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Green Innovation as a Strategy for Empowering *Batik* MSMEs: Improving Productivity and Diversification toward Sustainable Green Industry in Pasuruan Regency

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Abstract

The empowerment program for the *Batik Canting Cantik* community in Pasuruan Regency aims to strengthen the productivity, competitiveness, and sustainability of traditional hand-drawn *Batik* through the implementation of green innovation. Using a Participatory Action Research (PAR) approach, the study involved 15 artisans over six months through a series of participatory activities, including training, co-design workshops, production trials, and evaluation sessions. Artisans were trained in eco-printing techniques that utilize environmentally friendly natural dyes as alternatives to synthetic dyes, which are known contributors to hazardous waste. Technological innovations such as the introduction of steamers and multifunctional *Batik* dryers were also implemented to accelerate production processes and reduce dependency on weather conditions. The results show a 50% increase in productivity, a significant reduction in drying time, improved color durability, and enhanced product quality. In addition, marketing capacity was strengthened through training in branding, innovative packaging design, and digital marketing, including the use of social media and online marketplaces, which contributed to a broader national and international market reach. Beyond economic impacts, the program also generated environmental and social benefits by raising awareness of natural resource conservation and promoting sustainable cultural production practices. These findings demonstrate that green innovation is effective in enhancing the competitiveness and long-term sustainability of *Batik*-based MSMEs.

Keywords *Batik* Eco-Print; Community Empowerment; Green Innovation; Participatory Action Research; Sustainable Creative Industry

1. INTRODUCTION

Pasuruan Regency is one of the regions in Indonesia with significant potential in the *Batik* industry. The traditional *Batik tulis* of Pasuruan has been continuously developed and supported by the local government, resulting in a variety of distinctive motifs that reflect the region's local wisdom and unique cultural identity. Some of the well-known Pasuruan *Batik* motifs include matoa, randu (kapok tree), *daun kelor* (moringa leaf), *penanjakan, krisan* (chrysanthemum), and *sedap malam* (tuberose), among others. One of the prominent groups of *Batik* artisans in Pasuruan Regency is the *Batik Canting Cantik* community, whose *Batik* patterns are inspired by the local wisdom of Gempol District, characterized by the distinctive motif of the moringa leaf.

Batik Canting Cantik was established in 2019, during the COVID-19 pandemic, with its members primarily consisting of women from the community organization (PKK) and homemakers. The community specializes in producing hand-drawn *Batik* (*Batik tulis*) that combines the *daun kelor* (moringa leaf) motif with floral patterns, abstract designs, and mural or graphic elements. The market segment of *Batik Canting Cantik* spans local, regional, and international markets, supported by marketing collaborations with PT Sorini Corporindo. For the local market segment, the products are promoted and sold through exhibitions (expo) organized by the Cooperative Office of Pasuruan Regency and various local companies. This group of *Batik* artisans has great potential to grow and develop sustainably; however, in its operational implementation, the *Batik Canting Cantik* community often encounters several challenges and obstacles. The first challenge concerns the production process. The use of synthetic dyes such as Naptol, Indigosol, and Remasol in hand-drawn *Batik* production tends to generate residual waste, both in the form of leftover dye substances and wax residues from the canting (waxing) stage. *Third*, the production process at the drying stage is highly dependent on weather conditions/relying on sunlight. Hence, the uncertainty of the weather causes the quality and productivity of the *Batik Canting Cantik* group to decline. Second, the lack of innovation exhibited by *Batik* artisans reduces the appeal of both the product itself and its packaging, which utilizes a transparent OPP plastic wrap measuring 30 cm x 30 cm. Consequently, from these aspects, the price and customer interest in purchasing tend to be low. The selling price of hand-drawn *Batik* in the *Batik Canting Cantik* group ranges between IDR 250,000 and IDR 300,000, which is considered very low for the handmade *Batik* category, as it is created, written, or drawn manually using human labor.

The current monthly sales of *Batik Canting Cantik* have reached approximately IDR 10 million, equivalent to around 40 pieces of *Batik*. The average selling price of the hand-drawn *Batik* products is IDR 250,000. This sales figure is still considered relatively low, given that the group consists of 20 members. The limited productivity is primarily due to the lack of technological upgrades in the production process, which in turn causes delays in fulfilling customer orders, particularly from their loyal customer, PT Sorini, which consistently purchases *Batik* in large quantities for resale in the American and European markets.

