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ENVIRONMENTAL DEVELOPMENT OF BATIK VILLAGE LAWEYAN SURAKARTA TO ECO-INDUSTRIAL PARK*

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Abstract

The environmental development of the batik business has positive and negative effects in the environment. The batik industry still leaves environmental problems due to waste it use to produce. This research aims to identify the existing condition of the Laweyan Surakarta Batik Village area to develop the site into Eco-Industrial Park (EIP). The population of Batik entrepreneurs in the Laweyan Batik Village Area of Surakarta amounts to three enterprises. The method of research used qualitative descriptive variables with phenomenological design, with sample techniques using Snowball Sampling. Data collection involved observations and in-depth interviews. The results showed that batik medium-sized micro enterprises (MSMEs) in The Laweyan Batik Village area of Surakarta produce hazardous liquid, gas, and solid waste. For example, fabric processing and staining generate liquid waste containing chemicals that can increase the Chemical Oxygen Demand (COD) values in wastewater, while in the *pelorodan* process, the resulting liquid waste increases wastewater biological oxygen demand (BOD) values. Therefore, to mitigate the increasing environmental pollution, a solution can be applied by developing an Eco-Industrial Park in the Kampung Batik area. Batik MSMEs together can improve their environmental, economic, and social performance, in particular by changing from linear industrial system to circular system.

Keywords: eco-industrial park, environment, medium-sized micro enterprise, social aspects, waste production

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1. Introduction

Environmental alteration is part of the global change effect that brings various multiplier effects for human life. Environmental, economic, and social impacts on South Asia's economic development have been examined by numerous scientists (Bansal et al., 2021; Adebayo et al., 2021; Odugbesan et al., 2020; Rjoub et al., 2021). However, studies on ecological, economic, and social factors are still lacking, especially those addressing the conversion waste to energy on a large scale (Sharma et al., 2020). Environmental change can be beneficial or detrimental to the quality of the human environment both individually and as a group due to the community's activities (Mn and Nuringsih, 2020; Rjoub et al., 2017). The mining industry is an industry that has both positive and negative impacts on the three main pillars of sustainable development (Asr et al., 2019). The socio-economic goals emphasize promoting high-quality industrial development and reducing its negative impacts on society and the residents, which are reflected in the environmental sustainability (ES) indicators (Cheng et al., 2020). Awareness of rising energy demand, scarcity of fossil fuels, the world's heat, increased land consumption, urbanization, urban conflict, and inequality are all on the research agenda on the concept of environmental sustainability (Grazieschi et al., 2020).

The worst contributor to environmental pollution in half of China's prefecture-level cities is the rapid growth of industrial parks in China (Harwiki and Malet, 2020). The importance of improving the city's Environmental Sustainability (ES) system has made residents in China more stringent in calling for pollution control measures and environmental improvements (Yegina et al., 2020).

Environmental changes are also experienced by The Batik Village Area of Laweyan Surakarta. On October 2, 2009, UNESCO designated Batik as a Humanitarian Heritage for Oral and Non-Material Culture (Masterpieces of the Oral and Intangible Heritage of humanity) for Indonesia. Since then, batik production has increased, positively affecting the economy, culture, and tourism (Bin Mustafa et al., 2020). In this case, it can create more jobs in a community, increase social benefits and improve the regional economy (Afshari et al., 2020). Increase sustainable and clean production and environmentally friendly by optimizing resources (such as energy, water, power, carbon, and waste) in a comprehensive and integrated manner, as well as minimizing greenhouse gas emissions (including CO_2) and waste generation (Lawal et al., 2021).

Nevertheless, despite the positive benefits in the field of economy, culture, and tourism, it turns out that the batik industry in the Laweyan Batik Village area of Surakarta still leaves negative problems related to environmental pollution issues. The rapid growth of the tourism industry became the main source of the economy in Panjin (Sujianto, 2020). Although it brings economic benefits, the tourism industry harms the environment with millions of visitors (Komariah and Razzaq, 2020). Therefore, the tourism industry must find ways to maintain economic benefits, reduce negative environmental impacts, and meet people's expectations simultaneously (Wu et al., 2019).

