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Implementation of Circular Economy Model in Textile Industry in Purwakarta: Innovative Strategy Towards Sustainable Production

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ABSTRACT

This Study Aims to examine the implementation of the circular economy model in textile industry in Purwakarta Regency, West Java. Using a qualitative approach and case studies from some textile companies. The research explores the application of waste reduction (reduce), Reuse and Recycling with production operations. Data were collected through in depth interviews, field observations, and documentation, and analyzed using the miles and Huberman interactive analysis model. The findings indicate that circular economy practices have been partially implemented, particularly in water efficienscy, waste management, and fabric residue processing. However, implementation still faces challenge such as limited technology, low internal awareness, and suboptimal support from local government policies. The study recommends a synergetic collaboration between industry players, government, and academia to foster a sustainable circular economy ecosystem in the textile sector

Keywords: Circular Economy; Textile Industry; Sustainability

INTRODUCTION

[The global textile industry produces over 92 million tonnes of waste annually, accounting for around 10% of global carbon emissions (Sari, 2024). The textile industry is also the world's fourth-largest consumer of raw materials and water (Oprak and Anis, 2017). Public awareness of the environmental and social impacts caused by the industry has increased the demand for a transition from a linear economy to a circular economy (Hultberg, 2021). The circular textile economy minimizes the resource-intensive consumption of circular business models that create, capture, and deliver value, increasing resource efficiency and extending product life (Siderius and Poldner, 2021). The circular economy triggers restorative and regenerative industrial systems, from product design to life cycle (Neto et al., 2021). The circular economy provides an alternative to virgin natural resource consumption, through the recovery and reuse of products and materials at end-of-life, including design for the environment that contributes to sustainability (Mitchell, 2015). In Indonesia, this sector plays an important role in the national economy, but also contributes significantly to water pollution and solid waste. The dominant linear economic model—production, consumption, and disposal—has proven to be unsustainable.

Purwakarta Regency, West Java, is known as one of the national textile industry centers. More than 100 small—to large-scale textile business units operate in this area, especially in Campaka, Babakancikao, and Jatiluhur Districts. With a high industry concentration, this area faces significant ecological pressures, including river pollution and declining groundwater quality.

In this context, the circular economy approach is important as a transformative strategy that focuses on economic efficiency and environmental sustainability. The circular economy emphasizes the 9R principle (Refuse, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover) to maintain the value of resources as long as possible in the production cycle. Unlike the linear economic model, which is exploitative and exclusive, the circular economy carries inclusive and regenerative values (Nobre, 2021).

However, implementing the circular economy in the textile sector, especially at the regional level, such as Purwakarta, has not been studied in depth. The existing studies are still macro and tend to focus on metropolitan areas. Therefore,

this study is important to understand how the principles of the circular economy have (or have not) been applied in the Purwakarta textile industry and the obstacles and opportunities faced in the transition process.

The circular economy offers a new paradigm emphasizing a closed production and consumption cycle (Kircherr,2021). This approach includes product redesign, optimization of resource use, and strategic waste management. This study aims to analyze the potential for implementing a circular economy model in the textile industry in Purwakarta, by highlighting implementation strategies, obstacles, and potential added value.

Rahmawati and Yusuf have conducted several studies on the circular economy (Rahmawati et al, 2024) who studied the circular economy strategy in textile MSMEs in Bandung and found that reusing fabric waste into new fashion products increased sales value and reduced the burden on the TPA (Final Disposal Site). Then, Simanjuntak et al. (2020) in their research on large-scale industries in West Java showed that limited capital and technology were the main obstacles to implementing a circular economy. Sari et al. (2022) emphasized the importance of the role of local governments in providing incentives and supporting regulations so that industry players are encouraged to transform to a sustainable production system.

RESEARCH METHOD

This research is qualitative research with a case study approach. This approach was chosen to gain a deep understanding of the application of circular economy principles in the textile industry in Purwakarta Regency, especially from the operational aspects, internal company policies, and perceptions of industry players. Data were collected through literature studies, policy documents related to the circular economy, field observations, and semi-structured interviews with five industries and five textile MSMEs in Purwakarta Regency, focusing on textile industry players and MSMEs that have waste processing units or sustainability initiatives. The subjects and research criteria can be seen in Table 1.

Table 1. Research Subjects and Industry Criteria

	Subject and Criteria
Research Subject	1. Production leader or manager 2. Environmental or K3 (Occupational Health and Safety) staff 3. Waste processing operator
Industry Criteria	1. Have medium to large production volumes 2. Have a waste management or energy efficiency program 3. Willing to provide data access and interviews

SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis is conducted to identify Strengths: internal factors that support the circular economy; Weaknesses: internal barriers to implementation; Opportunities: external factors that support sustainability; and Threats: external challenges that hinder transformation. The SWOT results are then mapped in a strategy matrix.