From the above explanation, it can be inferred that innovation and environmental consideration are the keys to achieving business sustainability (Nizar et al., 2023) (Dari et al., 2024). Business sustainability is centered on three main elements, namely: the economic aspect, which relates to the financial benefits obtained by an organization through its operations (Nizar et al., 2025); the social aspect, as organizations are part of society and hold responsibilities in improving the welfare of their stakeholders; and most importantly, the environmental aspect, which focuses on protecting natural resources and preventing damage that could degrade the quality of human life (Adawiyah, 2022; Agustin et al., 2023). The following section presents examples of hand-drawn *Batik* products created by the *Batik Canting Cantik* community.

Limited access and the high cost of raw materials also pose significant challenges to the competitiveness of *Batik Canting Cantik* products. Therefore, it is necessary to adopt innovations that utilize natural, cultivable raw materials, including the use of plant-based natural dyes, environmentally friendly production processes, and the application of renewable technologies, to produce products that are more diverse, efficient, and have higher market value. The green innovation referred to in this context is the development of Eco-Print *Batik* products.

Several relevant initiatives implemented with the partner community include the provision of knowledge and workshops on green innovation, as well as training sessions on product creation, ranging from material identification and selection to step-by-step production tutorials and product finishing techniques, including advertising and branding aspects. Previous studies have consistently shown that green innovation and green intellectual capital have a positive influence on business sustainability across various industries (Adawiyah, 2022; Agustin et al., 2023; Bigio, 2009; Hendriyo, 2024) (1–6). However, most of these studies focus on medium or large-scale enterprises and formal industrial sectors, leaving a gap in understanding how green innovation can be effectively implemented within micro-scale creative

industries such as rural *Batik* artisans. This community empowerment project addresses that gap by demonstrating how green innovation can be translated into practical skills, local knowledge development, and sustainable production practices at the grassroots level, contributing new insights into the operationalization of green innovation in small, informal, creative ecosystems.

This empowerment program aims to enhance the partners' capacity in implementing green innovation, thereby improving competitiveness while reducing the environmental impact of *Batik* production. The initiative aligns with several Sustainable Development Goals (SDGs), particularly Goal 8 (Decent Work and Economic Growth), Goal 9 (Industry, Innovation, and Infrastructure), and Goal 12 (Responsible Consumption and Production). By applying the concept of green innovation, the empowerment partners are expected to develop a more sustainable and environmentally responsible business model. Furthermore, this program supports Key Performance Indicator (KPI) 3, which focuses on encouraging faculty members to participate in off-campus activities, such as empowerment programs, community service, and collaboration with industry partners. In addition, this initiative involves students throughout the entire process, thereby contributing to KPI 2, which emphasizes providing students with off-campus experiential learning opportunities.

From the perspective of the National Research Master Plan (RIRN), the focus of this activity is closely related to the development of environmentally friendly technologies and enhancing competitiveness within the culture-based creative industry. By integrating the principles of sustainability into the *Batik* industry, this program not only helps *Batik* artisans become more adaptable to market demands but also contributes to the development of a more inclusive and environmentally conscious regional economy.

From Asta Cita's perspective, this program contributes to the realization of the third aspiration, namely, enhancing the quality of employment opportunities, promoting entrepreneurship, developing the creative industry, and continuing infrastructure development. In addition, this activity also supports the second aspiration, which focuses on strengthening the national defense and security system while promoting national self-reliance through food, energy, and water self-sufficiency, as well as the development of the creative, green, and blue economies. Thus, this program aligns with the national development vision that emphasizes sustainability and the improvement of societal welfare, reflecting an integrated effort

to advance economic resilience, environmental responsibility, and social empowerment.

Based on the identification of the problems faced by the *Batik Canting Cantik* artisan community in Gempol District, several key challenges have been identified that hinder the sustainability of the business and the competitiveness of the *Batik* products produced. These issues can be categorized into two main aspects: production and marketing. First, in terms of production, the hand-drawn *Batik* (*Batik tulis*) process carried out by the *Batik Canting Cantik* community still relies on synthetic dyes such as Naptol, Indigosol, and Remasol, which generate hazardous waste. This waste includes leftover dye that is not absorbed into the fabric and residual wax substances used in the canting process. Without proper waste management, the use of these chemical materials can lead to environmental pollution and pose health risks to the artisans.

