highly relevant and possesses clear novelty, as evidenced by the continuously rising trend each year. Therefore, this research topic represents a new frontier in the global landscape, increasingly gaining attention from researchers across various countries, including Indonesia.

As shown in Figure 3, the publications recorded in the Scopus database related to this research have spread widely and demonstrate an increasing trend year by year from 2015 to the end of 2023. Countries that are highly active in publishing related research are spread across five continents, with the most active in order being Europe, Asia, North America, Australia (Oceania), and South America. Meanwhile, Africa and Antarctica have not yet shown any publication activity related to this research. This publication activity is likely linked to the numerous textile, fashion, and batik industry hubs located in countries across these five continents. The progress of publications related to this research indicates an increasing awareness and policy direction in the development of the textile, fashion, and batik sectors, moving towards a sustainable circular economy transition and beginning to move away from unsustainable linear economic practices [5, 6, 10, 11, 14, 17, 21, 59]. Countries that dominate this field possess a combination of strong regulations, advanced technology, high consumer awareness, access to capital, and cross-sector collaboration. These factors enable them to lead in the adoption of circular economy and sustainability practices, as well as to dominate publications and research in this area, as reflected in the publication data shown in Figure 3.

As shown in Figure 4, the 29 recorded journals represent the top 10 leading journals in a specific field of research, although there are 2 journals that are particularly significant in publishing studies on this topic. The distribution of publications is relatively even, except for these two journals, which stand out in terms of significant contributions. Based on

the data, publication trends and volume on this research topic have continued to rise year by year, especially from 2015 to 2023, and are predicted to keep growing globally in the coming years. This growth correlates with increasing awareness of the Sustainable Development Goals (SDGs), which optimally balance economic, social, and environmental interests [5, 17, 60-64]. In efforts to achieve the global SDG targets, the circular economy has emerged as the most robust strategy to date. The Indonesian government's policies through 2030 have emphasized five priority industrial sectors that are continuously encouraged to adopt circular economy practices. Furthermore, the circular economy has been incorporated into Indonesia's Vision 2024 agenda for all industrial sectors. This means that the circular economy will remain a central strategy in realizing sustainable development, particularly in Indonesia, with goals set to be achieved by 2045 [65].

3.2 Key drivers, barriers, and strategies at the global level

The next step after carrying out the SLR analysis is to identify key drivers, barriers and strategies for circular economy and sustainability practices in the global textile and fashion industries based on the findings of previous related research.

The data presented in Table 2 relates to the identification of key drivers of circular economy practices and sustainability in the global textile and fashion industries. Based on the data, it is clear that the government is the primary key stakeholder in driving circular economy practices and sustainability in the global textile and fashion industries, particularly in countries across Europe, Asia, Australia, South America, and Africa. The key drivers are government policies, subsidies and regulations relevant to circular economy practices, legal issues, and pressures. These key drivers fall under the social and environmental sustainability dimensions [1, 14, 29, 46, 66-76].

Producers are the second key stakeholder driving circular economy practices and sustainability in the global textile and fashion industries, particularly in countries across Europe, Asia, Australia, and South America. Their key drivers include increased knowledge, awareness, commitment, productivity and efficiency, profit or benefits from waste reduction, and meeting circular and green product export requirements. These key drivers fall within the economic, social, and environmental sustainability dimensions [14, 46, 66-70, 73-77].

Table 2. Key drivers of circular economy practices and sustainability in the global textile and fashion industries

Code of Drivers	Key Drivers	Stakeholders	Sustainability Dimension	Frequency of Mentions	Percentage of Total Mentions	Location of Study	Ref.
KD-G-SE	Government policies, subsidies and regulations relevant to circular economy practices, legal issues and pressures	Government	Social and environmental dimensions	15	33.3%	Poland, China, UK, Tanzania, Canada, Indonesia, Brazil, Belgium, Finland, Pakistan, Australia, Portugal, Sweden, Scandinavia, Italy	[1, 14, 29, 46, 66-76]
KD-P-SEE	Increased knowledge, awareness, commitment, productive and efficiency, profit or benefit from waste reduction and meet circular and green product export requirements	Producers	Social, economic and environmental dimensions	12	26.7%	UK, Tanzania, Canada, China, Belgium, Finland, Pakistan, Australia, Portugal, Hong Kong, Sweden, Scandinavia, Italy, Brazil	[14, 46, 66-70, 73-77]
KD-C-SEE	Increased consumer environmental and social awareness, trends, concern, ethic, economic growth and environmental impact	Consumers	Social, economic and environmental dimensions	11	24.4%	Poland, UK, Tanzania, Canada, China, Belgium, Finland, Pakistan, Australia, Portugal, Italy	[1, 14, 66, 67, 70, 73-79]
KD-P-SE	Appropriate technology and digitalization, ecological innovation, industrial managerial capabilities, production processes and market strategies	Producers	Social and environmental dimensions	7	15.6%	Poland, Indonesia, Pakistan, Finland, Portugal, Brazil	[1, 26, 29, 46, 67, 75, 80]

The third key stakeholder is consumers, whose key drivers include increased environmental and social awareness, trends, concern, ethics, economic growth, and environmental impact. These key drivers fall within the economic, social, and environmental sustainability dimensions and are primarily found in several countries across Europe, Asia, Australia, and Africa [1, 14, 66, 67, 70, 73-79]. Papamichael et al. [22] conducted a study on consumer behavior toward circular fashion products, finding that the higher the level of consumer education, the greater their awareness of circular and sustainable fashion products. Therefore, it is crucial to provide education to consumers with lower education levels to increase their awareness, particularly regarding environmentally friendly fashion products.

