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Green Innovation in Batik Production as a Sustainability Strategy for MSMEs: A Case Study of the Batik Seng Program

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Abstract
The conventional batik production process often causes environmental problems, particularly due to liquid waste and the use of synthetic chemicals, while support from Corporate Social Responsibility (CSR) programs can play an important role in encouraging sustainable business practices at the local level. This research aims to analyze green innovation in batik production as a sustainability strategy for Micro, Small, and Medium Enterprises (MSMEs) in the Batik Seng Program of Sengguruh Village. The program is part of the CSR initiative implemented by PT PLN Nusantara Power UP Brantas, which focuses on community empowerment through the development of the batik creative industry. The innovations introduced include the use of recycled batik wax and natural dyes as part of a clean production approach. This study employs a qualitative approach using a case study method. Data were collected through interviews, observations, and documentation. The findings reveal that environmentally friendly innovation not only reduces environmental pollution but also increases product added value, expands market opportunities, and strengthens the group's economic and social sustainability. These innovations have become an important strategy for maintaining the competitiveness of village-based MSMEs.

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play an important role in promoting economic growth, creating employment opportunities, and strengthening community economic resilience in many developing countries (Bekele & Muchie, 2009; Hayati & Fatarib, 2022; Sinaga & Sitorus, 2023; Takari et al., 2025). The MSME sector also serves as a key driver of local economic development and cultural preservation through creative industries based on local wisdom (Tambunan, 2019). In Indonesia, several MSME sectors not only support local economies but also contribute to cultural preservation through creative industries rooted in local traditions, one of which is the batik industry. As a globally recognized cultural heritage, batik has significant potential for the development of community-based creative economies. However, conventional batik production processes often generate environmental problems, particularly related to liquid waste, the use of synthetic chemicals, and environmentally unfriendly waste management practices.

Along with the growing global concern for sustainable development, environmentally friendly production practices have become increasingly important for business sustainability, including for MSMEs (Kadaba et al., 2022; Omowole et al., 2024; Ruslaini, 2021; Wielgórka, 2016). The concept of clean production encourages business actors to reduce environmental impacts through efficient resource utilization, waste reduction, and the use of more

environmentally friendly raw materials. Clean production emphasizes resource efficiency, waste minimization, and the use of eco-friendly materials (UNEP, 2010).

In addition to production innovation, support from various stakeholders is also an important factor in strengthening MSME sustainability. Corporate Social Responsibility (CSR) programs implemented by companies can play a significant role in enhancing community capacity, encouraging local innovation, and strengthening the economic sustainability of communities (Carroll & Shabana, 2010). Through CSR programs, companies not only contribute to social and economic development but also encourage more sustainable business practices at the local level.

One example of a sustainability-based community empowerment initiative is the Batik Seng Program in Sengguruh Village, initiated by PT PLN Nusantara Power UP Brantas. The program aims to empower local communities through the development of a village-based batik industry using an environmentally friendly innovation approach (Winarti et al., 2024; Hatammimi & Gunawan, 2024). The innovations introduced in this program include the use of recycled batik wax and natural dyes as part of the implementation of clean production principles in the batik-making process (Martuti et al., 2020; Sirait et al., 2022). This approach is intended not only to reduce environmental pollution but also to increase the added value of batik products produced by MSME groups and improve community income in Sengguruh Village (Fafurida et al., 2024; Sirait et al., 2022; Martuti et al., 2020).