Second, the final drying stage of the *Batik* production process still relies heavily on sunlight, making it highly dependent on weather conditions. As a result, weather uncertainty often hampers productivity and affects the quality of the final *Batik* products. During the rainy season, the production process becomes significantly longer, leading to delays in order fulfillment and potential financial losses for the artisans. First, the marketing of *Batik Canting Cantik* still relies heavily on expos and fashion shows, with limited distribution channels. This condition restricts market reach and prevents artisans from achieving optimal income growth. The minimal use of digital platforms also makes it difficult for the products to compete with more established *Batik* brands that have stronger online visibility and market recognition. Second, in terms of branding, *Batik Canting Cantik* still employs less varied designs and simple packaging, featuring transparent OPP plastic (30 x 30 cm). This results in low product appeal in an increasingly competitive market. The lack of innovation in both design and packaging further limits opportunities to enhance the product's market value.

From a theoretical perspective, these challenges underscore the limited adoption of green innovation within MSMEs, which is defined as the development of environmentally friendly processes, products, and business models that enhance both competitiveness and sustainability (Astadi et al., 2022; Yumei et al., 2015). In the creative industry sector, green innovation is closely aligned with the sustainability framework of the triple bottom line, which emphasizes the simultaneous pursuit of economic improvement, social empowerment, and environmental responsibility (Edeigba & Arasanmi, 2022; Gimenez et al., 2012). However, the current conditions of

Batik Canting Cantik indicate that key sustainability elements, such as eco-friendly production, value-added product differentiation, and inclusive community development, are still not fully realized. Strengthening green innovation is therefore essential, as previous studies demonstrate that it not only improves business performance but also enhances community empowerment through skills development, resource efficiency, and increased product value.

If these issues are not addressed promptly, the *Batik Canting Cantik* artisan community will face stagnation in business growth. From a social perspective, the lack of innovation and limited skills will constrain community empowerment opportunities, particularly for homemakers who depend on the *Batik* industry as their primary source of income. From an economic perspective, limited market access and insufficient innovation will reduce the competitiveness of the products, ultimately leading to a decline in artisans' income and threatening the sustainability of the *Batik* industry in the Gempol area. Therefore, the primary concern of this research is how the application of green innovation can enhance the productivity and competitiveness of the *Batik Canting Cantik* community sustainably.

Based on the identification of problems faced by the *Batik Canting Cantik* artisan community in Gempol District, this empowerment program focuses on strengthening aspects of production and business management through the implementation of green innovation as an effort toward a sustainable *Batik* industry. The main problems identified include the use of synthetic dyes that generate hazardous waste, the limited availability of production tools such as specialized dryers and steamers, and challenges in accessing the market and innovating product design. The proposed solutions include the adoption of natural dyes and eco-print techniques, the design of environmentally friendly *Batik* dryers and steamers, and the strengthening of digital marketing strategies and product packaging innovation. This program is expected to lead to increased productivity, product diversification, and greater environmental awareness among artisans, while also expanding market reach through the utilization of digital technologies. Thus, this empowerment initiative not only enhances the economic and social capacity of the community but also reinforces the transformation toward a green industry rooted in local wisdom and environmental sustainability. This service aims to design and implement green innovations in the production and marketing of *Batik Canting Cantik*, supporting the transformation towards a sustainable and environmentally friendly industry.

In terms of contribution, this program provides two key outcomes. First, the practical contribution is the development of a green innovation-based empowerment

model for *Batik* MSMEs, which can serve as a replicable framework for similar artisanal communities. Second, the academic contribution lies in strengthening the body of knowledge on the application of eco-innovation within traditional creative industries, particularly in the context of rural *Batik* production.

2. METHODS

The implementation site of this empowerment program is located in Kepulungan Village, Gempol District, Pasuruan Regency, with the *Batik Canting Cantik* artisan community, one of the characteristic *Batik* groups in the district, serving as the main participants and focus of the initiative. The method used in implementing the green innovation empowerment activities is Participatory Action Research (PAR) (Rahmat & Mirnawati, 2020). In this program, PAR is applied through a collaborative process involving 15 *Batik* artisans, comprising homemakers and informal workers aged 25–55 years, with the majority being women (90%), who play key roles in the production, coloring, and finishing stages of *Batik*. The teaching team comprises three university lecturers, assisted by five students from the Faculty of Islamic Economics and Business and the Faculty of Science and Technology. Local government stakeholders (village officials) and industry partners specializing in natural dyes and eco-friendly *Batik* equipment were also involved as facilitators and technical advisors. Participatory Action Research (PAR) emphasizes community awareness of their existing potentials and challenges while ensuring active participation of all stakeholders in the process of change and improvement (Nizar et al., 2024; Qomar et al., 2022). The activity is implemented over six months, from May to October 2024, with the activity phases carried out sequentially under the PAR cycle of planning, action, observation, and reflection.