RESULTS AND DISCUSSION

RESULTS

Circular economy is defined as an economic system that aims to eliminate waste and continue to use resources (Hutberg and Pal, 2021). In the context of the textile industry, this involves designing recyclable products, using biodegradable materials, and taking-back and remanufacturing systems (Neto et al., 2022). Various models have been developed to support this transition, including Cradle to Cradle (C2C), Product-Service System (PSS), and Closed Loop Supply Chain (CLSC). Previous studies indicate that adopting a circular economy can increase cost efficiency by up to 20% and reduce carbon emissions by up to 30% in the textile industry (Siderius and Poldner, 2021). The textile industry in Purwakarta is dominated by MSMEs (70%) that produce ready-to-wear and woven fabrics, with 30% of large companies focusing on exports. Based on observations, 80% of waste in the form of fabric scraps is disposed of without processing, and only 10% of companies have a wastewater recycling system. Local communities' consumption of fast fashion increases the volume of textile waste by 15% per year. Based on the results of interviews and observations, there are several circular economy practices that have been implemented by textile companies in Purwakarta, as can be seen in Table 2.

Table 2. Current Conditions of the Circular Economy Implemented

Reduce	*Reuse*	*Recycle*
• Companies A and B implement water and energy efficiency with a closed-loop cooling system and the reuse of water from the dyeing process.	• Waste fabric scraps are processed into basic materials for craft products such as recycled bags, industrial mops, and pillow filling materials.	• The remaining yarn and fiber are reprocessed into open-end yarn (recycled yarn), which is used for non-fashion products such as industrial carpets.
• Reduction of chemical waste through an automated dosing system, which reduces chemical residue by up to 25%.	• Company C reuses tertiary wastewater (with ozonation) for non-critical processes such as floor washing and machine cooling.	• Sludge from the wastewater treatment plant is dried and used in the local cement industry as an alternative fuel (co-firing).

Although some practices support the circular economy, they have not been running optimally. Interviews with industry players have revealed some challenges faced in implementing the circular economy in the textile industry.

1. Recycling Technology and Infrastructure

Industry players said that technology to recycle textile waste, especially mixed fabrics (i.e polyester and cotton), is still limited in Indonesia. The efficient fiber separation process requires expensive, high-tech equipment not widely available locally. In addition, many modern textile products use a combination of materials that are difficult to recycle. Textile materials often require special technology to be broken down without degrading the fiber quality, which increases the cost and complexity of the process.

2. Economy and Cost

One of the main obstacles is the high cost of adopting circular economy technology and systems, including investment in recycling machines, waste management, and workforce training. Many industry players, especially SMEs, do not have sufficient capital for this transition. In addition, recycled raw materials are often more expensive than new raw materials due to the intensive processing (I. The use of recycled raw materials is not yet fully competitive in the market, especially when competing with cheap imports from countries such as Bangladesh and Vietnam. The last obstacle is price volatility, where the price of textile materials in the global market pressures industry players to adopt a circular economy efficiently, because cost savings from recycling are often not comparable to fluctuations in raw material prices.

3. Regulation and Policy

Industry players stated that although the government has adopted the concept of a circular economy in the 2020-2024 RPJMN, concrete supporting regulations, such as tax incentives for recycling or penalties for waste, are still lacking. Therefore, a more comprehensive policy is needed to support sustainability. Then, regarding the green industry standard, industry players also said that several things are pretty challenging to fulfill, especially those related to technology and funds. The last point regarding regulation is the import policy. Trade policies that do not sufficiently protect the domestic market allow for a flood of cheap textile products from abroad, weakening the bargaining power of local products that implement a circular economy.

4. Social and Cultural

Industry players also said that from a socio-cultural aspect, people in Indonesia are not yet fully aware. Consumers in Indonesia do not fully understand the importance of buying sustainable textile products. The habit of throwing away used clothes without recycling or choosing cheap products over environmentally friendly products hinders market demand for circular products (Koszewska, 2018). Education and HR competency are also things that must be considered. The low competence of human resources in the textile industry, both in terms of technology and

understanding of the circular economy, is an obstacle to implementing the circular economy. Many workers and industry players still use traditional methods that do not support sustainability. The last is the rapid change in fashion trends that encourage mass production and excessive consumption, contrary to the principle of a circular economy that emphasizes the longevity of products. Global Market and Competition Industry players said that the flood of imported textile products from countries with high production efficiency, such as China, has caused a decline in local industry turnover of up to 30% in 2022. This makes it difficult for industry players to invest in more expensive circular practices. In addition, global market demand tends to change; for example, several countries are starting to implement zero-carbon policies, which require sustainable textile products. However, local industry players often have difficulty meeting these standards due to limited technology and costs, thus losing competitiveness in the export market.