Previous research has examined eco-friendly innovations in the batik industry from various perspectives. Nugroho and Suryani (2018) researched the application of natural dyes in the batik industry as an environmentally friendly innovation and found that the use of natural materials is able to reduce the impact of pollution while creating added value for products. Chen (2008) examines the drivers of green innovation and green image in the business context, concluding that eco-friendly innovations not only provide ecological benefits but also strengthen the competitiveness of companies in the market. Indriyaningrum and Fachrunnisa (2021) researched eco-branding and sustainable competitiveness in natural dye batik MSMEs, finding that sustainability-based branding strategies are able to increase product bargaining positions in markets that are increasingly environmentally conscious. Srikalimah, Idris, Akbar, Munawaroh, and Munir (2024) examine sustainable competitive advantage through green practices in batik MSMEs, showing that the application of green production practices contributes to sustainable competitive advantage. However, these studies still focus on technical aspects of production such as the use of natural materials and process efficiency, without examining their relationship thoroughly with sustainability strategies at the community level. In addition, most studies tend to place innovation as an effort to improve product quality alone, so studies that link environmentally friendly innovation with MSME sustainability strategies within the framework of CSR-based empowerment programs are still relatively limited. On the other hand, studies related to the implementation of CSR in the development of MSMEs generally still focus on short-term achievements, such as increasing individual capacity or supporting production facilities. This approach has not fully illustrated how CSR programs can play a role in building sustainable local economic systems through value chain development and collaboration between community groups.

Research on batik MSMEs and eco-friendly innovations in general still focuses on technical aspects of production such as the use of natural materials and process efficiency,

without examining their relationship thoroughly with sustainability strategies at the community level. In addition, most studies tend to place innovation as an effort to improve product quality alone, so studies that link environmentally friendly innovations with MSME sustainability strategies within the framework of CSR-based empowerment programs are still relatively limited.

On the other hand, studies related to the implementation of Corporate Social Responsibility (CSR) in the development of MSMEs generally still focus on short-term achievements, such as increasing individual capacity or supporting production facilities. This approach has not fully illustrated how CSR programs can play a role in building sustainable local economic systems through value chain development and collaboration between community groups.

Therefore, this study seeks to fill this gap by analyzing environmentally friendly innovations in the Batik Seng Program as part of an empowerment strategy that integrates economic, social, and environmental aspects simultaneously. The innovations developed not only provide benefits in reducing environmental impact, but also strengthen the added value of products and contribute to increasing the income of batik group members.

Although various studies have discussed MSME empowerment and environmentally friendly innovation in creative industries, studies specifically examining the integration of green production innovation with CSR-based community empowerment programs at the village level remain limited. Therefore, this study is important to understand how environmentally friendly innovation can function as a sustainability strategy for MSMEs, particularly in the context of company-supported community empowerment programs.

This study aims to analyze environmentally friendly batik innovation as a sustainability strategy for MSMEs in the Batik Seng Program in Sengguruh Village. This research is expected to contribute to the enrichment of studies on social innovation, MSME empowerment, and sustainable production practices in community-based creative industries.

METHOD

This research uses a qualitative approach with a case study method to gain an in-depth understanding of the application of environmentally friendly batik innovations in the Batik Seng Program. This approach was chosen because it is able to comprehensively explore the dynamics of community empowerment, production innovation processes, and the resulting impacts in a real context at the community level. The case study focuses on the Batik Seng Program as a form of implementation of community empowerment based *on Corporate Social Responsibility* (CSR) organized by PT PLN Nusantara Power UP Brantas.

The research was carried out at Griya Batik Seng which is located in Sengguruh Village, Kepanjen District, Malang Regency. This location was chosen because it is the center of production activities as well as a space for the implementation of the empowerment program of the Batik Seng Group. At this location, various batik production activities, the development of environmentally friendly innovations, and training and community assistance activities are carried out in an integrated manner.

Data collection in this study was carried out through several techniques, namely in-depth interviews, field observations, and documentation. In-depth interviews were conducted with members of the Batik Seng Group, program managers, and company representatives

involved in the implementation of CSR programs to obtain comprehensive information related to the empowerment and innovation process carried out. Field observations were carried out directly to observe the batik production process and the implementation of environmentally friendly innovations in the group's daily activities. In addition, documentation is used to complement research data through the collection of program reports, activity data, and visual documentation relevant to community empowerment activities.

The data obtained is then analyzed using qualitative descriptive analysis techniques through the stages of data reduction, data presentation, and conclusion drawn. The analysis process is carried out systematically to identify patterns, relationships, and meanings of the data obtained in the field. To increase the validity and reliability of the data, this study uses triangulation techniques, both source triangulation and method triangulation, so that the research results obtained can be scientifically accounted for.