In general, the stages of the Participatory Action Research (PAR) method are integrated into a continuous cycle that begins with the observation and reflection stage, followed by action planning and program implementation. After the program is implemented, an evaluation stage is carried out to assess its effectiveness and impact on the target community. The results of the evaluation serve as the basis for further reflection, planning, and implementation of the next program, thereby forming a continuous cycle of learning and social change. Through this cycle process, it is hoped that social transformation and community capacity building will be achieved, which is the main goal of the implementation of this PAR-based service program (Goessling, 2024; Modderkolk et al., 2023).

The implementation of this community empowerment program was carried out systematically and progressively following a structured flow diagram, which comprised five key stages of execution, as described below:

1. The socialization stage began with preliminary observations of the partner community, namely the *Batik Canting Cantik* artisans, followed by a series of reflection and joint planning sessions to identify priority issues, agree on appropriate solutions, and outline the expected outcomes of the program. A formal socialization meeting was then conducted to present the implementation plan, clarify team roles, and gather initial feedback from the artisans as an input mechanism for refining the program design. The success of this stage is indicated by the clear identification and validation of key problems, the establishment of mutual agreement on priority interventions, the commitment and active participation of the majority of artisans, the collection of documented feedback used to strengthen the program plan, and the completion of a formal socialization session attended by at least 80% of the targeted participants.
2. The training stage was implemented through a series of focused capacity-building sessions designed to strengthen the artisans' technical skills and business capabilities. The basic eco-print training introduced the fundamental techniques of environmentally friendly *Batik* production. In contrast, the advanced eco-print training expanded artisans' skills through more complex patterning methods and the initial design of a specialized steamer for natural dye extraction. This was followed by technology testing and simulation sessions, in which artisans conducted trials on the newly developed drying equipment and practiced eco-print production using the improved tools. Additional training on branding and packaging was delivered to enhance product attractiveness through innovative packaging designs and the development of a distinctive brand identity. Ultimately, digital marketing training equipped participants with strategies for promoting their products through online marketplaces, social media, and digital advertising, thereby broadening their market reach and strengthening their online presence. The success of this stage is reflected in the artisans' increased mastery of eco-print techniques, their ability to operate the newly developed production tools, the creation of initial prototype products with improved quality, the development of enhanced branding and packaging outputs, and measurable improvements in digital marketing skills as demonstrated through active use of online platforms.

3. Technology Implementation: The technologies introduced in this program were specifically designed and adapted to meet the conditions and needs of the partner community, ensuring their ability to apply them independently after the program's completion. The implementation of innovations was carried out through the following activities:
   a. Application of Eco-Print Steamer and *Batik* Dryer Equipment: Utilization of tools developed by the community service team to improve production efficiency and environmental sustainability.
   b. Utilization of Digital Platforms for Marketing and Distribution: Encouraging the use of online marketplaces and social media to expand market reach and facilitate digital transformation.
   c. Development of Locally Branded Product Packaging: Designing packaging that reflects local identity and strengthens brand positioning in the creative industry market.
4. The assistance and evaluation stage was conducted after the completion of the training and technology implementation activities to assess the participants' acquired skills and the effectiveness of the introduced innovations. Evaluation was carried out through continuous mentoring, during which the project team observed production processes that utilized the newly developed tools, assessed the progress of branding outputs, and monitored the artisans' level of activity on digital promotional platforms. Data for the evaluation were collected using several methods, including direct field observation, semi-structured interviews with artisans, and analysis of weekly production and marketing progress reports, which university student mentors supported. Additional documentation, including photos, videos, and samples of production output, was compiled to enhance the assessment of skill improvement and the adoption of green innovation practices. Consistent improvements in production quality indicate the success of this stage, demonstrating the ability to operate new technologies, enhanced branding outputs, and active utilization of digital marketing channels by the artisan community.
5. Program Sustainability: As a form of dissemination and to ensure the sustainability of the program, an Innovation *Batik* Expo was organized by the Canting Cantik community (Step 10), showcasing program outcomes to the broader public. A comprehensive evaluation of the program was conducted, including plans for replication and capacity strengthening of the partner community regularly. The team also developed Standard Operating Procedures

(SOPs) for equipment use, instructional video tutorials, and facilitated the establishment of internal facilitators to act as program cadres for future continuation.

