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Challenges and strategies for enhancing environmental performance in Indonesia's batik industry

Wenti Ayu Sunarjo[1*], Siti Nurhayati[1]

[1] Faculty of Economics and Business, Universitas Pekalongan, Pekalongan, Indonesia
[*] Corresponding author's email: wentiayu@unikal.ac.id

Abstract

Sustainability is now accepted by all stakeholders as a guiding principle for public policy making and corporate strategy. However, the biggest challenge still lies in the implementation of achieving environmental performance in an industry. The current concept of environmental waste focuses on the total waste production from the remaining production results. Therefore, there is an emphasis on limiting waste within the boundaries of the industry and implementing post-production processes to clean it up. The batik industry as a livelihood for some Indonesian people still produces waste from production (solid and liquid waste) which disrupts environmental sustainability. This study aims to determine the effect of eco-efficiency, non-product output, and waste reduction on environmental performance. The associative method was used in this study. The types of data used are primary and secondary data, with data collection methods through questionnaires. Quantitative methods with Smart PLS analysis tools were used in collecting research data and analyzing the answers collected to questions from available respondents. The results showed that the relationship between eco-efficiency and environmental performance had a significant effect, as well as the relationship between non-product output and environmental performance, the results were significant. However, the relationship between waste reduction and environmental performance was not significant. Efforts to achieve better environmental performance must be carried out by reducing sources such as low-waste technology and on-site management performance. Meanwhile, encouraging sorting behavior such as increasing stakeholder awareness of waste, improving regulations, strengthening government supervision and controlling illegal dumping should be emphasized.

Keywords

Environmental performance, Eco-efficiency, Non-product output, Waste reduction, Batik industry

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Introduction

Based on the current hot issue, it is interesting to analyze regional environmental performance in Indonesia [1]. As we know, Indonesia has experienced economic growth in recent decades. Although Indonesia has made significant strides in achieving economic growth in recent years, much remains to be done to ensure that this growth is sustainable and inclusive [2]. Creating a circular and environmentally friendly economic development is one of the goals of sustainable development [3].

One of the sectors that supports sustainable economic development in Indonesia is MSMEs. Batik MSMEs in Indonesia not only contribute to environmental preservation but also support sustainable and inclusive local economic growth [4]. MSMEs are considered to have a major contribution to reducing poverty (SDG 1), improving welfare (SDG 2), and encouraging inclusive economic growth (SDG 8) [5]. The existence of MSMEs as part of all national business entities is a real manifestation of the diverse economic life in Indonesia [6]. The primary raw materials used in batik production, such as textiles and auxiliary materials that include hazardous chemicals for the environment, cannot be separated from the process. Consumers are becoming more conscious about environmentally friendly items these days [7][8].

One major problem is the production process, which produces a lot of chemically laden effluent from dyeing and waxing operations [9]. When this frequently untreated effluent is released into nearby water bodies, it seriously pollutes the water [10][11]. Studies have shown that batik manufacturing results in high levels of chemical and biological oxygen demand (BOD and COD), which are harmful to aquatic environments and nearby communities [12].

Furthermore, the industry's environmental impact is exacerbated by its reliance on conventional techniques that employ synthetic chemicals and non-renewable energy sources [13][14]. The Indonesian batik industry continues to implement environmentally friendly practices inconsistently despite the growing global emphasis on sustainability [15]. This is primarily because micro small and medium-sized businesses (MSMEs) face financial constraints, lack of awareness of environmental issues, and limited access to green technology [16].

The use of cleaner production methods, the introduction of eco-friendly dyes, and the deployment of Environmental Management Systems (EMS) are all attempts to address these issues [17]. Nevertheless, not enough study has been done on how well these actions can improve environmental performance throughout the sector. The shift to more sustainable practices is mostly driven by elements like international cooperation, market demand for sustainable products, and governmental restrictions [18].

This study also closes the gap left by [19] research in Malaysia, which found that more in-depth study of eco-efficiency is still needed. By incorporating businesses from developing nations with comparable institutional and cultural structures, the topic will be better understood [20].