RESULT AND DISCUSSION

Batik Seng Program as a Model for MSME Empowerment

The Batik Seng Program in Sengguruh Village is one form of Corporate Social Responsibility (CSR) implementation organized by PT PLN Nusantara Power UP Brantas. The program was designed as a community empowerment initiative through the development of a batik-based creative industry that focuses not only on economic improvement but also on environmental and social sustainability. Unlike short-term philanthropic CSR approaches, this program adopts an empowerment-based approach that emphasizes sustainable community capacity building. This approach is implemented through various activities such as batik-making skills training, business mentoring, institutional strengthening of community groups, and the development of environmentally friendly production innovations.

Figure 1. Batik Seng Activities
Source: Documentation of Corporate CSR Activities in 2025

Based on program data, the number of beneficiaries increased from 12 people in 2022 to 20 people in 2025. This increase indicates the growth of group capacity as well as rising community participation in community-based economic activities. In addition to the increase

in membership, the program has also succeeded in encouraging the formation of a broader community ecosystem through the development and replication of the empowerment model. The Batik Seng Program, which has been intensively guided and assisted since 2022, has not only functioned as the main production group but has also become the starting point for the emergence of new community-based groups.

Figure 2. Products of the Batik Seng Group as a Community-Based MSME
Source: Documentation of Corporate CSR Activities in 2025

The replication of the program is reflected in the establishment of the Batik Kaputren Group in 2024, which was specifically encouraged to expand community involvement and create new employment opportunities. The existence of this group demonstrates that more community members are becoming involved in batik production activities, thereby expanding the production base while increasing local economic participation. Furthermore, in 2025, the Ki Ageng Sengguruh Waste Bank Group was established to manage batik production waste and transform it into economically valuable products. The establishment of these groups indicates that the empowerment program has evolved into a collaborative ecosystem that not only strengthens the economic aspect but also promotes sustainable environmental management at the community level.

These findings are consistent with the concept of community-based development, which emphasizes that local economic development will be more sustainable when it actively involves community participation throughout the entire business development process. From the perspective of social inclusiveness, the program also provides participation opportunities for vulnerable community groups. Program data indicate the involvement of two persons with disabilities and four elderly individuals in batik production activities. The involvement of these groups demonstrates that economic empowerment functions not only as a strategy for increasing income but also as a means of empowering vulnerable communities.

Overall, these findings demonstrate that the Batik Seng Program has not only succeeded in improving the economic capacity of the community but has also been able to establish an

inclusive and sustainable empowerment system. The integration of community-based economic development with the expansion of participation among vulnerable groups reflects that the program is not solely oriented toward business growth but also toward equitable distribution of development benefits. Through a participatory and inclusive approach, the program has been able to create an adaptive socio-economic ecosystem in which improved welfare goes hand in hand with stronger social cohesion and environmental sustainability at the community level.

Environmentally Friendly Batik Production Innovation

One of the main characteristics of the Batik Seng Program is the implementation of production innovations oriented toward environmental sustainability. The Batik Seng group has developed several production innovations through a clean production approach that emphasizes resource efficiency, waste reduction, and value creation at every stage of production. This approach is not only focused on the final batik products but also on ensuring that the entire production process operates in a sustainable and integrated manner. The implementation of these innovations can be explained through three main aspects: the utilization of batik wax waste, the use of natural dyes, and the processing of fabric scraps.

1. **Utilization of batik wax waste**

   The utilization of batik wax waste is one form of innovation that directly transforms the production pattern from a linear to a circular model. In conventional batik production practices, batik wax waste is generally discarded after the dewaxing process, potentially causing environmental pollution. However, in the Batik Seng Program, batik wax waste is systematically collected and reprocessed through heating, filtering, and mixing with additional materials to produce reusable batik wax for subsequent batik-making activities. From January 2025 to February 2026, approximately 740 kilograms of batik wax waste had been successfully reused.

   This innovation has generated significant impacts in two main aspects. From an environmental perspective, the utilization of batik wax waste not only reduces the volume of solid waste but also directly decreases the level of environmental pollution caused by batik wax residue from Batik Seng production activities. Meanwhile, from an economic perspective, the recycling process improves production cost efficiency because the group no longer relies solely on purchasing new raw materials. In addition, this activity contributes to improving the technical capacity of group members, particularly in production waste management, thereby fostering collective awareness of more responsible and sustainable production practices.