The implementation process of this community service program is divided into several stages, as follows:

1. Observation**:** The initial stage involves observing the partner and conducting direct interviews to identify opportunities, challenges, and obstacles.
2. Reflection and program planning stage.
3. Socialization: conducted through an initial meeting with the partner to introduce the proposed community service program.
4. Training: Several training sessions are carried out in this program, including basic training on eco-print *Batik* production techniques.
5. First trial training: simulation of eco-print *Batik* production.
6. Second trial training: advanced simulation of eco-print *Batik* production.
7. Follow-up and eco-print skill assessment.
8. Branding and packaging training.
9. Online marketing and advertising training.
10. Assistance in organizing a *Batik* exhibition with the theme "Green Innovation by *Batik Canting Cantik*."
11. Evaluation and follow-up planning: conducting regular mentoring, performing evaluations, and adjusting strategies to improve program effectiveness.
12. Program sustainability: encouraging partner independence in managing their business after the program concludes, connecting partners with marketing networks and further guidance, and developing a long-term strategy to ensure program continuity even after the community service activities have ended.

The partner is involved from the early planning stage to implementation. The design of the steamer and *Batik* drying technology will be carried out in parallel with the training, allowing for adjustments to meet the partner's needs during the activities and enabling immediate use. Furthermore, in the implementation of the program, the *Batik Canting Cantik* community plays an active role in strategy formulation, activity implementation, and program evaluation. With this approach, the partner is expected to be independent in carrying out the provided solutions.

This program leverages technology and innovation to enhance the production efficiency and competitiveness of the partner's *Batik* products. The main innovations include the use of a steamer and a *Batik* dryer to accelerate the production process, as

well as the eco-print technique, an environmentally friendly natural dyeing method with high market value. In addition to improving production, the program introduces the principles of a green industry to support long-term business sustainability. The technology is tailored to the partner's workload, allowing for easy adoption without disrupting ongoing production activities. The priority is focused on improving efficiency, reducing waste, and strengthening digital marketing to expand market reach. All activities are carried out with the consent and voluntary participation of the partner community, and ethical principles are upheld throughout the entire research and empowerment process. Through the application of this method, the partners' capacity in production, innovation, and digital marketing has increased, as further explained in the results section. From the series of activities above, we can present the Core PAR Stages in the Community Empowerment table in Figure 1:

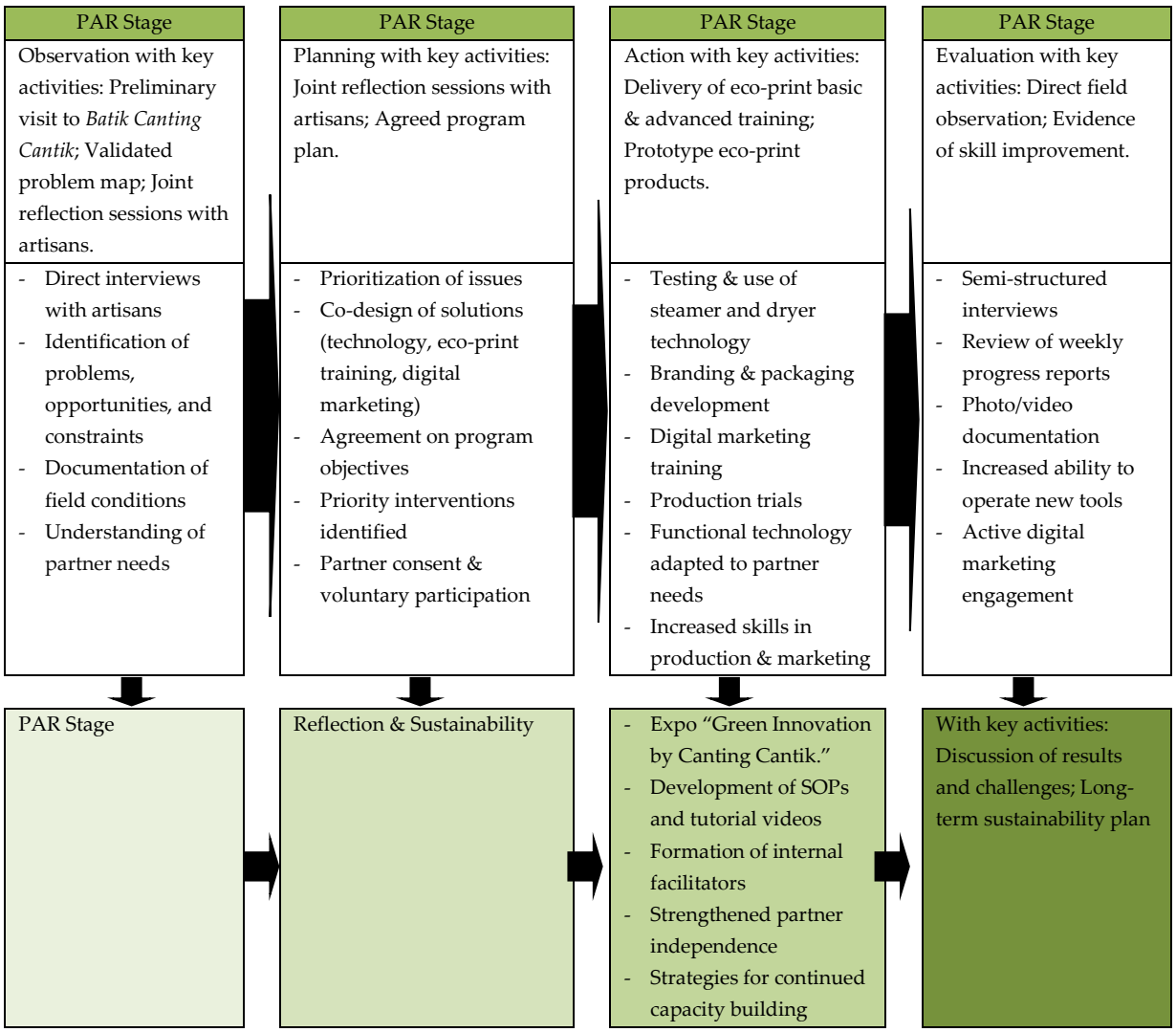

Figure 1. Core PAR Stages in the Community Empowerment Program

3. FINDINGS AND DISCUSSION

3.1. Findings

The implementation of this community service program successfully introduced the eco-print technique as an environmentally friendly innovation in the *Batik* production process. During the training sessions, artisans were able to produce eco-print *Batik* samples using various types of leaves and flowers, resulting in unique natural patterns. Participants demonstrated increased skill in arranging plant materials, applying pressure techniques, and controlling steaming duration to produce consistent color outcomes. The use of natural dyes also reduced dependence on synthetic colorants, contributing to lower production costs and minimizing hazardous waste generation. In addition, the artisans reported improved product aesthetics and expressed strong interest in further developing eco-print designs for commercial purposes (Alfarizi et al., 2024; Mardiana et al., 2020; Nadagouda et al., 2020).

Figure 2. Green Innovation in *Batik* Through Ecoprint Technique

The green product innovation training was attended by 20 members of the *Batik* group and conducted over two days at the Malang Creative Center building. The training followed a practical pattern, starting from basic stages up to product finalization. All members of *Batik Canting Cantik* demonstrated great enthusiasm in participating in the training, and ultimately, the final products produced were highly satisfactory. Figure 2 illustrates the outdoor training activities on the first day, followed by a series of training processes carried out on the second day.

Figure 3. Material Presentation Session

To support more efficient eco-print production, two primary technologies were designed: the Eco-Print *Batik* Steamer and the *Batik* Dryer. The Eco-Print *Batik* Steamer was designed to optimize the extraction of natural dyes onto fabric through a steam-heating system powered by either electric elements or a gas stove. The following activities illustrate the design and implementation of appropriate technologies aimed at enhancing production efficiency and effectiveness in mitigating weather-related uncertainties, with the ultimate goal of improving the productivity of *Batik* artisans:

The specifications of the designed equipment are as follows: it is made from Stainless Steel 304 with dimensions of 70 cm in diameter and 60 cm in height, and has a capacity to process 5–10 sheets of fabric at once. The equipment is equipped with aluminum or steel wire racks to ensure even steam circulation, operates at a temperature range of 80–100°C, and includes a small pressure ventilation system. The benefits of this design include improved production efficiency, enhanced color durability, and support for the eco-print trend, which utilizes natural dyes.