Improving environmental performance in the batik business is an ecological need and a strategic opportunity to increase its competitiveness in the global market, especially in light of the growing demand for sustainable fashion and responsible production [21]. However, the effectiveness of these measures in improving environmental performance across the industry remains under-researched [22].

[23][24][25] first suggested eco-efficiency as a tool for sustainability research, and the World Business Council for Sustainable Development (WBCSD) later popularized it [26, 27]. While gradually lowering ecological impacts and resource intensity throughout the life cycle to a level at least equal to the Earth's estimated carrying capacity, eco-efficiency is defined by the WBCSD as "the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life" [28][29]. Stated differently, it represents the capacity to generate more products and services with reduced environmental effect and natural resource use Eco-efficiency has so far been viewed at a variety of scales, including the national economy, the regional level, the industrial sector level, and the level of businesses [30].

Finding an appropriate method to gauge eco-efficiency is crucial. Eco-efficiency is typically measured using the frontier approach, the ratio approach, and the material flow analysis [31]. According to the ratio approach, eco-efficiency is the ratio of the economic value of the produced goods or services to their environmental impacts. This ratio can only be computed if the denominator and the numerator can be combined to give a specific value [32]. Eco-efficiency is the most rational concept of the relation between environmental and financial performance. In order to save costs while maintaining the environment, this concept helps to show the ratio of product value and environmental load [33][34][35][36]. Eco-efficiency is a concept that encourage companies to develop their environmental performance level [37][38]. The proposed hypothesis can be stated as follows;

H1: eco-efficiency has a significan effect on environment performance

Non-product output (NPO) is output that is not a product and can be categorized as reusable waste [39][40]. NPO is all the materials, energy, and water used in the production process, but does not end up in the desired end product [41]. Expenses often account for the largest portion of overall environmental costs. With this information, management may suggest ways to improve material usage efficiency and lessen its effects on the environment [42]. The material purchase value of non-product output was one of the main cost factors identified in corporate workshop studies [43].

The design developed to control NPOs taking into account regulatory and managerial needs [44], the system is designed to evolve from a fragmented set of indicators based on an ecological perspective to a holistic set of indicators based on a comprehensive overall perspective to consider changes in business environmental performance [45]. Non-product output shows that there is a significant influence on environmental

performance in Indonesian companies [46]. Therefore, the proposed hypothesis can be stated as follows;

H2: NPO has significant effect on environment performance

Considering that polluting enterprises really spend three times as much for non-product output, non-product outputs are a significant cost factor for businesses [47]. The first is the price of buying the raw material, which is ultimately a waste product [48] [48]. Second, the business has to pay labor and investment costs for the operational use of raw materials [49]. To determine which material streams are used to make the finished product and which do not [50]. Improvement strategies and chances to cut expenses by preventing material losses are found when material losses have been measured [51].

Businesses should ideally be encouraged to think about non-landfill waste disposal options via waste reduction initiatives fueled by market intervention (e.g., higher disposal costs) or government restrictions (e.g., packaging or disposal laws) [52]. Firm-level investments in pollution control are also thought to be significantly influenced by pressure from stakeholders and customers [53]. However, many businesses continue to see waste reduction as a complex alternative to trash removal (and non-reducing) choices like treatment or landfill disposal, and they fail to see its worth [54].

Many businesses continue to resist, despite the fact that more and more institutional measures have been put in place to encourage or compel them to minimize their waste [55]. Businesses react to institutional pressure by considering how important it is to their existence [56][57]. However, they also have the choice to spend money on resources that will provide them more alternatives for responding to pressure than their rivals [58]. Growing institutional demand to reduce waste points to a tendency in a company's operational environment that can necessitate both present and future resource investments [59]. Businesses that can anticipate future needs and achieve their institutional waste reduction goals are likely to have a competitive edge over their peers [60]. Therefore, the proposed hypothesis can be stated as follows;

H3: waste reduction has significant effect on environment performance

It has been demonstrated in various contexts that enterprises can gain a competitive edge by responding to institutional pressures in an adaptive rather than reactive manner [61]. For instance, businesses' choices to spend money on training materials have been connected to the creation of ecologically friendly products and procedures [62][63]. The environmental performance of businesses has also been connected to investments in pollution reduction technologies and skills [64]. Businesses are better positioned to gain distinct and strategic advantages when they invest in and develop internal resources with particular performance goals in mind. Businesses may compete and adjust to changes in their environment by investing in resources [65].