Table 3. SWOT Analysis

SWOT Analysis	
Strengths: 1. The large number of industries, plus textile MSMEs, allows flexibility in circular product innovation. 2. Availability of skilled labor, especially women (58% of total workers). 3. Support for local materials such as recyclable cotton and linen. 4. Adoption of simple technology for recycling leftover fabrics by several MSMEs.	**Weaknesses:** 1. The initial cost of recycling technology and environmentally friendly materials is high. 2. Lack of knowledge of business actors about the circular economy (only 20% understand the 3R concept). 3. Minimal textile waste recycling infrastructure. 4. Dependence on imported raw materials (40% of total needs).
Opportunities: 1. Government policy support through PP No. 28/2021 concerning the sustainable industry. 2. Market potential for environmentally friendly products, with 65% of young consumers choosing slow fashion. 3. Pentahelix collaboration (government, industry, academics, community, media) for education and funding. 4. Projected GDP of IDR 593–638 trillion from the circular economy in 2030.	**Threats:** 1. Competition from low-cost fast fashion from abroad. 2. Lack of consumer awareness of the impact of textile waste (only 30% understand this issue). 3. Recycling regulations are not yet strict at the local level. 4. Fluctuations in the price of recycled raw materials are due to limited supply.

Implementing a circular economy in the Purwakarta textile industry can reduce waste by up to 30% through recycling leftover fabrics and using environmentally friendly materials such as organic cotton and tencel. The successful adaptation of a circular economy, such as a local brand at PT Jauh Mata Memandang, shows that circular fashion is environmentally friendly and increases market competitiveness. The SWOT analysis reveals that the main strengths are the flexibility of MSMEs and skilled labor, which can be utilized for product innovation based on 9R (Refuse, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover). However, weaknesses such as high initial costs and minimal recycling infrastructure are significant obstacles. Repp et al. (2022) shows that clothing with a lifespan twice as long can reduce carbon emissions by up to 44%, making slow fashion a strategic solution. Opportunities such as government policy support and environmentally friendly markets must be maximized through pentahelix collaboration. Consumer education and strict regulations can overcome threats such as fast fashion (De Oliviera et al, 2022)

DISCUSSION

The findings of this study indicate that the concept of a circular economy has begun to be adopted by the textile industry in Purwakarta, although it is not yet systematic. Reduce, reuse, and recycle practices have been carried out on a small to medium scale, but have not been fully included in the core business strategy. This finding is in line with research by Simanjuntak et al. (2020), which states that textile industry players in West Java are reactive, not proactive, in adopting a sustainability model. This strengthens the argument that implementing a circular economy

requires collaboration across actors, including government, industry, academics, and civil society. Theoretically, implementing circular economy principles has the potential to increase production efficiency and expand the economic value of industrial waste. However, these efforts are difficult to scale up significantly without adequate systemic and regulatory support.

Table 4. Inovation Strategy

Innovative Strategy	
SO (*Strengths-Opportunities*)	**WO (*Weaknesses-Opportunities*)**
1. Developing circular fashion products based on local materials (cotton, linen) for the eco-friendly market. 2. Establishing MSME cooperatives to share recycling technology and access government funding.	1. Circular economy training for MSMEs through collaboration with local universities. 2. Tax incentives for companies that adopt recycled materials.
ST (*Strengths-Threats*)	**WT (Weaknesses-*Threats*):**
1. Slow fashion promotion through social media to raise consumer awareness. 2. Partnership with local brands for circular product branding.	1. Development of textile waste recycling center in Purwakarta with APBD funds. 2. Local regulations to limit imports of low-quality fast fashion.

SO (Strengths-Opportunities) Strategy

1. Development of circular fashion products based on local materials
   Indonesia has local raw materials such as cotton and linen, which can be produced sustainably with a lower carbon footprint than imported synthetic materials. In addition, several local brands have successfully used natural materials such as pineapple fiber and recycled cotton, proving local expertise in sustainable fashion design. The global market for environmentally friendly products continues to grow, driven by zero-carbon policies in developed countries such as the European Union and increasing consumer awareness of sustainability. According to the Cotton USA Sustainability Forum report, demand for sustainable textiles is increasing along with European regulations such as Extended Producer Responsibility (EPR).
2. Establish a Recycling Cooperative
   Cooperatives can collectively purchase textile fiber recycling machines, such as mechanical recycling technology for cotton, which members use together. To finance the technology, cooperatives can also apply for funding from government programs, such as the Ministry of Industry's Small and Medium Industry Machinery and/or Equipment Restructuring Program. In addition, cooperatives can collaborate with local waste banks to collect post-consumer textile waste, creating an integrated circular supply chain.