Figure 5. Ecoprint *Batik* Steamer

The next equipment is the *Batik* Dryer, a technology designed to accelerate the drying process without damaging the fabric's color or fibers. This tool is made from 1.5 mm galvanized iron, equipped with aluminum racks, and measures 150 cm × 100 cm × 60 cm. It is capable of drying 4–5 sheets of fabric in a single process and is supported by an 800–1000-watt blower heater with a temperature range of 50–70°C, along with an automatic temperature control and timer system. The *Batik* Dryer offers several benefits, including reduced dependence on weather conditions, a shorter drying time of 1–2 hours compared to 4–6 hours, and improved energy efficiency compared to oil- or gas-based heaters. In addition to innovations in the production process, this program also enhanced the partners' digital marketing capabilities by utilizing social media platforms and online marketplaces, as well as improving *Batik* packaging design to make it more attractive and increase its market value.

Figure 6. Packaging Design of *Batik Canting Cantik* Products

Previous studies have highlighted that the application of eco-print technology as a natural dyeing alternative can enhance the competitiveness of *Batik* MSMEs without causing environmental harm (Maharani et al., 2024). Other research has shown that the use of renewable energy in the *Batik* production process can reduce carbon footprints and improve cost efficiency (Brillyantina et al., 2024). Further studies examining the implementation of the green industry concept in the *Batik* sector found that sustainability-oriented strategies and sustainable production systems can increase product value while expanding market access (Pujiastuti & Dalengkade, 2024). In addition, previous research has emphasized the importance of advertising and branding in *Batik* products, which has been proven to boost sales by up to 90%. This is achieved through distribution on WhatsApp (40%), Facebook (10%), Shopee (35%), and TikTok (5%) (18). Building on these findings, this program aims to empower *Batik Canting Cantik* MSMEs in Gempol, Pasuruan, through green

innovation initiatives that support the transition toward a sustainable green industry. The effective use of steamer and *Batik* dryer technologies has also been shown to enhance color durability and increase production productivity (Andayani et al., 2022; Kusumaningtyas & Wahyuningsih, 2021; Pandansari et al., 2022; Wibowo et al., 2020). Therefore, the effectiveness of this program is expected to enhance MSME productivity, preserve the quality of *Batik* colors, and strengthen product competitiveness in an increasingly dynamic market.

The follow-up and eco-print skill assessment stage demonstrated a significant improvement in the artisans' abilities to apply natural dyeing techniques and to utilize both the *Batik* steamer and dryer technologies effectively. Evaluation results indicated that most participants were able to produce more consistent and higher-quality motifs and colors compared to their initial attempts. Quantitatively, the evaluation showed a notable increase in production efficiency, with drying time reduced from an average of 6 hours to 2 hours, representing a 67% improvement. In addition, 85% of the participants (17 out of 20) successfully produced eco-print *Batik* independently after completing the final training phase.

The branding and packaging training resulted in modern and more attractive packaging designs that significantly enhanced the market image and perceived value of *Batik Canting Cantik* products. Through the digital marketing and advertising training, artisans became active in promoting their products via Instagram, Facebook, and local online marketplaces. This digital engagement led to a 60% increase in social media followers, indicating a broader market reach and increased consumer engagement. Furthermore, artisans reported an estimated 40% increase in sales turnover during the first three months following program implementation, driven by higher product visibility and enhanced branding strategies.

The program culminated in the *Batik* Innovation Expo organized by the *Batik Canting Cantik* Community, which successfully attracted buyers, visitors, and potential collaboration partners. The final evaluation confirmed that the program effectively improved production capabilities, strengthened marketing networks, and enhanced the competitiveness of local *Batik* MSMEs. Overall, the initiative made a significant contribution to promoting sustainability principles and reinforcing green innovation practices in the Gempol *Batik* industry.