This study intends to add to the conversation on sustainable practices in cultural industries by examining how governmental frameworks, technical innovation, and

stakeholder involvement interact, emphasizing the particular potential and problems faced by the Indonesian batik industry [66] (Harsanto & Permana, 2021). The industry are becoming more conscious of the fact that their ability to survive also hinges on how they interact with the environment and society in which they operate [67]. This is consistent with the legitimacy theory, which holds that businesses have an agreement with the community to conduct their operations following justice principles and how they react to different interest groups to justify their actions. According to legitimacy theory, companies must constantly work to make sure that their operations respect social norms and boundaries [68]. Legitimacy theory was first proposed by Dowling and Pfeffer in 1975. This theory focuses on the interaction between companies and society. By applying the legitimacy theory, companies can avoid unwanted things and increase the value of the company [69].

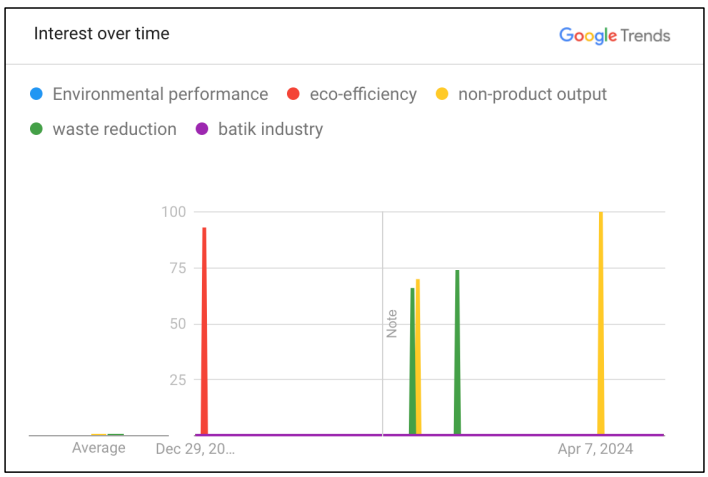

Figure 1. Google Trends Data on Environmental Performance Issues in Indonesia in the Last 5 Years

In addition, sustainable practices that can be carried out by the batik industry are the concepts of waste management [70]. The current concept of environmental waste focuses on the total waste production from the remaining production results. Therefore, there is an emphasis on limiting waste within the boundaries of the industry and implementing post-production processes to clean it up. The batik industry as a livelihood for some Indonesian people still produces waste from production (solid and liquid waste) which disrupts environmental sustainability [71].

Based on data obtained from Google Trends on Environmental Performance Issues in Indonesia in the Last 5 Years (Figure 1), it appears that issues on environmental performance in the batik industry are still a hot issue and based on the data, there are issues related to the variables studied, namely environmental performance, eco-efficiency, non-product output, waste reduction.

In line with this background, the objectives of this study are to determine the effect of eco-efficiency, non-product output, and waste reduction on environmental performance. Furthermore, the associative method is used in this study.

Method

This study was analyzed using SEM-PLS with the reason being that it has limited sample size but the model built is complex, with the number of samples needed following the minimum requirement of 5 times the number of indicator variables (Ferdinand, 2014). A total of 21 indicators was multiplied by 5, and then the sample obtained according to the calculation is 105 samples. The duration of questionnaire distribution was limited to three weeks, namely in November (November 2 to November 23, 2024). The research data in the form of questionnaires were distributed directly to respondents with details of the level of response to the questionnaire.