Based on the Pareto analysis of the key drivers, as shown in Figure 5, it was found sequentially that the government, producers, and consumers are prioritized as key stakeholders. These prioritized key drivers (KD-G-SE, KD-P-SEE, and KD-C-SEE) contribute 80% to the achievement of circular economy practices and sustainability in the global textile and fashion industries. Therefore, based on the recommendations from the Pareto analysis results, there are three prioritized key drivers. These can serve as a strong motivation for circular economy practices and sustainability in the textile, fashion, and batik industries. The Pareto analysis results can also be used as a reference in designing key strategies according to the key drivers, particularly in the Indonesian batik industries.

Table 3. Key barriers of circular economy practices and sustainability in the global textile and fashion industries

| Code of Barriers	Key Barriers	Stakeholders	Sustainability Dimension	Frequency of Mentions	Percentage of Total Mentions	Location of Study	Ref.
KB-P-SE1	Lack of knowledge, skills, managerial capability, motivation and awareness for circular economy and sustainable product development	Producers	Social and environmental dimensions	33	21.6%	India, Pakistan, Italy, Turkey, Taiwan, Europe, UK, West Africa, Iran, China, Norway, Ghana, Finland, Spain, Brazil, Sweden, Canada, Tanzania, China, Netherlands	[6, 12, 14, 23, 25, 28, 47, 70, 75, 77, 81-103]
KB-P-EE	High financial investment, difficulty in accessing financial capital, costly raw materials, infrastructure and hazardous waste maintaining, unpredictable market demand	Producers	Economic and environmental dimensions	27	17.6%	India, Italy, Pakistan, Bangladesh, Taiwan, Netherlands, UK, Turkey, France, China, West Africa, Iran, Finland, Spain, Brazil, Tanzania, Canada, Poland, Scandinavia	[1, 6, 12, 14, 23, 25, 28, 47, 69, 70, 75-77, 81, 84, 86-88, 93, 102, 104-109]
KB-C-SEE	Lack of knowledge, motivations and awareness in the circular initiatives and willingness to pay for eco-friendly products, poor customer demand, and difficulty of changing behaviours and attitudes to circular product and strategies	Consumers	Social, economic and environmental dimensions	25	16.3%	Italy, UK, Bangladesh, Netherlands, Taiwan, Turkey, Poland, Germany, Finland, Brazil, Australia, Canada, Tanzania, China, Indonesia, Australia, European Union, Brazil	[3, 6, 8, 14, 25, 28, 29, 66, 76, 81, 83, 93, 98, 102-104, 107, 109-115]
KB-G-SE	Lack of government regulations, support, certifications and incentives for eco-friendly policies and obligation to circular economy practices	Government	Social and environmental dimensions	24	15.7%	Italy, Pakistan, UK, Bangladesh, Netherlands, Taiwan, Turkey, Poland, West Africa, Iran, India, China, Spain, Finland, France, Indonesia, European Union	[6, 12, 23, 25, 28, 29, 47, 75-77, 81, 83-85, 87-89, 93, 102, 104, 116, 117]
KB-P-SE2	Lack of circular economy business models innovation and technology (in collection, separation, recycling and designing eco-friendly product)	Producers	Social and environmental dimensions	23	15%	India, Pakistan, Italy, Europe, UK, Bangladesh, Netherlands, Taiwan, Turkey, Poland, India, China, Germany, Finland, Denmark, US, China, Tanzania, Canada, Scandinavia	[6, 8, 12, 14, 25, 47, 69, 76, 81-83,85-89, 93,102, 104, 110, 111, 118, 119]
KB-P-S	Lack of Supply chain management, commitments, shared vision and involvement of top management, supply chain complexity and collaboration	Producers	Social dimension	21	13.7%	Italy, Pakistan, Bangladesh, Europe, Taiwan, Turkey, China, India, West Africa, Poland, UK, Ghana, Brazil, Southeast Asian, Scandinavia	[1, 6, 12, 25, 28, 47, 69, 70, 75, 81, 82, 85-89, 91, 94, 103, 104, 120]
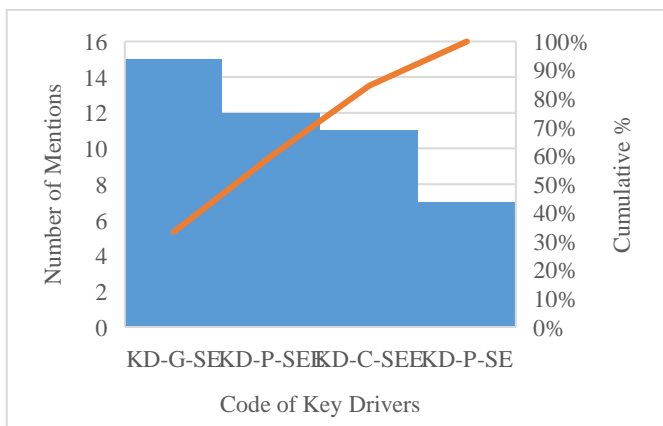
Figure 5. Pareto diagram: prioritization of key drivers

The data presented in Table 3 relates to the identification of key barriers to circular economy practices and sustainability in the global textile and fashion industries. Based on the data, it is evident that producers are the first and second key stakeholders in hindering circular economy practices and sustainability in the global textile and fashion industries, particularly in countries across Europe, Asia, South America, and Africa. The first key barrier falls under the social and environmental dimensions, which include a lack of knowledge, skills, managerial capability, motivation, and awareness for circular economy and sustainable product development [6, 12, 14, 23, 25, 28, 47, 70, 75, 77, 81-103]. The second key barrier falls under the economic and environmental dimensions, such as high financial investment, difficulty in accessing financial capital, costly raw materials, infrastructure and hazardous waste management, and unpredictable market demand [1, 6, 12, 14, 23, 25, 28, 47, 69, 70, 75-77, 81, 84, 86-88, 93, 102, 104-109].