Two tributaries of Bengawan Solo River located in Laweyan Subdistrict, namely Premulung River and Jenes River, are polluted due to liquid waste produced by Batik. Batik waste has not been processed or has not been optimally processed and immediately disposed of in the River (Martuti et al., 2020). Industrial symbiosis is a potential solution for manufacturing sustainability, aiming to reuse waste (Ibekwe and Murinda, 2018). Wastewater and waste energy can be optimized with waste exchange and recycling networks (Huang et al., 2020; Lawal et al., 2021).

The two tributaries of Bengawan Solo are heavily polluted due to batik waste exceeding the standard quality threshold because the chemical content of batik waste has been exceeded. The level of water pollution falls into the category of fourth class, which is not feasible for irrigation of agriculture and fisheries (Meng et al., 2017). Rugged protection standards are established for environmental protection from industrial pollution (Ghrair et al., 2020). For example, water pollutant release standard for paper making industry in Shandong Province, BOD emission concentration from wood pulp process should be lower than 30 mg/L (Yu et al., 2015). Most of the

literature suggests that wastewater treatment by anaerobic methods is preferable given the environmental and techno-economic sustainability (Guardia-Puebla et al., 2020). The facet of the conversion of waste to energy is considerable, but from an ecological perspective, the release of toxic gases and heavy metals is threatening (Gerend, 2019). The study of the conversion of waste to energy by considering the main factors, namely the environment, economy, and social is still lacking (Fitri et al., 2019). Biogas, water digestion, solid digestion are anaerobic digestive products. Solid digestion is rich in nutrients, potentially becoming soil conditioners and bio-fertilizer (Malolan et al., 2020).

Two communal wastewater treatment plants have been built in the Laweyan sub-district, but the existence has not accommodated waste from all batik craftsmen. The combined wastewater treatment plant can accommodate nine small and medium-sized micro enterprises (MSMEs) (Yuzvovich et al., 2020). Land limitations in the area do not allow rebuilding the Wastewater Treatment Plant (Xiao et al., 2020). However, the fact is that MSMEs batik must remain produced, and in the process of boiling (*nglorot*) in the manufacture of Batik, many valuable resources, such as water, electricity, gas. Excessive and non-recyclable use of resources causes the environment around Laweyan Surakarta Batik Village to be less good (Nawi et al., 2019). Therefore, it is very important and urgent to research by identifying the existing condition of Kampung Batik Laweyan Surakarta, which is used as an analysis material to go to the Eco-Industrial Park batik. Eco-Industrial Park is a channel to realize sustainable industrial development. The emphasis is on sustainable economic, environmental and social development. Furthermore, to measure the relationship between monetary value and environmental impact, it is recommended to use eco-efficiency (Pai et al., 2018).

2. Methods

This study combines a qualitative descriptive approach with phenomenological design. The population addressed by this research is Batik Entrepreneurs in the Kampung Batik Laweyan Surakarta area totaling three entrepreneurs. The research sample uses Snowball Sampling, involving data collection with in-depth interview techniques. Qualitative data analysis techniques used in this study are narrative analyses that focus on developing the Area of Laweyan Surakarta Batik Village towards Eco-Industrial Park. In this area, batik entrepreneurs in the Laweyan Surakarta Batik Village Area jointly improve environmental, economic, and social performance.

3. Results and discussion

3.1. Profile of respondents

This research data was obtained from Batik Entrepreneurs in Kampung Batik Laweyan Surakarta. Namely, a prominent businessman of Merchant descent with much experience in the field. The profile of batik entrepreneurs who became respondents in the study can be seen in Table 1. This Table shows that the entrepreneurs in this study have experience and knowledge in terms of Batik for generations and are rich in information.

