

## Exploration of trend methods and scenarios in the implementation of an Sistem Manajemen Lingkungan (SML) in the batik industry of Klampar, Pamekasan Regency.

**Hendri Setiawati 1<sup>a\*</sup>**

1<sup>a\*</sup> Master's Program in Environmental Studies, Open University, Indonesia

**A Hadian Pratama Hamzah 2<sup>b\*</sup>**

2.<sup>b\*</sup> Master's Program in Environmental Studies, Open University, Indonesia

**Nurhasanah**

3.<sup>c\*</sup> Master's Program in Environmental Studies, Open University, Indonesia

\*Correspondence: [hendri.zaidanbasmalah@gmail.com](mailto:hendri.zaidanbasmalah@gmail.com)

### Abstract ← 11pt, Times New Roman, Bold

*To realize sustainable development, environmental preservation is a very important aspect, especially in efforts to reduce the negative impacts resulting from various industrial processes. Batik industry waste consisting of solid, liquid and gas waste has the potential to pollute the environment if not managed properly. This study aims to predict long-term environmental impacts and develop sustainable management strategies. The methods used are the GEMI (Global Environmental Management Initiative) checklist and scenario trend analysis. The results of the study indicate that the Klampar Batik Industry has not yet implemented SML optimally, so a sustainable strategy is needed to manage an environmentally friendly industry. The strategy is formulated through the Plan-Do-Check-Act (PDCA) approach, which is applied to each scenario, namely the normal scenario, the best scenario, and the worst scenario. Each scenario includes two types of preventive strategies to prevent problems and corrective to overcome environmental impacts. In the Normal Scenario, the strategy includes phased planning, implementation of simple waste processing technology, and evaluation through environmental audits. In the Best Scenario, the focus is on modern technology and ISO 14001 certification, while in the Worst Scenario, basic steps such as awareness campaigns and environmental remediation are taken to restore market confidence and ensure industry sustainability.*

### Article History:

#### Keywords:

*Environmental Management System, ISO 14001:2015, Batik Industry, Environmental Sciences*

### 1. Introduction ← 12pt, Times New Roman, Bold

The industrial sector is a highly strategic area for the stimulation of national development by encouraging continuous economic growth in the manner of raising productivity, being innovative, and contributing to GDP (Kristiyanti, 2012; Sumbar, 2013). Among others, small-scale industries are the most involved, often called SMEs. In addition, among SMEs, there is a particular industry called the batik industry, which has not only an economic but also a cultural value. As an Indonesian cultural heritage recognized globally, the batik industry not only contributes to preserving the nation's cultural identity but also supports national economic development (Sujiwo et al., 2023).

The batik industry in Madura, particularly in Pamekasan Regency, has been an integral part of the community's life for decades. However, official recognition as a "Batik City" was only granted on June 24, 2009. This designation aimed to strengthen Pamekasan Regency's identity as a center for batik

artisans in Madura while also supporting the preservation and development of the batik industry at both local and national levels. This recognition aligned with UNESCO's declaration of Indonesian batik as a cultural heritage on October 2, 2009 (Galih, 2017).

Batik production is still carried out traditionally, using simple tools and manual techniques. The batik production process has the potential to impact the environment, necessitating the implementation of environmental management systems to mitigate these effects and promote sustainable practices (Sujiwo et al., 2023).

One of the main issues is water pollution caused by the use of chemical dyes and the improper disposal of liquid waste (Hannan et al., 2024). This not only threatens environmental sustainability (Apriyani, 2018) but also harms surrounding communities and reduces the competitiveness of the batik industry in the global market.

To address this challenge, the implementation of an Sistem Manajemen Lingkungan (SML) has become an essential step in achieving more environmentally friendly batik production (Yuliasari et al., 2023). SML provides a framework for identifying, managing, and minimizing the environmental impacts of industrial activities. However, the implementation of SML in the batik sector often faces obstacles, such as a lack of understanding of long-term impacts, limited resources, and inadequate data-driven strategic planning.

The trend and scenario methods offer innovative solutions to address this challenge. By utilizing the trend method, potential environmental impacts and development opportunities can be identified based on emerging patterns in the batik industry. Meanwhile, the scenario method enables more adaptive strategic planning by mapping out various possible future conditions (Putra et al., 2024). The combination of these two methods provides a proactive approach that not only focuses on managing current environmental impacts but also prepares the industry to tackle future environmental challenges.