Consumers are the third key stakeholder in hindering circular economy practices and sustainability in the global textile and fashion industries, particularly in countries across Europe, Asia, Australia, South America, and Africa. The key barrier in this case falls under the social, economic, and environmental dimensions, including a lack of knowledge, motivation, and awareness in circular initiatives, unwillingness to pay for eco-friendly products, poor customer demand, and difficulty in changing behaviors and attitudes toward circular products and strategies [3, 6, 8, 14, 25, 28,29, 66, 76, 81, 83, 93,98, 102-104, 107, 109-115].

Papamichael et al. [22] conducted a study on consumer behavior toward circular fashion products, it was found that barriers such as a lack of education and awareness hinder the widespread adoption of sustainable fashion practices. Therefore, educating consumers is essential to raise their awareness of circular and sustainable fashion.

The fourth key stakeholder is the government, with the key barrier falling under the social and environmental dimensions, such as a lack of government regulations, support, certifications, and incentives for eco-friendly policies and obligations to circular economy practices. This fourth key barrier is mainly found in several countries across Europe, Asia, and Africa [6, 12, 23, 25, 28, 29, 47, 75-77, 81, 83-85, 87-89, 93, 102, 104, 116, 117].

Puglia et al. [121] reviewed government policies in Europe and highlighted their key role in enabling and accelerating the transition to a circular economy, particularly in the textile and fashion industries. The study identifies several gaps, including insufficient focus on replacing the linear economy, an overemphasis on the beginning and end of the resource life cycle with neglect in the core stages, the dominance of external over internal policy measures, and inadequate policy coverage that addresses key actors, infrastructure, and resources.

Abdelmeguid et al. [10] conducted a study examining the significance levels of challenges identified in the literature to assist top management in shaping strategies. Decisions will be made and prioritized based on the key challenges to ensure the successful and effective implementation of circular economy practices in the fashion industry. The findings indicate that regulatory pressures, along with poor management and leadership, are the most significant challenges. Therefore, achieving a successful and effective circular economy implementation requires adjustments in managerial strategies.
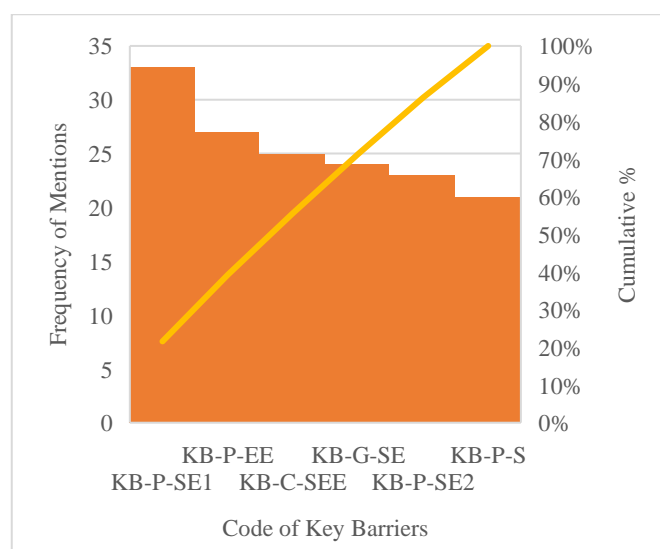

Figure 6. Pareto diagram: prioritization of key barriers

Based on the Pareto analysis of the key barriers, as shown in Figure 6, it was found sequentially that the producers, consumers, and government are prioritized as key stakeholders. These prioritized key drivers (KB-P-SE1, KB-P-EE, KB-C-SEE, and KB-G-SE) contribute 80% to the inhibition of circular economy practices and sustainability in the global textile and fashion industries. Therefore, based on the recommendations from the Pareto analysis results, there are four prioritized key drivers. These can serve as a strong blockage for circular economy practices and sustainability in the textile, fashion, and batik industries. The Pareto analysis results can also be used as a reference in designing key strategies according to the key barriers, particularly in the Indonesian batik industries.

Although regulations can serve as a key driver, poor implementation can turn them into barriers. Therefore, the focus should be on addressing weaknesses in regulations to maximize their benefits. In developed countries, strong environmental regulations have been a major driver for the adoption of circular economy practices. Conversely, in developing countries, inconsistent regulations often act as barriers. Environmentally friendly technology can serve as a driver if it is widely available and affordable. However, if the costs are too high or it is difficult to access, it becomes a barrier for many industry players, especially SMEs.