Table 1 indicates that a total of 120 surveys were sent out, and 112 of them were returned. Following verification, 98 questionnaires were found to be usable, while 14 were deemed unfit for usage. The study's questionnaire disclosure level (response rate) was 93.33%, falling inside the permitted range as the figure exceeded 60%. This outcome was determined by dividing the total number of questionnaires distributed (120) by the percentage of questionnaires returned (98) without approximate feasibility. In the meantime, the study's questionnaires had a usable response rate of 81.67%, which was higher than 76.7% and placed the questionnaires in the dubious category. This outcome was determined using the percentage.

Table 1. Details of Response Rates to the Questionnaire

No	Desciption	Sum
1.	Sum of Questionnaires Distributed	120
2.	Questionnaires Not Returned	8
3.	Questionnaires Returned	112
4.	Questionnaires Damaged	14
5.	Questionnaires Used	98
6.	Response rate	93,33%
7.	Usable response rate	81.67%

Results and Discussion

A total of 98 respondents, all of whom have implemented eco-efficiency, such as reusing the remaining batik wax that was scattered, cutting the cloth as needed, and reusing the batik dye solution for the next batik coloring process. A total of 91 batik industries produces natural dyes and synthetic dyes, the remaining 7 batik industries only focus on producing batik with natural dyes.

Results

In this discussion, the characteristics of respondents are explained based on gender, age, educational background, length of business, number of employees, batik coloring, wastewater treatment plant (WWTP). Table 2 shows that the results of the characteristics of respondents based on gender in this study are dominated by men, with a percentage of 69.4% because most batik entrepreneurs are men, and the previous batik business was also mostly done by men. The remaining 30.6% are women.

In addition, 34.7% of respondents in this study have a high school education, which shows that most batik entrepreneurs do not continue their education at the college level. They prefer to focus on managing batik businesses and increasing their insight with non-formal education.

Based on the length of the business, the largest is 11-15 years as much as 34.8%, which means that the batik business is promising and has been carried out from generation to generation. In the respondent data, the largest number of employees is on average 21-30 or is still included in the micro business category. It can be seen from the type of batik dye from respondents, 83.7% carry out a combination coloring process, namely in their batik business using natural dyes and sometimes chemical dyes because they fulfill consumer orders. Meanwhile, most respondents use communal WWTP or 62.2% in WWTP ownership. Communal WWTP is a WWTP with a large capacity that can be used by many batik entrepreneurs to process their waste, this WTP is generally built by the government or CSR that supports environmental conservation.

Table 2. Demograpics Data

Demographics	Categories	Frequency	Percentage
Gender	Male	68	69.4
	Female	30	30.6
Total		98	100
Age	17-25	6	6.1
	26-30	7	7.1
	31-35	12	12.2
	36-40	21	21.4
	41-45	30	30.7
	>46	22	22.5
Total		98	100
Educational Background	Master	1	1
	Bachelor	24	24.4
	Degree	5	5.1
	Senior High School	34	34.7
	Junior High School	22	22.4
	Elementary School	10	10.2
Total		98	100
length of business	1-5 years	5	5.1
	6-10 years	2	2
	11-15 years	34	34.8
	years	27	27.6
	>20 years	28	28.5
Total		98	100
Number of Employee	1-10	25	25.5
	11-20	15	15.4
	21-30	37	37.7
	31-40	17	17.3
	41-50	3	3.1
	>50	1	1
Total		98	100
Batik Coloring	Natural Dyes	15	15.3
	Chemical Dyes	1	1
	Combine	82	83.7
Total		98	100
WWTP	Communal WWTP	61	62.2

Demographics	Categories	Frequency	Percentage
	Simple WWTP	37	37.8
		98	100

Figure 2 conventional SEM analysis solution demonstrated how strongly the constructs were related to one another. Only two testing criteria—RMSEA with a value of 0.065 (cut-off value ≤ 0.08) and GFI with a value of 0.918 (cut-off value ≥ 0.90)—met the requirements or produced a fit model, according to the results of the fit model test. Chi-square (430.036), AGFI (0.886; cut-off value ≥ 0.90), CMIN / DF (3.496; cut-off value ≤ 2.00), TLI (0.918; cut-off value ≥ 0.95), and CFI (0.934; cut-off value ≥ 0.95) were among the other categories that failed to meet the prerequisite cut-off value. The fit model was widely regarded as marginal, even though not all index values were satisfied.