3.2. Discussion

The success of this stage is reflected in the artisans' increased mastery of eco-print techniques, their ability to operate the newly developed production equipment,

improved product design through more innovative branding and packaging, and enhanced digital marketing skills that enable them to reach wider markets. The importance of skill mastery and technology adoption aligns with the principles of community capacity building (Zimmerman, 1995) and the effective application of technology for MSMEs (Booth, 2018). Indicators of achievement at this stage include active participation of at least 80% of artisans in each training session, completion of basic and advanced eco-print modules, successful trials of the dryer and steamer prototypes, production of improved packaging designs, and the establishment of digital marketing accounts used for product promotion (Hadrian et al., 2021).

The mentoring stage involved an intensive hands-on assistance process to ensure that the trained skills could be applied consistently and effectively in the artisans' daily production. Mentoring is a crucial component of sustainable empowerment, ensuring that knowledge is internalized through practical application (Nizar et al., 2024). This stage included continuous guidance on eco-print production techniques, supervision in the use of the dryer and steamer tools, and troubleshooting of technical challenges encountered during production. Mentoring also covered marketing practices, including product photography, online catalog creation, social media content development, and customer engagement strategies. The success of this stage is indicated by the artisans' ability to produce eco-print *Batik* with consistent quality independently, operate the new equipment without technical errors, utilize digital platforms for marketing, and improve overall production efficiency (Saura et al., 2023).

The monitoring and evaluation stage was conducted to assess the effectiveness, efficiency, and sustainability of the implemented program. This process included structured observation, interviews, and documentation to evaluate progress in production capacity, product quality enhancement, environmental impact reduction, and market expansion. Monitoring and evaluation principles correspond with the PAR cycle of observation, reflection, and improvement (Nizar et al., 2023). Both formative and summative evaluations were conducted to assess the achievements of each activity and to measure the overall outcomes of the program. Success indicators for this stage include a significant improvement in artisans' skills, increased production output, diversification of eco-print products, strengthened digital marketing presence, and positive feedback from partner communities and stakeholders.

The reflection and follow-up planning stage served as the concluding phase, during which lessons learned were identified, recommendations formulated, and

sustainability strategies outlined for the continued growth of the *Batik Canting Cantik* community. Reflection is an essential part of participatory action research, allowing communities to co-identify solutions and develop long-term strategies (Muhammad & Muhammad, 2024). Follow-up planning included the development of a sustainability roadmap, strategies for maintaining eco-friendly production practices, and potential collaborations with industry partners and local government. Indicators of success at this stage include the completion of a formal reflection document, identification of sustainability goals, commitments from artisans to continue eco-print production, and the initiation of discussions for future partnerships.

4. CONCLUSION

The community empowerment program for *Batik Canting Cantik* in Pasuruan Regency successfully demonstrates the effectiveness of green innovation in enhancing the productivity and competitiveness of local hand-drawn *Batik*. Through the Participatory Action Research (PAR) approach, artisans were actively involved in adopting eco-print techniques using natural dyes as sustainable alternatives to synthetic materials. Technological interventions, such as the development of multifunctional steaming and drying equipment, have improved production efficiency, reduced weather dependency, and increased energy efficiency. These findings confirm that green innovation significantly boosts productivity, accelerates drying time, and maintains fabric color durability, thereby addressing the program's primary research focus on enhancing the performance of MSMEs through environmentally responsible practices.

Practically, the program enhances artisans' technical skills, strengthens branding capacity, and expands digital marketing reach to national and international markets. Socially, it encourages environmental awareness and community participation in sustainable creative industries. Academically, the program provides empirical evidence demonstrating that green innovation can serve as a transformative tool for capacity building within MSMEs. Conceptually, this program offers a replicable model for empowering MSMEs through green innovation that other creative sectors can adopt.

The results affirm that green innovation not only improves current performance but also lays the foundation for long-term sustainability within the *Batik* industry. The next development plan focuses on establishing a Green *Batik* Innovation Center and a sustainable marketing network among MSMEs, ensuring continued impact aligned with green industry principles and the Sustainable Development Goals (SDGs). Thus, the implementation of green innovation has proven effective in

increasing the productivity, efficiency, and competitiveness of the *Batik Canting Cantik* MSME while strengthening the foundation for a sustainable green *Batik* industry.

Several challenges remain, including the seasonal availability and high cost of natural dye materials, as well as the limited adoption of green innovation among artisans. To address these issues, future programs should involve collaboration with research institutions to develop long-lasting natural dyes, strengthen the supply chain for natural materials, and promote government-supported certification for environmentally friendly products. These steps are essential to ensure broader adoption and long-term sustainability of green innovation practices in the local *Batik* industry.

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