Table 4. Key strategies for circular economy practices and sustainability in the global textile and fashion industries

| Code of Strategies	Main Strategies	Stakeholders	Sustainability Dimension	Number of Mentions	Percentage of Total Mentions	Location of Study	Ref.
KS-P-SEE	Practicing green design, sustainable innovation, selection and consumption of resources (raw materials, energy and water), recycling or upcycling, extra marketing, internal research and development	Producers	Social, economic and environmental dimensions	11	36.7%	Pakistan, Germany, Brazil, India, Indonesia, Netherlands, Malaysia	[3, 21, 24, 26, 41, 47, 102, 122-125]
KS-PC-SEE	Training program to increase motivation on eco-innovations, awareness and knowledge about technology, trends and ethic, process design and green products as well as social, economic and environmental benefits	Producers and Consumers	Social, economic and environmental dimensions	10	33.3%	Swedish, Pakistan, India, Taiwan, China, Malaysia, Brazil	[3, 32, 41, 47, 87, 124-127]
KS-G-SE	Development of green policies (R&D, providing incentives and subsidies to industries that practice CE) and cross-sector collaboration	Government	Social and environmental dimensions	9	30%	Pakistan, India, Taiwan, United States, China, Swedish	[32, 47, 86, 87, 124, 128-131]
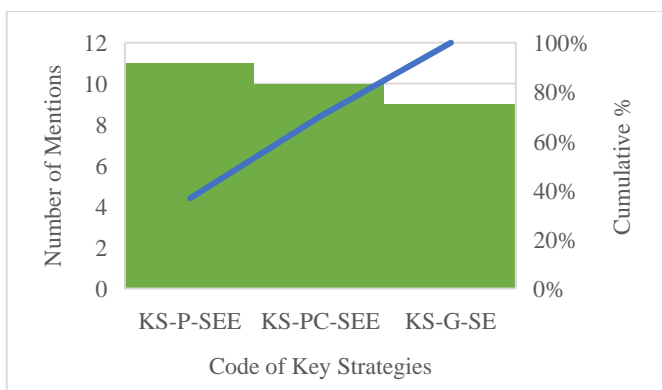
Figure 7. Pareto diagram: prioritization of key strategies

The data presented in Table 4 shows the key strategies for circular economy practices and sustainability in the global textile and fashion industries, which should be prioritized sequentially according to the number of mentions. The first strategy specifically relates to producers, involving practicing green design, sustainable innovation, selection and consumption of resources (raw materials, energy, and water), recycling or upcycling, extra marketing, and internal research and development [3, 21, 24, 26, 41, 47, 102, 122-125]. The second strategy relates to both producers and consumers, particularly in training programs to increase motivation on eco-innovations, awareness, and knowledge about technology, trends, ethics, process design, and green products, as well as their social, economic, and environmental benefits [3, 32, 41, 47, 87, 124-127].

Klemm and Kaufman [132] conducted a study on consumer acceptance of new circular products. The overall findings reveal that consumers value circular attributes, particularly durability, when purchasing fashion and textile products. However, the study also highlights challenges in designing products that are easier to recycle and price competitively. Recommendations to address these challenges include involving consumers in product design and development, as well as creating policies that internalize the social and environmental impacts of fast fashion.

The strategic priorities involve producers as the key stakeholders in the effort to implement circular economy practices and sustainability in the global textile and fashion

industries, followed by consumers and then the government. Based on the Pareto analysis results, as shown in Figure 7, it is evident that the key recommended strategies from global research are closely related to producers and consumers, while strategies involving the government appear to be of lower priority. This means that the key determinants or main contributors to the success of circular economy practices and sustainability in the global textile and fashion industries are producers and consumers.

Abdelmeguid et al. [11] conducted a study addressing the need for a transition toward sustainable and circular practices by exploring the connection between management strategies and behavior across the fashion value chain. The study offers recommendations to stakeholders, including producers, consumers, and governments, to promote more sustainable and circular behaviors in the fashion industry. For instance, the approach highlights the importance of strategic partnerships with suppliers, waste management companies, and consumers to minimize waste and enhance circularity throughout the value chain. It urges the use of sustainable materials and eco-friendly designs for environmentally conscious consumers, while promoting visual storytelling for greater transparency. Moreover, the study underscores the need for circular business models, recommending on-demand and custom-fit manufacturing to align production with demand and reduce overproduction. It also suggests end-of-life strategies, such as take-back programs, recycling initiatives, and repair services, to extend product life cycles and create sustainable value.

Dace et al. [63] identified barriers across four key sectors-construction, chemicals, plastics, and textiles-that face significant challenges in the current linear economy and are in critical need of sustainable transitions. Across these sectors, cultural and structural obstacles were found to be the most prominent. The lack of incentives for changing consumer behavior and insufficient stakeholder collaboration were the most frequently cited barriers in the literature. From a value chain perspective, most obstacles were linked to material processing and product manufacturing stages. Lastly, potential solutions drawn from gray literature were suggested to bridge gaps and address these identified barriers. Many of the challenges were common across the four sectors, indicating that broader, cross-sectoral solutions could effectively support the transition towards sustainability.