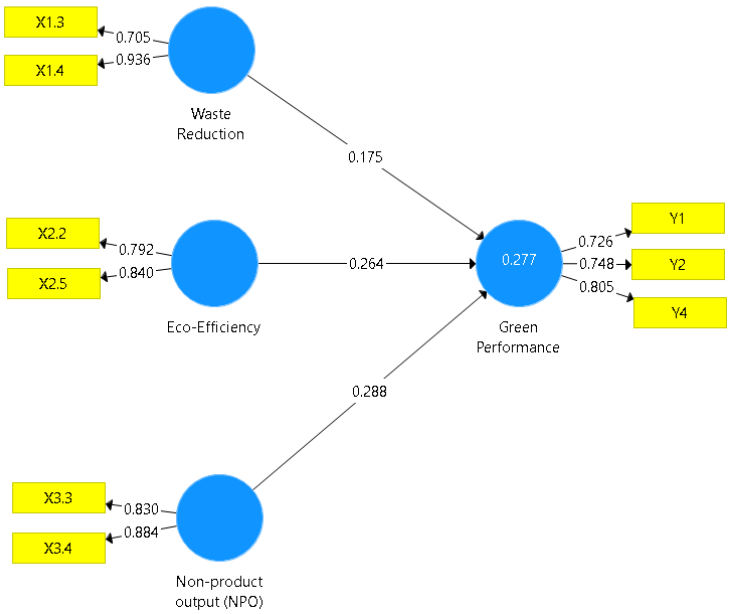

Figure 2. Empirical research model

It is shown in Table 3 that overall, the findings demonstrated that the measurement model satisfied the relevant statistical requirements. Since all loading variable values were more than or equal to 0.5, all variables were deemed valid for usage continuous utility, or all indicators passed the validity test. The construct reliability score was over 0.70, and the extract variance was above 0.50, indicating that all variables (observed) were valid, then the data generated from the study can be trusted to be true and accurately measure what should be measured. Every variable's Average Variance Extracted (AVE) was greater than 0.5.

Table 3. Construct reliability dan validity

	Composite Reliability	Average Variance Extracted (AVE)
Waste Reduction	0.811	0.687

	Composite Reliability	Average Variance Extracted (AVE)
Eco-Effficiency	0.800	0.666
Non-Product Output (NPO)	0.847	0.735
Environment Performance	0.804	0.578

It can be seen in Table 4 that average R-Square (ARS), and average adjusted R-Square (AARS) values are less than or equal to 0.05 at 5% significance. Based on the Fornell & Lacker (1981) Criteria, the values of all constructs have been met because they show values that are greater than the correlation between constructs (Table 5).

Table 4. R Square Determination Test

	Average Adjusted R Square (ARS)	Average Adjusted R Square (AARS)
Environment Performace	0.277	0.254

Table 5. Discriminant validity

	Eco-Efficiency	Environment Performance	Non-Product Output (NPO)
Eco-Efficiency	0.816		
Environment Performance	0.408	0.760	
Non-Product Output (NPO)	0.216	0.376	0.858
Waste Reduction	0.466	0.351	0.183

Based on the VIF values in the Table 6, it can be seen that all VIF values <5 so it can be concluded that the data does not have high collinearity. The results of the hypothesis testing show that the first hypothesis is accepted with a p-value of 0.017, the second hypothesis is accepted with a p-value of 0.030, and the third hypothesis is not accepted with a p-value of more than 0.5, namely 0.084. (Table 7).