   The approach applied in managing batik wax waste is aligned with the 3R concept (Reduce, Reuse, Recycle), which emphasizes waste reduction, resource reuse, and recycling processes to improve production efficiency. Therefore, this innovation functions not only as a technical solution for waste management but also as part of a sustainability strategy that integrates environmental and economic aspects within batik production activities.

2. **Utilization of natural dyes**

   Another innovation implemented in the program is the use of natural dyes derived from local organic materials as an alternative to synthetic dyes. The Batik Seng Group utilizes various plants and organic waste materials, including mango leaves, mahogany

wood, tingi wood, indigofera, and coconut husks. Each material produces distinctive color characteristics, which not only supports environmental sustainability but also strengthens the identity and uniqueness of the batik products.

The utilization of natural materials represents a strategic step toward reducing the use of hazardous chemicals that may adversely affect the environment and endanger artisans' health. In particular, the use of coconut husks as a dyeing material constitutes a significant innovation, considering that these materials previously had no economic value and were often burned as waste. Through an extraction process, coconut husks can be transformed into safe and environmentally friendly natural dyes. Program data indicate that from January 2025 to February 2026, the utilization of coconut husks reached 220 kilograms, while other natural dye materials reached 120 kilograms.

The use of natural materials provides dual benefits. First, it reduces dependence on synthetic chemicals that may adversely affect the environment. Second, it optimizes the use of local resources available within the village environment. In this context, Batik Seng contributes to the management of organic waste, particularly coconut husks, by transforming previously unused waste into productive resources. In addition to generating ecological benefits, the use of natural dyes also increases product added value, especially in reaching market segments that are concerned with sustainability issues. Thus, this innovation functions not only as a technical production solution but also as a product differentiation strategy that strengthens the competitiveness of village-based MSMEs.

3. Utilization of fabric scraps

The utilization of fabric scraps represents a further innovation that reinforces the implementation of the 3R principles within the Batik Seng Program. Fabric remnants from the production process that were previously discarded are now productively managed by the Ki Ageng Sengguruh Waste Bank Group. These fabric scraps are processed into various economically valuable handicraft products such as bags, wallets, and other accessories. Based on program data, the utilization of fabric scraps from January 2025 to February 2026 reached 318 kilograms.

This practice not only contributes to reducing textile waste but also creates new business opportunities for community members outside the main production group. Therefore, the management of fabric scraps has impacts not only on environmental aspects but also on expanding the economic benefits of the program through product diversification. Furthermore, the involvement of other community groups in waste management demonstrates the integration among communities within a mutually supportive empowerment ecosystem. This strengthens program sustainability because each production process is interconnected within a complementary system rather than operating independently.

Overall, these three innovations demonstrate that the Batik Seng Program has successfully developed a production system that is not only efficient but also environmentally and socially sustainable. The integration of waste utilization and environmentally friendly materials reflects a transformation toward more responsible production practices. Furthermore, these innovations not only improve product quality and added value but also expand the empowerment impact through the creation of new economic opportunities at the community level.

Market Diversification

The environmentally friendly innovations implemented in the Batik Seng Program not only provide environmental benefits but also enhance the market attractiveness of the products. Increasing consumer awareness of environmental issues has encouraged the emergence of new market segments that are more concerned with sustainable and environmentally friendly products. This condition has been utilized by the Batik Seng Group to expand its market reach through product differentiation based on sustainability values.

One concrete form of this market diversification strategy is the classification of products based on sustainability characteristics, such as the application of "eco-friendly" or "zero waste" labels and tags. These products are visually distinguished from conventional products, both in direct marketing displays and promotional activities, thereby providing a clear identity for consumers. This approach functions not only as a marketing strategy but also as a means of educating consumers about the added value of the products. By February 2026, environmentally friendly labeled products recorded sales of 358 batik shirts, 1,174 pieces of batik fabric, 50 fabric scrap bags, and 32 prayer sets, totaling 1,614 units, indicating a positive market response toward sustainability-based products.