3.3 Key strategies for Indonesian batik industries

The identification and analysis of key drivers, barriers, and strategies for circular economy and sustainability practices in the global textile and fashion industries then serve as a reference for designing strategies to be recommended for the batik industries in Indonesia. Tables 5 and 6 and Figure 8 display the results of the analysis and strategy design recommended for the batik industries in Indonesia. These recommended strategies are designed based on research conducted in many countries around the world, reflecting similarities in economic, social, and environmental dimensions. These findings come from various studies conducted globally, especially from countries across Europe,

Asia, North America, South America, Australia, and even Africa. The recommended key strategies have been validated through in-depth interviews with relevant stakeholders, including the Chairman of the Batik Industry Association in Sleman, D.I. Yogyakarta, Indonesia, who oversees 42 batik industry groups, each comprising 15-20 batik industries. These findings were further confirmed by the Indonesian public and batik consumers through a survey assessing their perceptions, knowledge, behavior and awareness, involving 152 respondents. Additionally, alignment was ensured with the Regulation of the Minister of Industry of the Republic of Indonesia Number 10 of 2023 concerning Green Industry Standards for the Batik Industry.

Table 5. Recommended strategies based on key drivers according to the Pareto Principle for circular economy practices and sustainability in the Indonesian batik industry (the author's elaboration)

Code of Strategies	Pareto Principle's Key Drivers	SWOT Factors	Stakeholders	Sustainability Dimension	Recommended Strategies
MD-G-SE	Government policies, subsidies and regulations relevant to circular economy practices, legal issues and pressures	External factors (opportunities)	Government	Social and environmental dimensions	Development of green policies (R&D, providing incentives and subsidies to industries that practice CE) and cross-sector collaboration
MD-P-SEE	Increased knowledge, awareness, commitment, productivity and efficiency, profit or benefit from waste reduction and meet circular and green product export requirements	Internal factors (strengths)	Producers	Social, economic and environmental dimensions	Practicing green design, sustainable innovation, selection and consumption of resources (raw materials, energy and water), recycling or upcycling, extra marketing, internal research and development
MD-C-SEE	Increased consumer environmental and social awareness, trends, concern, ethic, economic growth and environmental impact	External factors (opportunities)	Consumers	Social, economic and environmental dimensions	Training program to increase motivation on eco-innovations, awareness and knowledge about technology, trends and ethic, process design and green products as well as social, economic and environmental benefits

Table 6. Recommended strategies based on key barriers according to the Pareto Principle for circular economy practices and sustainability in the Indonesian batik industry (the author's elaboration)

Code of Strategies	Pareto Principle's Key Barriers	SWOT Factors	Stakeholders	Sustainability Dimension	Recommended Strategies
MB-P-SE1	Lack of knowledge, skills, managerial capability, motivation and awareness for circular economy and sustainable products development	Internal factors (weaknesses)	Producers	Social and environmental dimensions	Training program to increase motivation on eco-innovations, awareness and knowledge about technology, trends and ethic, process design and green products as well as social, economic and environmental benefits
MB-P-EE	High financial investment, difficulty in accessing financial capital, costly raw materials, infrastructure and hazardous waste maintaining, unpredictable market demand	Internal factors (weaknesses)	Producers	Economic and environmental dimensions	Practicing green design, sustainable innovation, selection and consumption of resources (raw materials, energy and water), recycling or upcycling, extra marketing, internal research and development
MB-C-SEE	Lack of knowledge, motivations and awareness in the circular initiatives and willingness to pay for eco-friendly products, poor customer demand, and difficulty of changing behaviors and attitudes to circular product and strategies	External factors (threats)	Consumers	Social, economic and environmental dimensions	Training program to increase motivation on eco-innovations, awareness and knowledge about technology, trends and ethic, process design and green products as well as social, economic and environmental benefits
MB-G-SE	Lack of government regulations, support, certifications and incentives for eco-friendly policies and obligation to circular economy practices	External factors (threats)	Government	Social and environmental dimensions	Development of green policies (R&D, providing incentives and subsidies to industries that practice CE) and cross-sector collaboration

The data displayed in Tables 5 and 6 represent the recommended strategies specifically for circular economy practices and sustainability in the Indonesian batik industry. These recommended strategies were generated through a process of extraction and synthesis of key drivers, barriers, and prioritized strategies based on the results of the Pareto analysis. The extraction and synthesis process were conducted using content analysis methods. The stages of the process included identification, screening, eligibility, determining the most relevant references, Pareto analysis, and the determination of internal and external factors according to the Strengths, Weaknesses, Opportunities, Threats (SWOT) framework. Based on internal factors such as strengths and weaknesses, and external factors such as opportunities and threats—which include each of the prioritized key drivers, key barriers, and key strategies aligned with relevant stakeholders—the key strategies for the Indonesian batik industry were then recommended. These key strategy recommendations have been tailored to the environmental, social, and economic characteristics of Indonesia.

Several studies in Indonesia have highlighted the drivers and barriers to circular economy practices and sustainability in the batik industry. Gunawan et al. [29] conducted an exploratory study on institutional obstacles and drivers of sustainability in Indonesia's batik industry, which is renowned for its cultural heritage and plays a crucial role in the country's identity. They found that a lack of customer knowledge, along with socio-cultural factors and regulations, posed significant barriers to sustainability in the batik industry. Meanwhile, ecological, technological, socio-cultural, and political factors were identified as key drivers of sustainability goals.

Additionally, Nugroho et al. [40] assessed the sustainability of a batik industry in Pekalongan, Indonesia, which uses natural dyes. Their analysis employed five environmental, four economic, and six social indicators, resulting in a sustainability score of 77.50, classifying the industry as sustainable. The use of natural dyes emerged as a key strategy for enhancing sustainability in batik production. In terms of circular economy practices, batik industries using natural dyes have adopted the highest circular strategy, "refuse," which entails rejecting environmentally harmful raw materials.

