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Development of Dye Natural Batik Based on Fiber Coconut Waste and Leaf Avocado through Extraction Method in Supporting Green Business

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Abstract

Purpose: The development of natural batik dyes based on a combination of coconut fiber waste and avocado leaves using the extraction method is important to support the green economy and reduce chemical waste in Indonesia. **Research design, data and methodology:** The research explores the use of coconut fiber and avocado leaf waste extraction as a natural batik dye and conducts market testing to assess consumer satisfaction. **Results:** Indonesian batik exports are growing, but synthetic dye practices are causing a decline in demand. To address this, natural dyes are being explored, including coconut fiber waste and avocado leaf waste. **Conclusion:** Test results from washing at 40 degrees Celsius in terms of color changes and color staining, from sweat in terms of changes in acid color and changes in base color, to sunlight in terms of color fastness value, to heat to iron in terms of color change and color staining shows a value of 3-4 (quite good) and 4-5 (good), meaning that coconut fiber and avocado leaves waste can be used as natural batik dye.

Keywords : Avocado leaves, Batik, Coconut Fiber, Green Economy

JEL Classification Code : F64, O13, Q51

1. Introduction

UNESCO has officially acknowledged traditional Indonesian batik as a masterpiece in the oral and intangible heritage of humanity (Krisnawati et al., 2019; Steelyana, 2012). In 2017, this material had a significant presence in the worldwide fabric market, accounting for a dominant share. The export value of this material amounted to USD 58.46 million. Moreover, the utilization of synthetic dye methods has resulted in a decrease in the market demand for this fabric in several target nations. The issue arises from the utilization of artificially produced derivatives of synthetic dyes, which possess the capacity to give rise to significant health complications for humans (Lellis et al., 2019) and disrupt the balance of organisms and ecosystems (S. Lestari et al., 2017). The little knowledge among batik manufacturers on environmental sustainability is the primary reason for the extensive utilization of synthetic dyes without proper waste management protocols (Yaacob et al., 2015). The increasing momentum of Indonesian batik exports presents both a difficulty and an opportunity. Moreover, the worldwide consumer demand for eco-friendly products is a direct result of the adoption of green lifestyles and the rise of environmental awareness initiatives

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(Martuti et al., 2020)

Currently, natural dyes are highly recommended, but many obstacles are still encountered, especially in terms of processing and supply. One of the main problems is still using plants that are still productive. Therefore, it is necessary to look for substitute materials for natural dyes that come from other sources (Eskak, 2020), namely the use of plant waste. Only 15% of the supply of coconut fiber in Indonesia is reused by the community, while 85% is left to accumulate as waste (Andini & Widiawati, 2014). In fact, coconut fiber waste has the potential to become natural batik coloring. Based on previous research, coconut fiber waste can produce light brown, gray, light brown, black and dark brown (Fitriyah & Ciptandi, 2018).

Meanwhile, the utilization of avocado leaf waste is currently still very poor, even though this waste also contains tannin, quinone and flavonoid compounds. Tannin is known to be a coloring substance that can produce a brown color (P. Lestari, 2014). Therefore, avocado leaf waste can be used as a natural dye for batik. Based on research (Saputry & Suryani, 2018), the level of color fastness that comes from avocado leaves is categorized as good and very good, namely (4-5) from a value range of 1-5.

However, so far, research with natural batik dyes has only focused on one material, such as seaweed (Haerudin et al., 2017), rambutan skin (Amalia & Akhtamimi, 2016), and black tea (Triwiswara & Indrayani, 2020), only little attention is given to the combination of several materials as natural batik dyes. Apart from that, to date, the most frequently used separation method is the solvent extraction method because of its effectiveness and efficiency compared to other separation methods (Handayani & Maulana, 2014). Thus, the development of natural batik dyes based on a combination of coconut fiber waste and avocado leaves using the extraction method is important in order to support the green economy and reduce chemical waste in Indonesia by turning it into value-added products while also responding to the challenges and opportunities of consumer demand. Globally regarding environmentally friendly batik products. So, the aim of this research is to determine the feasibility of using a combination of coconut fiber and avocado leaf waste extraction as a natural batik dye and also market testing regarding the level of consumer satisfaction regarding prototype batik cloth products with coconut fiber and avocado leaf waste extracted dye.