Figure 3. Eco-Friendly Products Batik Seng
Source: Documentation of Corporate CSR Activities in 2025

On the other hand, batik products that have not fully implemented zero-waste principles or still utilize synthetic dyes and partially non-recycled batik wax also continue to demonstrate strong sales performance. Various products such as batik fabrics, shirts, bags, udeng (traditional Javanese head wrap), shawls (selendang), house dresses (daster), vests, and batik slippers (selop) recorded total sales of 6,563 units by February 2026. This finding indicates that market diversification does not rely solely on one specific segment but is capable of reaching various consumer groups with different preferences. Thus, the strategy implemented is not exclusive but inclusive, maintaining the conventional market base while simultaneously developing new sustainability-oriented markets.

Furthermore, program findings indicate that the added value of Batik Seng products lies not only in their aesthetic and quality aspects but also in their environmentally friendly production process. This uniqueness serves as a distinguishing factor that strengthens the product's market position, particularly amid the growing trend of sustainable consumption. Consumers no longer consider only price and design but also pay attention to the environmental impact of the products they consume. In this context, Batik Seng has successfully positioned its products as part of a sustainable lifestyle, which indirectly enhances the competitiveness of village-based MSMEs at both local and regional levels.

Moreover, this market diversification strategy is supported by the strengthening of the program's value chain, which involves various groups within the Batik Seng ecosystem. The involvement of the Batik Kaputren Group in production activities and the Ki Ageng Sengguruh Waste Bank Group in waste processing has enriched the diversity of products produced. This condition enables the creation of more varied and innovative derivative products, thereby expanding market opportunities while increasing the economic value generated from each production process.

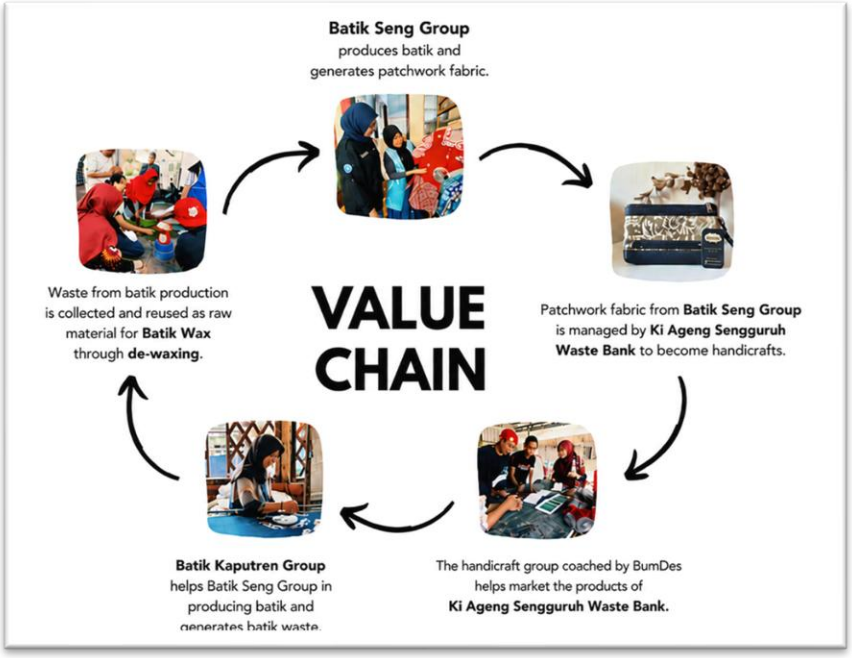

Figure 4. Batik Seng Program Value Chain
Source: Corporate CSR Data in 2025

Overall, the market diversification strategy implemented by the Batik Seng Program demonstrates that environmentally friendly innovation contributes not only to ecological aspects but also serves as a strategic instrument for market development. By combining sustainability values with product quality, Batik Seng has been able to reach a more heterogeneous market, ranging from general consumers to consumers with a high level of concern for environmental issues.