3.2. Batik materials and batik making process

Batik is a form of craft that has high artistic value. Batik has been part of Indonesian culture (primarily Javanese). Batik comes from the Javanese language, namely "*amba*" and "*titik*," which means to write, "*titik*" is interpreted as an element of scratches that start from "*sethithik*" (a little). Batik fabric is a textile with a pattern produced by the material *"malam"* (batik candles) applied to the fabric so that the wax serves to withstand the entry of dyes (Informant 2).

Table 1. Profile of Batik Entrepreneurs in Batik Laweyan Village, Surakarta

No.	*Name*	*Gender*	*Age*	*Status*	*Description*
1	Informant 1	Male	64 years old	Descendants of Batik Merchants and Heirs of Batik Business	Owner of Batik Merak Manis
2	Informant 2	Male	53 years old	Third descent in batik business and Solo batik conservationist	Owner of Batik Putra Laweyan
3	Informant 3	Male	60 years old	Chairman of Kampoeng Batik Laweyan Development Forum	Owner of Batik Mahkota Laweyan

Raw materials and auxiliary materials for making Batik, namely *mori* cloth, batik dyes, batik candles, additional substances, among others caustic soda, soda ash (Na2CO3), Turkish Red Oil (TRO), teepol, chloride acid, sulfuric acid, alum, lime, *ijo* medicine / ijo water, peanut oil.Making batik (*batik tulis*) in Laweyan Surakarta batik village, namely: Cutting *mori* cloth, Motif making, Colet, Nembok, Immersion, *Nglorot*, Laundering (Informant 1, Informant 2).

3.3. Types of business from MSMEs

Currently, there are 93 Batik MSMEs who are members of the Paguyuban Forum for The Development of Kampung Batik Laweyan Surakarta. The type of business in Kampung Batik Laweyan Surakarta can be seen in Table 2.

Table 2. Types of business in Kampung Batik Laweyan Surakarta

No.	*Business Type*	*Amount*
1	industry	15
2	industry, showroom	27
3	showroom	41
4	showroom, confection	6
5	showroom, modiste	2
6	batik medicine/seasoning shop	2

Table 2 shows six types of businesses in Laweyan Surakarta Batik Village. The industrial business is processing raw materials of *mori* fabric into batik fabric. Type of industrial business, a showroom that processes raw materials mori fabric into batik fabric, also has a museum where to sell the product. Showroom business is a business from MSMEs that sells batik fabrics, batik bed linen, batik clothing, handicrafts from batik materials, batik accessories, etc. Showroom business type, confectionary, namely MSMEs, make finished clothes such as *hem* batik, batik blouse, *daster*, batik pants, etc. MSMEs also have showrooms to display their products. Showroom business type, Modiste, makes women's clothing with various models according to customer demand and has a showroom to display the seam products. Type of business drug store/seasoning batik is a business that provides batik medicine, such as dyes, candles, chemicals for batik making materials (Informant 3).

3.4. Batik waste from MSMEs

Batik waste consists of solid waste, liquid, and gas as a byproduct of a series of batik processing processes. Batik industry liquid waste is the most produced waste and potentially pollutes the environment if not managed properly. From Table 3, it appears that Batik MSMEs produce waste in the form of liquid waste, solids, and gases. Batik industry liquid waste comes from

processing fabrics, coloring, and pelorodan (Novianti, 2020). The fabric processing and dyeing process produces liquid waste containing chemicals and increases the Chemical Oxygen Demand (COD) value. In addition, while in the highlighting activities, the resulting liquid waste contributes to wastewater's increasing Biological Oxygen Demand (BOD).

Table 3. Waste sources and types of batik waste (Informant 3)

No	***Source of batik making waste***	***Types of waste produced***	***Description***
1	Fabric Processing	- waste gas from heating fumes - liquid waste contains acids, oils, detergents - waste *mori*	waste gas, liquid waste solid waste
2	Pemalaman	- waste gas from heating fumes and wax vapor - wax waste	waste gas-solid waste
3	Coloring	- wastewater waste liquid staining contains dyes, Turkish Red Oil (TRO) solution, diazo salt, caustic soda (NaOH)	liquid waste
4	Pelorodan/Nglorod	- waste gas from heating fumes - wax sewage - liquid waste contains kanji and soda ash	gas waste, solid waste, liquid waste