WO (Weaknesses-Opportunities) Strategy

1. Circular Economy Training
   Training can focus on topics such as design for circularity (designing products that are easy to recycle), simple recycling technologies (e.g., shredding textile waste), and management of textile industry liquid waste to meet Green Industry Standards (SIH). For example, higher education providers can collaborate with the Purwakarta Industry Office, targeting textile industry players and MSMEs in Purwakarta Regency. This program can be funded through grants from the Ministry of Research, Technology, and Higher Education or sponsorship from major brands such as Cotton USA. Training can include digital marketing modules to promote circular products to environmentally friendly markets, such as through local e-commerce platforms (Tokopedia Green or Shopee). For example, community-based training in Kulonprogo improves the ability of batik artisans to manage natural dye waste (Rahmawati et al., 2024).
2. Tax incentives for companies that adopt recycled materials
   Tax incentives can be designed for companies that use at least 30% recycled materials in their products, such as recycled cotton from garment waste or recycled polyester from plastic bottles. For example, the government can expand the tax holiday scheme for green industries, which currently focuses on renewable energy,

including the circular textile industry (Wahyudin, 2019). This incentive will reduce the financial burden for industry players such as Ever Shine Tex, who have tried to adopt recycled materials but are constrained by costs. In addition, incentives can be combined with sustainability certification (e.g., the Global Recycled Standard) to increase product competitiveness in export markets.

WO (Strengths-Threats) Strategy

1. Promoting slow fashion through social media to raise consumer awareness
   Slow fashion campaigns can be carried out through educational and engaging social media content, such as short videos about the textile waste recycling process or the stories behind making clothes from local materials. For example, industry players can collaborate with local influencers to promote recycled batik with the narrative "one piece, one story". The campaign can target young urban consumers who care about the environment, with hashtags such as #SlowFashionIndonesia or #CircularTextile. In addition, industry players can use e-commerce features on Instagram to sell circular products directly, increasing market access.
2. Partnerships with local brands for circular product branding
   Partnerships with local brands can involve launching collaborative collections that use textile waste from MSMEs, such as batik scraps or recycled cotton. This partnership can include co-branding to increase consumer trust, such as "Daur Ulang Bersama (local product name)". In addition, collaborations can expand access to export markets through the brand's distribution network, which has penetrated the Asian and European markets. For example, collaborations between local brands and international designers at Jakarta Fashion Week can increase the visibility of sustainable products.

WT Strategy (Weaknesses-Threats)

1. Development of textile waste recycling center in Purwakarta with APBD funds
   The Purwakarta regional government can allocate APBD funds to build an integrated textile recycling center that serves industry and MSMEs in the Purwakarta Regency area. This center can be equipped with simple technology, such as a shredder to process textile waste into new fibers, and work with waste banks to collect used clothes. APBD funds can also subsidize initial operational costs, such as operator training and waste transportation. Integrating cooperative industries and MSMEs to distribute the products produced would be better. The success of this project can attract private investment or funding from the Ministry of Industry's Green Economy program.
2. Local regulations to limit imports of low-quality fast fashion
   Local governments at the provincial and district levels can propose local regulations limiting the distribution of low-quality fast fashion products in traditional markets and malls. These regulations can be in the form of minimum quality standards (for example, material durability or recycled content) or additional taxes on imported products below specific standards. For example, the West Java Industry Agency can work with merchant associations to prioritize local products in markets such as the Wholesale Market in Bandung. This regulation can also be combined with the "Love Local Products" campaign to raise consumer awareness. A similar success is the MSME product protection policy in Bali, which increased local craft sales by 15% in two years (Wulandari, 2019).

CONCLUSION

Challenges to implementing a circular economy in the Indonesian textile industry include technological limitations, high costs, lack of supporting regulations, low consumer awareness, and global competition. However, collaboration, innovation, and policy support can be key to overcoming these obstacles. Industry players emphasize that the transition to a circular economy is an environmental necessity and an opportunity to improve the competitiveness and sustainability of the Indonesian textile industry on the global stage.

AUTHOR CONTRIBUTIONS

Conceptualization and Methodology, Formal Analysis, Investigation, M. Amirul Ghiffari; Resources, Data Curation, Rian Christian Sondakh; Writing – Original Draft Preparation, Writing – Review & Editing, Visualization; Ma'ruf Pambudi Nurwantara.

DISCLOSURE

The author reports no conflicts of interest in this work.

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