1. The Impact of the Program on Increasing Community Income

The implementation of innovation within the Batik Seng Program has generated significant economic impacts for the Batik Seng Group. Prior to the implementation of environmentally friendly innovation and branding strategies, product sales from the Batik Seng Group reached 5,824 units as of December 2024. Following the implementation of innovation initiatives, product diversification, and collaboration with various stakeholders, sales increased to 8,177 units by February 2026, consisting of 6,563 conventional products and 1,614 environmentally friendly products.

Based on the financial reports of the fostered group, the income of group members increased by 9.79%, with an average increase of IDR 223,000 after the implementation of the innovation program. This increase was influenced not only by the expansion of production capacity but also by the transformation of product value through the application of environmentally friendly principles that enhanced product attractiveness and competitiveness in the market. The increase in income was also driven by the emergence of more diverse market opportunities. Environmentally friendly batik products possess unique appeal for consumers who are increasingly concerned with sustainability issues.

In addition, the economic activities generated by the batik groups have also created indirect impacts on the surrounding community. Batik production activities encouraged the involvement of other groups, such as the Batik Kaputren Group, which received production orders and experienced growth in membership, as well as the Ki Ageng Sengguruh Waste Bank Group, which gained economic benefits from processing production waste into marketable products. The interconnection among these groups demonstrates that the economic activities established through the program do not operate independently but rather develop within a mutually supportive system.

Therefore, the program has not only increased income at the individual level but has also created an economic multiplier effect at the village level. The existence of the Batik Seng Program has encouraged the growth of new economic activities, expanded employment opportunities, and strengthened the local economic structure in a more inclusive and sustainable manner.

2. The Role of PT PLN Nusantara Power UP Brantas in the Empowerment Program

The Batik Seng Program represents one form of social and environmental responsibility implementation carried out by PT PLN Nusantara Power UP Brantas. The program was designed to support community empowerment around the company's operational areas through the development of a community-based creative industry.

In its implementation, PT PLN Nusantara Power UP Brantas acts as the initiator, facilitator, and primary supporter of the empowerment program. The company provides various forms of support, including skills training and certification programs, business mentoring, institutional capacity strengthening, provision of equipment and facilities, as well as market access support.

Furthermore, the company also encourages the implementation of environmentally friendly production innovations as part of its commitment to environmental sustainability. Through this approach, the empowerment program focuses not only on increasing community income but also on developing more sustainable business practices. This collaborative approach between the company and the community enables the creation of

an empowerment model that not only improves local economic capacity but also strengthens social and environmental sustainability at the community level.

CONCLUSION

This study demonstrates that environmentally friendly batik production innovation can serve as an effective strategy in supporting the sustainability of community-based Micro, Small, and Medium Enterprises (MSMEs). Through the Batik Seng Program organized by PT PLN Nusantara Power UP Brantas as part of its Corporate Social Responsibility (CSR) implementation, the community of Sengguruh Village has been provided with opportunities to develop a batik-based creative industry that focuses not only on economic improvement but also on environmental sustainability. The implementation of production innovations, such as the reuse of batik wax waste, the use of natural dyes derived from organic materials, and the processing of fabric scraps, demonstrates that environmentally friendly production practices can be effectively applied within community-based MSMEs. These innovations not only contribute to reducing the potential environmental impacts of batik production processes but also improve resource efficiency and create added value for the resulting products.

In addition to providing environmental benefits, these innovations also play an important role in enhancing the competitiveness of batik products in the market. Environmentally friendly batik products possess unique appeal for consumers who are increasingly concerned about sustainability issues. This condition has encouraged the emergence of a more heterogeneous market and created opportunities for MSMEs to expand their market segments. This achievement is reflected in the 9.79% increase in the income of Batik Seng Group members since the implementation of innovation initiatives and environmentally friendly branding strategies in 2025. The findings of this study indicate that the integration of corporate CSR programs, environmentally friendly production innovation, and community capacity strengthening can become an effective empowerment model for supporting the sustainability of village-based MSMEs. Therefore, empowerment approaches that integrate economic, social, and environmental aspects should continue to be developed as a strategy for sustainable local economic development.

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