Previously, Budi et al. [31] examined the drivers and barriers to sustainability in the batik industry of Laweyan, Surakarta. The study revealed that the primary driver was the enforcement of environmental regulations and strict oversight, while the main barrier was the lack of subsidies to support sustainable practices in the batik industry. However, research on circular economy practices and sustainability in Indonesia's batik industry remains scarce and fragmented, with no comprehensive studies addressing drivers, barriers, and recommended intervention strategies. Therefore, this research aims to contribute to a deeper understanding of key drivers, barriers, and strategic interventions in circular economy and sustainability practices, specifically in Indonesia's batik industry and, more broadly, in batik industries in other developing countries.

These barriers result in a slow transition of the batik industry toward sustainability, both in terms of environmental impact and economic competitiveness. These implications also create pressure on industry players to urgently seek solutions, such as training, government incentives, raising consumer awareness, and investing in environmentally friendly technologies. Without addressing these barriers, the batik industry risks losing its competitiveness in the global market, which increasingly demands high sustainability standards. In detail, the recommended strategies designed as shown in Tables 5 and 6 are further characterized based on SWOT principles as displayed in Figure 8.

Figure 8 presents the design of key priority strategies for circular economy practices and sustainability in the Indonesian batik industry. Characterizing the strategies based on their sources, the involved stakeholders, and sustainability dimensions is crucial for determining the necessary follow-up actions. Based on the SWOT analysis, the key and priority strategies that need to be pursued become clear. The SWOT analysis yields four recommended strategy models: S-O Strategy, W-O Strategy, S-T Strategy, and W-T Strategy. Each strategy model includes two key and priority strategies based on the Pareto analysis results, as shown in Tables 5 and 6.

S-O Strategy (Leveraging internal strengths to capitalize on external opportunities):
1) Optimize knowledge and awareness to leverage government policies: Utilize existing knowledge and commitment to ensure that companies meet requirements and gain subsidies or support from the government for circular economy practices.
2) Increase productivity and efficiency to meet consumer trends: Leverage operational efficiency to develop products that align with growing consumer trends in environmental and social awareness.

S-T Strategy (Using internal strengths to counter external threats):
1) Leverage knowledge to address customer awareness gaps: Use existing knowledge and awareness to educate the market on the benefits of eco-friendly products, reducing the threat of low demand.
2) Utilize efficiency to overcome a lack of government regulations: Apply efficiency and waste reduction to proactively comply with eco-friendly practices, even in the absence of stringent regulations.

W-O Strategy (Addressing internal weaknesses by exploiting external opportunities):
1) Improve managerial and financial capabilities through government policies: Leverage subsidies and regulatory support to address gaps in managerial skills and access to financial capital.
2) Boost motivation and awareness through consumer trends: Capitalize on increasing consumer awareness to drive internal motivation and the development of sustainable products.

W-T Strategy (Minimizing weaknesses and avoiding threats):
1) Develop internal training programs to overcome skill and knowledge gaps: Address weaknesses in skills and knowledge through internal training, which can also help mitigate the threat of low awareness in circular initiatives.
2) Enhance access to capital through collaboration with the government and financial institutions: Seek partnerships with the government and financial institutions to overcome challenges in accessing capital and high financial investment.
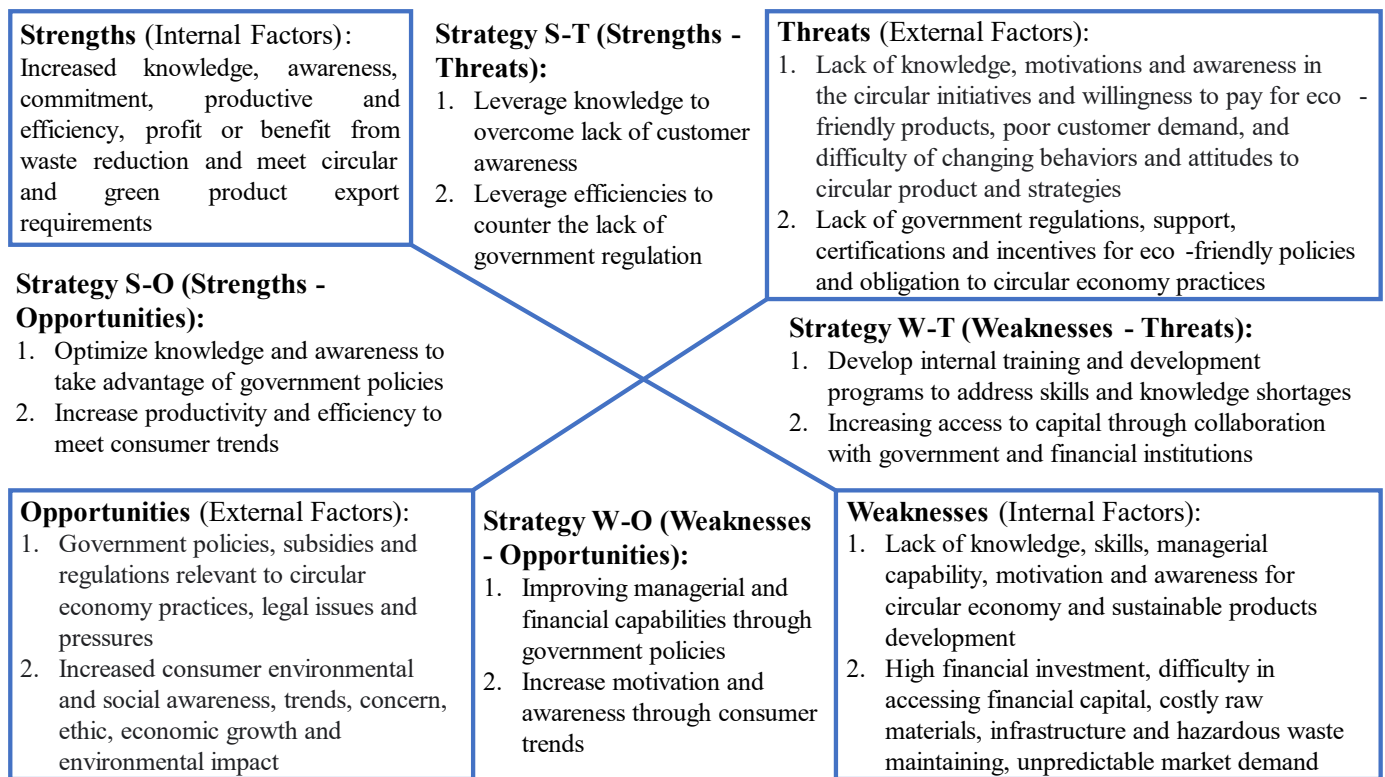
Strengths (Internal Factors):
Increased knowledge, awareness, commitment, productive and efficiency, profit or benefit from waste reduction and meet circular and green product export requirements