This study aims to explore the application of trend and scenario methods in the implementation of SML within the batik industry. Through this approach, it is expected to develop sustainable environmental management strategies that can support the continuity of the batik industry while preserving environmental sustainability.

## 2. Methodology

### 2.1 Research Location

The focus of this research is the Batik Industry Center in Klampar, Pamekasan Regency, Madura, East Java Province. This location was chosen due to the absence of an environmental management system, with the expectation of adopting and implementing the stages outlined in the ISO 14001 environmental management system to promote environmentally friendly practices in the Klampar batik industry.

### 2.2 Method Analysis

#### 2.2.1 Model GEMI (*Global Environment Management Initiative*)

GEMI or *Global Environment Management Initiative*, is a scoring method used to identify areas requiring improvement, thereby facilitating researchers in pinpointing the root causes of environmental issues within the company under study (Pandriratri et al., 2023). It encompasses seven principles: context of the organization, leadership, planning, support, operation, performance evaluation, and improvement (Ramadan et al., 2019). The GEMI scoring system uses a scale of 0–2, as detailed in the following table:

Table 1

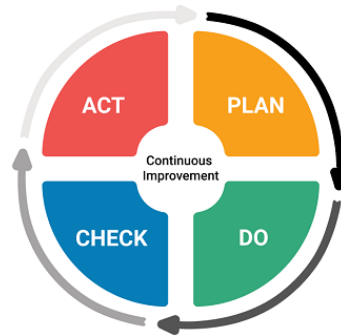
*GEMI checklist rating scale*

No	Information
0	the organization/company has not met the requirements
1	The organization/company has fulfilled some of the requirements
2	the organization/company has fully met the requirements

Source: (GEMI, 2017)

A score of 0 in Table 1 indicates that the organization being studied has not yet met the specified requirements or clauses. A score of 1 signifies that the organization/company has partially implemented the requirements or clauses but has not yet documented them. Meanwhile, a score of 2 indicates that the organization/company has fully implemented or executed the requirements or clauses.

Image 1  
*Siklus Plan Do Check Act (PDCA)*



Source: (Rahmalia, 2021)

The seven principles are interconnected to form the plan-do-check-act (PDCA) cycle, which represents a model of continuous improvement implemented by organizations or companies (Fauza & Kautsar, 2018; Rahmalia, 2021; Setiawan, 2021). The PDCA cycle, developed by W. Edwards Deming, is a method designed to enhance organizational or company operations on an ongoing basis (Rahmalia, 2021). This method focuses on identifying existing problems to develop sustainable improvement solutions (Maruta, 2012; Sokovic et al., 2010). The PDCA approach is intended to be integrated into the culture of an organization or company, fostering a systematic and quality-oriented workflow (Silva et al., 2017). By applying PDCA, organizations can establish a framework that promotes repeated process evaluation, data-driven decision-making, and the effective implementation of corrective actions. This method also enables organizations to adapt to changes, improve operational efficiency, and ensure long-term sustainability and competitiveness (Isniah et al., 2020).

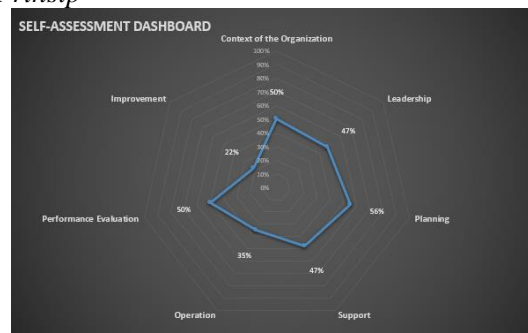
### 3. Result and Discussion

#### 3.1 Model GEMI

The Klampar Batik Industry in Pamekasan Regency has made efforts to enhance the implementation of ISO 14001. A checklist is used, where each condition is scored based on the principles of ISO 14001 to evaluate their application within the batik industry. The purpose of scoring each principle is to assess the current state of the industry. The following are the scoring results for the ISO 14001 principles, which include context of the organization, leadership, planning, support, operation, performance evaluation, and improvement.

Image 2

*Total Skor Masing-Masing Prinsip*



Source: The writer, 2024

Based on observations at the research location, progress in practices can be reported, showing that the Klampar Batik Industry Center has implemented several clauses of the ISO 14001 environmental management system. The performance of these implementations is as follows:

1. Clause 4: Context of the Organization

The context of the organization clause requires an organization to identify all internal and external issues that could threaten the achievement of the environmental management system's objectives. Based on the figure above, this clause demonstrates a relatively high score of 50%. The Klampar Batik Industry has established an organizational structure to support roles in the batik production process. The organization of the Klampar Batik Industry Center is structured by tasks and roles, with a focus on environmental sustainability both in the production process and in waste disposal.