3.5. Eco-industrial park concept

The model and technology of batik making apply to generations of *Batik community* actors in the industrial area of Laweyan batik village, namely with the linear system. The system correlates with the effect of destruction on the environment on the negative impacts created by the construction and operation of batik production (Rahmadyanti and Febriyanti, 2020). The environmental damage caused by industry and the rising unemployment rate motivates governments and enterprises to consider social and environmental aspects and economic aspects (Handayani et al., 2018). A sustainable supply chain can balance environmental, economic, and social elements (Sumadi et al., 2020).

Business management that still has a traditional pattern, especially in the production process in Kampung batik Laweyan Surakarta, has not been environmentally friendly, excessive use of natural resources, there will undoubtedly be inefficiencies. There are two actions taken to overcome the depletion of natural resources due to our lifestyle. The first is implementing waste prevention policies (Anisykurlillah et al., 2020). The second change from the classical linear system is the integrated waste management into a circular design (Cobo et al., 2017). Excessive use of non-recyclable materials, such as water, electrical energy, and gas, for the boiling process (*nglorot*) emits a certain amount of emissions into the air, water and soil. The way to save energy and reduce emissions in traditional manufacturing is to reduce damaged products (Zheng et al., 2020).

Batik making that applies for generations, from generation to age, by using materials that can not be recycled, with linear system production is an existing condition of the traditional area of Laweyan Surakarta Batik Village. Therefore, it became the basis for developing batik industrial area in Kampung Batik Laweyan Surakarta to Eco-Industrial Park with a circular system. The schematic of a linear system with a circular design in the Eco-Industrial Park (EIP) batik area can be seen in Fig. 1. The picture on the left shows the existing condition of the MSME production process in the Kampung Batik Laweyan Surakarta area with a linear system. The image on the right is a futuristic idea for the MSME production process in the Kampung Batik Laweyan Surakarta area towards an Eco-Industrial Park with a circular system. Eco-Industrial Park (EIP) is a batik industry area, where batik MSMEs located in one area jointly improve environmental, economic, and social performance (Qom and Azad, 2017).