Strategy S-T (Strengths - Threats):
1. Leverage knowledge to overcome lack of customer awareness
2. Leverage efficiencies to counter the lack of government regulation

Threats (External Factors):
1. Lack of knowledge, motivations and awareness in the circular initiatives and willingness to pay for eco-friendly products, poor customer demand, and difficulty of changing behaviors and attitudes to circular product and strategies
2. Lack of government regulations, support, certifications and incentives for eco-friendly policies and obligation to circular economy practices

Strategy S-O (Strengths - Opportunities):
1. Optimize knowledge and awareness to take advantage of government policies
2. Increase productivity and efficiency to meet consumer trends

Strategy W-T (Weaknesses - Threats):
1. Develop internal training and development programs to address skills and knowledge shortages
2. Increasing access to capital through collaboration with government and financial institutions

Opportunities (External Factors):
1. Government policies, subsidies and regulations relevant to circular economy practices, legal issues and pressures
2. Increased consumer environmental and social awareness, trends, concern, ethic, economic growth and environmental impact

Strategy W-O (Weaknesses - Opportunities):
1. Improving managerial and financial capabilities through government policies
2. Increase motivation and awareness through consumer trends

Weaknesses (Internal Factors):
1. Lack of knowledge, skills, managerial capability, motivation and awareness for circular economy and sustainable products development
2. High financial investment, difficulty in accessing financial capital, costly raw materials, infrastructure and hazardous waste maintaining, unpredictable market demand

Figure 8. Recommended strategies based on SWOT analysis for circular economy practices and sustainability in the Indonesian batik industry (the author's elaboration)

Referring to the SWOT analysis results outlined in Figure 8, each strategy has specific strengths and weaknesses depending on the industry context and challenges faced.

- The S-O strategy is the strongest, leveraging the synergy between available and measurable internal strengths and external opportunities, supported by market trends and government policies. The S-O strategy stands out by utilizing existing internal strengths, such as knowledge, commitment, and productivity, to capitalize on external opportunities backed by government policies and growing consumer awareness. The synergy between government, market, and technology makes this strategy easier to implement and yields positive long-term impacts.
- The W-T strategy is the weakest due to complex and layered barriers in skills, capital access, and behavioral changes, which take significant time to overcome effectively. Structural and cultural barriers are challenging to address in the short term. Limited capital access, low skills, and slow behavioral shifts make this strategy less effective than others, particularly without substantial support from financial institutions or the government.
- The S-T strategy is fairly strong as it focuses on using internal strengths, such as knowledge and efficiency, to address external threats, like low consumer awareness and regulations. However, results may be slow and depend on consumer behavior changes and regulatory environments.
- The W-O strategy has great potential, leveraging government policies and consumer trends to improve internal weaknesses in management and motivation. However, it is also vulnerable to policy uncertainty, with long-term results that take time to achieve.

Compared to S-O and W-T, the S-T and W-O strategies are moderate in strength and weakness. While impactful, they require more time and depend on many external factors to achieve optimal results. Thus, implementing strategies focused on optimizing knowledge, innovation, and leveraging existing policies is more realistic and brings significant outcomes for the Indonesian batik industry.

Implementation of S-O and S-T Strategies in the Indonesian Batik Industry

1) Optimize Knowledge and Awareness to Leverage Government Policies

In the Indonesian batik industry, strengths such as knowledge and awareness of circular economy and eco-friendly products must be maximized to take advantage of government policies. The Indonesian government has initiated various green economy regulations, such as Government Regulation No. 46 of 2021 concerning the Management of Hazardous Waste (B3) and the promotion of circular economy efforts. Batik producers need to further study these policies to ensure they meet the requirements, such as by obtaining eco-friendly certifications and utilizing government subsidies for environmentally friendly technologies.