2. Clause 5: Leadership

The leadership clause in the Klampar Batik Industry shows a score of 47%. Leadership in the Klampar Batik Industry is reflected in both the improvement of human resource capacity and more efficient production processes to support the SML. The Klampar Batik Industry Center is led by an individual committed to environmental sustainability. The center has a clear division of roles, with each worker/staff member having specific responsibilities in carrying out the batik production process. Additionally, every employee has received training from relevant agencies to enhance their human resource capacity.

3. Clause 6: Planning

The planning clause shows a score of 56%. A high score indicates that the organization understands the risks and opportunities it faces in production. The Klampar Batik Industry Center is aware of the risks and opportunities involved in batik production. In the planning clause, the Klampar Batik Industry Center focuses on:

- Waste

To minimize the risk of environmental damage, the Klampar Batik Industry Center has taken preventive measures by managing waste before disposal, ensuring that the waste is safe for environmental sustainability.

- Material

The Klampar Batik Industry Center uses materials such as textile dyes and chemicals, none of which are made from natural ingredients. In 2023, based on a survey, the amount of material used was around 30-50 kg per month.

4. Clause 7: Support

The support clause shows a score of 47%. In the organizational structure of the Klampar Batik Industry, there is clear support for resources that can manage the environment sustainably. This support is reflected in the competence of human resources (HR) and the employees' level of environmental awareness.

- Competence

The human resources at the Klampar Batik Industry Center are supported by qualified personnel, where employees receive adequate training and guidance, enabling them to support batik production that is both high-quality and environmentally friendly.

- Awareness

Training is provided to be applied in batik production, ensuring that every employee understands and cares about environmental issues.

- Information and Documentation

Not all activities are fully documented. However, there is documentation and information available regarding batik production volumes, the use of production materials, and the management of the waste generated.

5. Clause 8: Operation

The operation clause shows a score of 35%, which is relatively low compared to the other clauses. The low score is due to the fact that the industry has not yet fully implemented preparedness and emergency response measures. However, there have been efforts to establish emergency preparedness,

such as evacuation route signs in case of an emergency, and daily briefings to ensure employee safety during operational activities.

#### 6. Clause 9: Performance Evaluation

The performance evaluation clause shows a score of 50%. The Klampar Batik Industry has conducted monitoring, analysis, and evaluation of performance, ensuring that performance targets are met and risks are minimized. This is expected to support the improvement of environmentally-friendly performance quality. However, performance evaluations have not been fully implemented because performance documentation is not well-organized in report form, making it difficult to carry out evaluations without supporting data.

#### 7. Clause 10: Improvement

The improvement clause shows a score of 22%. This clause involves a commitment to continuous improvement based on the results of performance evaluation and measurement. The low score is due to the Klampar Batik Industry's still suboptimal implementation of the EMS. One improvement made is the employment of competent and environmentally-conscious workers, with the use of a Wastewater Treatment Plant (IPAL) for waste management.

### 3.2.2 Scenario Trend Analysis

The first step in this phase is to identify the main risks that could affect the environmental performance of the Klampar Batik Industry. This can be done by analyzing the GEMI results shown in Figure 2. In this diagram, the lowest score refers to the improvement aspect. This aspect is related to the suboptimal implementation of the SML at the Klampar Batik Industry, which requires strategic planning to avoid negative environmental impacts. Three scenarios were developed: normal scenario, best-case scenario, and worst-case scenario.

#### 1. Normal scenario

In this scenario, the SML implementation proceeds as it currently is, with minimal improvements but still not optimal. This scenario is characterized by the Klampar Batik Industry using a simple wastewater treatment system that can only manage a portion of the liquid waste, while solid and gas waste management remains inadequate. Employee training lacks a long-term strategy, and the use of hazardous chemicals continues with minimal supervision.

The consequence is that the suboptimal SML implementation in the Klampar Batik Industry still results in environmental pollution, albeit on a small scale. Compliance with regulations is partial, putting the industry at risk of penalties.