Table 6. Collinearity Statistics (VIF)

	Eco-Efficiency	Green Performance	Non-Product Output (NPO)
Eco-Efficiency		1,.07	
Environment Performance			
Non-Product Output (NPO)		1.058	
Waste Reduction		1.289	

Table 7. Hypothesis Testing

Hipotesis	**Original Sample**	**P-Value**	**Information**
H1: Eco-Efficiency → Environment Performance	0.264	0.017	Accepted
H2 : Non-Product Output (NPO) → Environment Performance	0.288	0.030	Accepted
H3 : Waste Reduction → Environment Performance	0.084	0.175	Rejected

Discussion

Sustainability is now accepted by all stakeholders as a guiding principle for public policy making and corporate strategy [72]. However, the biggest challenge still lies in the implementation of environmental performance achievements in an industry. The current concept of environmental waste focuses on the total waste production from the remaining production results. Therefore, there is an emphasis on limiting waste within the boundaries of the industry and implementing post-production processes to clean it up.

The batik industry as a livelihood for some Indonesian people still produces waste from production (solid and liquid waste) that disrupts environmental sustainability [71]. This study aims to determine the effect of eco-efficiency, non-product output, and waste reduction on environmental performance. This study uses the Legitimacy Theory which means that companies must operate in accordance with the norms and social values that apply in the community where they operate [68]. This theory aims for the company's activities to be accepted by the community as something legitimate.

The associative method is used in this study. The types of data used are primary and secondary data, with data collection methods through questionnaires. Quantitative methods with Smart PLS analysis tools are used in collecting research data and analyzing the answers collected to questions from available respondents. The results of the study indicate that the relationship between eco-efficiency and environmental performance has a significant influence, this is in line with research [73][37], meaning that the batik industry has carried out eco-efficiency activities in its production process and it has been proven that it can improve environmental performance. However, [36] states different results from this study, that eco-efficiency has no significant effect on environmental performance. As well as the relationship between non-product output and environmental performance, the results are significant, through efforts to utilize waste that is still useful, it certainly has an impact on improving environmental performance and supporting environmental sustainability [41][44].

The research results support the research of [74]. This means that the batik industry has mostly understood the concept of output that is not a product and can be categorized as waste that can be reused. However, there are research results that differ from this study, where NPO has no significant effect on environmental performance [41], because entrepreneurs think that carrying out activities related to NPOs requires more costs. Companies must spend a lot of money to invest in end-of-life care to improve environmental performance rather than adopting cleaner production technologies and techniques. Cleaner production is considered by management as an expensive strategy that requires innovation without financial benefits for the company in the short term [75].

However, the relationship between waste reduction and environmental performance is not significant. This means that waste reduction efforts that are carried out are not necessarily one of the things that improve environmental performance, considering that only reducing waste without managing waste properly has not been able to improve

environmental performance [76], it seems that this is a new effort that appears to support waste reduction, but needs to be improved again to support environmental sustainability [52]. Therefore, to achieve better environmental performance of construction waste reduction management, attention should be paid to source reduction such as low waste technologies and on-site management performance [77].

Efforts to achieve better environmental performance must be made by reducing sources such as low-waste technology and on-site management performance [77]. Meanwhile, encouraging sorting behavior such as increasing stakeholder awareness of waste, improving regulations [78], strengthening government supervision, and controlling illegal waste disposal must be emphasized to achieve environmental performance and have an impact on environmental sustainability [80].

Conclusion

This work has expanded the legitimacy theory that advocates the batik industry to ensure that its activities and performance are acceptable to the community. By showing the results of the study that eco-efficiency has a significant effect on environmental performance, as well as the relationship between non-product output and environmental performance. While waste reduction actually shows the opposite relationship, namely not significant to environmental performance. This is in line with the purpose of the study, namely to determine the effect of eco-efficiency, non-product output, and waste reduction on environmental performance. Furthermore, the associative method is used in this study. This research is still limited to the locus of the batik industry in one region, it is necessary to expand the research area in the future so that the research results can be generalized, then future researchers can expand the model and studies related to competitiveness, environmental management system (EMS).

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