Related Stakeholders:
- Producers: Responsible for complying with policies and adopting eco-friendly technologies.
- Government: Provides regulations and subsidies related to circular economy and waste management.

2) Increase Productivity and Efficiency to Meet Consumer Trends

With increasing consumer awareness of eco-friendly products, the batik industry must enhance production efficiency. This includes reducing chemical dye waste and reusing unused materials in the production process.

Related Stakeholders:
- Producers: Implement more efficient technology and

innovation.

- Consumers: Appreciate and choose eco-friendly batik products.
- Government: Provides regulations and incentives for eco-friendly products.

Implementation of W-O and W-T Strategies in the Indonesian Batik Industry

3) Improve Managerial and Financial Capabilities through Government Policies

Weaknesses in management and access to capital can be overcome by leveraging government policies that support the development of small and medium-sized enterprises (SMEs). Programs like KUR (People's Business Credit) or environmental grants can be utilized to promote managerial development in the batik industry.

Related Stakeholders:

- Producers: Utilize training and financial assistance.
- Government: Provides training programs and capital access for better management development.

4) Increase Motivation and Awareness through Consumer Trends

Capitalizing on environmentally-conscious consumer trends can drive internal motivation for producers. With high demand for eco-friendly products, batik producers need to foster an internal culture that emphasizes sustainability.

Related Stakeholders:

- Producers: Play an active role in increasing internal awareness.
- Consumers: Support through purchasing eco-friendly products.
- Education: Educate future workforce about circular economy.

5) Develop Training Programs to Address Skill Gaps

The batik industry faces challenges in the lack of skills related to the circular economy. Therefore, training programs focused on using environmentally friendly technology and waste management are essential.

Related Stakeholders:

- Producers: Actively implement training programs.
- Government: Provide training and certification for workers.
- Workers: Acquire new skills to increase efficiency and sustainability in the production process.

6) Improve Access to Capital through Collaboration with the Government

To address challenges in accessing capital, the batik industry needs to collaborate with the government and financial institutions. This includes leveraging green financing programs and incentive schemes for SMEs transitioning to a circular economy.

Related Stakeholders:

- Producers: Play a role in applying for capital access.
- Government and financial institutions: Provide affordable financial support.

4. CONCLUSIONS

Based on the findings from the combination of SLR, Pareto, and SWOT analysis of the study, several important conclusions can be drawn regarding the implementation of circular economy and sustainability practices in the Indonesian batik industry. The combination of SLR, Pareto, and SWOT analysis has provided a comprehensive framework for advancing circular economy and sustainability practices in the Indonesian batik industry. The integration of environmental, social, and economic considerations in these strategies will be critical for ensuring the long-term sustainability and competitiveness of the batik industry, both locally and globally. Key stakeholders such as producers, the government, and consumers all have significant roles in realizing a more sustainable batik industry that is responsive to the growing global market demand for sustainability.

The SWOT analysis yielded four key strategic models (S-O, S-T, W-O, and W-T), which were then translated into actionable recommendations:

- S-O Strategy (Strengths-Opportunities): By optimizing existing knowledge and awareness of circular economy principles, batik producers can capitalize on government policies promoting eco-friendly practices. This strategy emphasizes utilizing government subsidies for technological investments and improving operational efficiency to meet the rising demand for sustainable batik products.
- S-T Strategy (Strengths-Threats): Leveraging the industry's operational strengths, producers can proactively address external threats such as insufficient customer awareness by educating consumers about the environmental benefits of eco-friendly batik products. Additionally, demonstrating compliance with sustainability practices, even in the absence of stringent regulations, can help mitigate potential risks.
- W-O Strategy (Weaknesses-Opportunities): The lack of managerial skills and access to capital in the industry can be overcome by utilizing government programs and consumer-driven sustainability trends. This strategy includes leveraging financial support schemes such as green financing and promoting managerial training to enhance business operations.
- W-T Strategy (Weaknesses-Threats): To minimize weaknesses and avoid external threats, the batik industry needs to develop internal training programs and collaborate with the government to improve skills and secure financial access. These initiatives will help batik producers transition to more sustainable practices while addressing skill gaps and reducing reliance on unsustainable production methods.

The results of this study provide valuable insights for the Indonesian batik industry and similar industries in other developing countries. For the Indonesian batik sector, the study highlights key strategies to overcome challenges and leverage opportunities for implementing circular economy practices. By addressing barriers like limited consumer awareness and regulatory gaps, and promoting the use of sustainable technologies such as natural dyes and efficient waste management, the industry can enhance its environmental sustainability while maintaining cultural heritage. For batik industries in other developing nations, the study offers a framework for aligning traditional practices with global sustainability goals. The recommended strategies, including government collaboration, financial access, and skills development, can be adapted to local contexts, helping these industries adopt eco-friendly practices while improving competitiveness in the global market. The findings underscore the importance of integrating economic, social, and

environmental dimensions for long-term sustainability and growth.

The study's reliance on qualitative analysis, such as SWOT and Pareto, may limit the generalizability of the results across different batik-producing regions with varying levels of economic and technological development. For future research, deeper empirical studies focusing on the Indonesian batik industry are needed to validate these findings through primary data collection. There is also a need for research that explores the effectiveness of the recommended strategies in practice, particularly those involving government policy and consumer behavior. Furthermore, future studies should investigate the integration of advanced sustainable technologies in batik production and assess their impact on both the environment and industry profitability.

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