#### 2. Best-case scenario

In the best-case scenario, the Klampar Batik Industry fully implements the Environmental Management System (SML), addressing all identified environmental risks. Strategic steps include investing in modern Wastewater Treatment Plant (IPAL) technology for efficient waste management, comprehensive employee training to raise awareness and improve worker competence, and the use of eco-friendly dyes. Additionally, a regular monitoring system is applied to ensure compliance with environmental standards. Collaboration with the government, academia, and environmental organizations is also an essential part of developing a comprehensive sustainability strategy.

The positive consequences of this approach are significant. Environmental pollution is drastically reduced, local ecosystems recover, and public health risks are minimized. The industry fully complies with environmental regulations, avoiding legal risks. The Klampar batik products become more competitive in the global market with added value as eco-friendly products. Moreover, the well-designed sustainability strategy ensures the long-term viability of the industry, both economically and environmentally.

#### 3. Worst-Case Scenario

In this scenario, the SML is either not implemented at all or fails due to a lack of resources and support, causing significant negative impacts on the Klampar Batik Industry. Liquid, solid, and gas waste are poorly managed, leading to environmental pollution. The absence of environmental training or awareness for workers worsens the situation, while the use of hazardous chemicals without control results in severe environmental damage.

The consequences include worsening environmental damage, polluting water, soil, and air, which disrupts the lives of surrounding communities. Industries also risk facing legal sanctions such as hefty fines, operational shutdowns, or business license revocation for failing to comply with environmental regulations. Kamar batik products lose their competitiveness in the market, particularly due to a negative image as environmentally unfriendly products. In the long term, this failure threatens the sustainability of the industry, with potential customer loss and the risk of closure due to legal pressures and declining consumer trust.

Based on the analyzed scenarios, a PDCA (Plan-Do-Check-Act) strategy has been developed for each scenario. The detailed strategies are outlined in the following explanation.

1. Skenario Normal

- Plan* : A phased plan for investing in simple waste treatment technology and worker training programs.
- Do* : The initial implementation of wastewater treatment systems, collaboration with the government, and basic environmental monitoring are carried out..
- Check* : An environmental audit is conducted to evaluate the effectiveness of the implementation and identify gaps that need to be addressed.
- Act* : Improvements are made, including refining standard operating procedures (SOPs), conducting internal campaigns to raise awareness, and providing incentives to artisans who begin adopting environmentally friendly practices.

2. Skenario Terbaik

- Plan* : The integration of modern wastewater treatment technology, the use of natural dyes, and obtaining ISO 14001 certification.
- Do* : The implementation proceeds effectively with advanced training for artisans, the integration of an eco-friendly supply chain, and the adoption of new technologies.
- Check* : Regular evaluations of the implementation of Environmental Management System (SML).
- Act* : The development of innovative products, resolution of minor detected issues, and transparency through sustainability reporting.

3. Skenario Terburuk

- Plan* : Regular evaluations of EMS implementation focus on developing environmental awareness campaigns, securing government incentive support, and planning simple waste management solutions.
- Do* : The implementation of basic steps, such as waste segregation and consultations with environmental organizations.
- Check* : An assessment is conducted to evaluate the impact of pollution and determine the extent of the damage.
- Act* : involves environmental remediation, operational restructuring, and product rebranding to regain market trust and ensure the long-term sustainability of the industry.

#### 4. Conclusion

This includes environmental remediation, operational restructuring, and product rebranding to restore market trust and ensure the long-term sustainability of the industry.

Based on the analysis conducted, the implementation of SML in the Kamar batik industry is still not optimal, requiring a sustainable strategy to manage an environmentally friendly industry. These strategies are developed using the PDCA approach, applied to each scenario: normal, best, and worst.

In the Normal Scenario, while SML is partially implemented, improvements are still needed through the application of simple technologies and regular training for workers. Using the PDCA cycle,

continuous evaluation and improvement will help reduce environmental impacts and increase compliance with regulations.

In the Best Scenario, optimal SML implementation with full support from all parties will lead to significant positive impacts, such as reduced pollution, improved product competitiveness, and long-term industry sustainability. By fully following the PDCA cycle, the evaluation and development of environmentally friendly products as well as efficient waste management can be achieved.

However, in the Worst Scenario, where SML is not implemented or fails, the Kampar batik industry faces greater environmental impacts, legal issues, and the risk of losing the market. Therefore, it is crucial to promptly adopt appropriate preventive and corrective strategies, including using the PDCA cycle to identify and correct errors before the negative impacts become too significant.

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