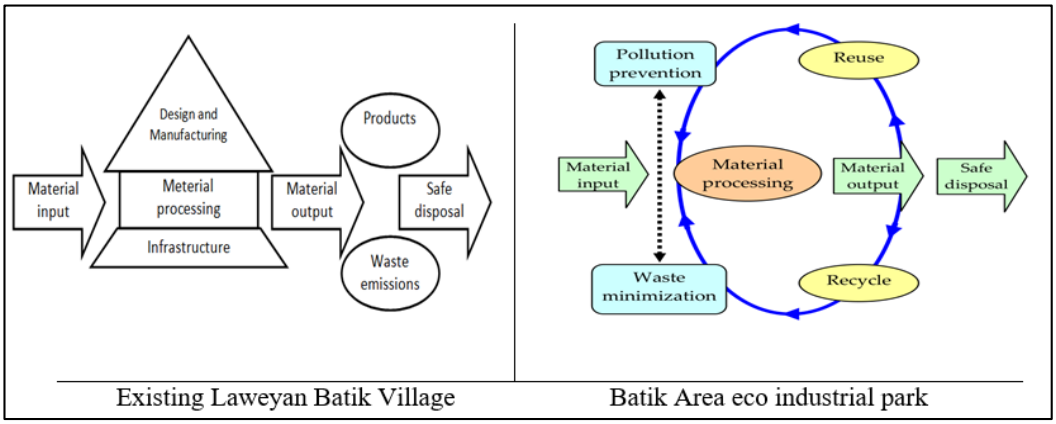

Fig. 1. Laweyan Batik Village Scheme to Eco-Industrial Park

Eco-Industrial Park (EIP) and industrial symbiosis are the main drivers for the sustainability and ecology of the industry (Chandu and Chandu, 2020). The Eco-Industrial Park concept seeks to minimize environmental impact and maximize resource efficiency by utilizing waste, byproducts, pollutants, and unused energy in closed loops. The shift from traditional production patterns with linear systems to closed loops promoted vigorously in the circular economy (Le Tellier et al., 2019).The result of identification about the closed-loop in the area of Laweyan Surakarta batik village, namely MSMEs whose type of business makes batik fabric, waste in the form of pieces of batik cloth. This waste can be used as raw materials for MSMEs whose connected businesses. Furthermore, waste patchwork from MSMEs confection and MSMEs modiste can be used to make accessories, such as necklaces, bracelets, earrings, footwear, *blangkon* etc. The cooperative network of materials, energy, water, and product exchanges created by particular industries is an industrial symbiosis, a competitive advantage in an industry (Baldassarre et al., 2019).

Solid waste, liquid waste, and gas emissions, which are wastes from making batik cloth, must be managed in an integrated manner not to burden the environment. Industrial materials no longer used in the production process must be safely returned to the biophysical environment by integrating chemical, biological, and geological processes. These materials will be usable in the following production process. Materials for producing bioenergy are needed in the modern era. Waste-to-energy, which refers to the principle of 5R (Reduce, Reuse, Recycle, Recover, and Restore), is the basis of sustainable development. Waste-to-energy can help shift from a linear system (make-use-throw approach) to a circular design (make-use-recycle-reuse approach) (Sharma et al., 2020). The optimal path to sustainable development is circular economic, which simultaneously focuses on improving material circularity in a system. Such circularity must be sustainable for the economy, environment, and society (Corona et al., 2019). The circular economy concept is based on three main pillars: 1). Design a preventive system to use lower resources and less waste to be disposed of; 2). Replacing unrenewable resources with renewable resources; 3). Reuse and recycle by-products and waste (Santagata et al., 2020).

Thus the need for essential materials in the future will be met without overexploitation and leaving no waste that destroys the environment. A new business model directed at waste prevention is to improve production efficiency, reduce consumption, recycle, and reuse materials (Bassi et al., 2021). Laweyan Batik Village area of Surakarta is a group of batik MSMEs that can become an Eco-Industrial Park Area. Solid waste from MSMEs batik in cloth can be the raw material in other batik MSMEs in one industrial area. The concept of reusing and recycling for batik fabric waste will be implemented. EIP is an industry that agrees to reduce the use of materials and energy. EIP converts waste into wealth, uses resources to increase production, improves the quality efficiency of goods, welfare, and safety of workers, and improves profitability. EIP's design considers tools

that simultaneously integrate resources (energy, water, power, carbon, and waste) and synergize (Lawal et al., 2021).

4. Conclusions

One of the results of our research is that the results of MSMEs batik waste in Kampung Batik Laweyan Surakarta can be identified from fabric processing, embroidery, coloring, and *nglorot* consisting of liquid waste, solid waste, and gas waste. MSMEs batik liquid waste is the most produced waste and can pollute the environment. Hazardous waste and environmental pollutants are from liquid staining wastewater containing dyes, Turkish Red Oil (TRO) solution, diazo salts, caustic soda (NaOH). Solid waste of MSMEs batik in fabric can be reused and recycled as byproducts and increase profit. Minimizing energy needs, environmental pollution, and waste generation are future concerns. Therefore, energy-saving and reducing emissions can be done by suppressing damaged products in the manufacture of batik fabrics.

Eco-Industrial Park, which emphasizes economic, environmental, and sustainable development, will be realized in Laweyan Batik Village Surakarta. Because it is identified that batik MSMEs are in one area, the type of business can cooperate in utilizing waste to increase the profit of each BATIK MSMEs in one place. Therefore, what is needed for the design of EIP Kampung batik Laweyan Surakarta is the synergy of all BATIK MSMEs and focuses on considering tools that can integrate resources (such as energy, water, power, carbon, and waste) simultaneously. This research provides an overview and guidance to stakeholders to realize a sustainable batik industry area. Sustainable on economic, social, and environmental aspects.

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