2. Literature Review

2.1. Green Economy in Micro-Small Medium Enterprises (MSMEs)

The Green Economy is a new view in the economic concept and sustainable development strategy based on a balance between social, environmental and economic. This model concept is expected to be able to overcome the shortcomings of the old development strategy, which focused on development without paying attention to the environment. The old concept of economic development focused solely on the owner's profits was pragmatic and often harmed several other parties, namely suppliers, customers and society. Balancing the activities of business actors and the availability of natural resources is the basis for the importance of the Green Economy model. The green economy concept is expected to be a way out, a bridge between growth and development, social justice and environmental friendliness, as well as saving natural resources. This solution shows a shift in corporate responsibility because economic demands do not only focus on current conditions but also the future. Thus, all development activities are expected to be able to contribute to the welfare of future generations, namely the availability of natural resources, science and technology. This is the meaning of sustainable development, which has become mainstream economics and development (Noble, 2004). Several studies regarding the green economy in MSMEs in Indonesia, namely (Sriyono, 2014) focus on green economy developers, (Biduri & Proyogi, 2021) focus on performance and competitiveness based on the green economy and (Meflinda, 2019) the influence of the green economy on business development and performance MSMEs.

Transitioning from the utilization of synthetic colors to natural dyes might exert a substantial influence on the operational endeavors of MSMEs (Micro, Small and Medium Enterprises). The explanations pertaining to the impact of this transformation encompass economic, environmental, and market factors. There are multiple factors contributing to this influence: To begin with, cost adjustments, the utilization of natural dyes may necessitate distinct methodologies and essential resources. Micro, Small, and Medium Enterprises (MSMEs) must make adaptations to their equipment and production procedures, which can have an impact on the total costs of production. Furthermore, the utilization of natural dyes in product manufacturing can contribute to the distinctiveness of the product, enhance its overall worth, and attract consumers. Nevertheless, this alteration necessitates a profound comprehension of the utilization of natural dyes to guarantee the preservation of product excellence, hence stimulating market demand. Furthermore, if customer preferences shift towards environmentally friendly and sustainable products, the use of natural dyes by MSMEs might enhance the market appeal of their products. Furthermore, in terms of environmental impact, the production of natural dyes tends to be more ecologically sound compared to synthetic dyes. MSMEs that transition to sustainability can leverage current

environmental trends to enhance their corporate image and garner support from environmentally conscious consumers. Furthermore, the establishment of relationships and commercial networks is crucial. The adoption of natural dyes can create possibilities for collaborations with producers of natural raw materials or industry participants specializing in the advancement and exploration of natural dyes.

It is crucial to acknowledge that these modifications are contingent upon the context and can differ based on the industry, target audience, and other variables. Hence, it is imperative for MSMEs to do meticulous market analysis and devise business strategies in order to transition to natural dye processing.

2.2. Natural Dyes from Coconut Fiber Waste

Coconut fiber weighs 35% of the total coconut fruit. Each coconut consists of 175 grams of cork (25% coir) and 525 grams of fiber (75% coir) (Rohaeni, 2016). In Indonesia, only 15% can use coconut fiber and the rest is just thrown away and burned. In fact, processing coconut fiber waste can certainly increase its economic value, one of which is by using it as a natural dye. It is known that coconut fiber waste contains tannin compounds in the fiber particles amounting to 3.12% (Setiawati et al., 2014). Tannins can be defined by chromatography, and the phenolic compounds from tannins have astringent, antiseptic and color-giving action. Tannin is also a coloring agent which will produce a brown or brownish color. Therefore, the use of coconut fiber waste can be used as a natural dye with a brown or brownish color. Research that has used coconut fiber as a natural dye (Fitriyah & Ciptandi, 2018; Hanum, 2015; Rosalindah et al., 2021).

2.3. Natural Coloring from Avocado Leaf Waste

Plant leaves have pigments that can produce color. Avocado leaves can produce brown and yellow colors because they contain tannins. Tannin is a natural pigment that is capable of producing a brown color. Based on the results of research by (Widihastuti, 2005), avocado leaf extract can provide a good coloring effect on silk fabric with the quality of the dyeing results seen from the color fastness to washing and the heat of ironing. Several studies have used natural dyes from avocado leaf waste (Rahman, 2018).

3. Research Methods and Materials

Experimental research was carried out by dipping cotton batik cloth into coconut fiber and avocado leaf extract, followed by fixation using Alum and tunjung.

Research objects include 1) Coconut fiber extract, 2) Avocado leaf extract, 3) Cotton batik cloth, and 4) Fixation substances which include Alum and tunjung.

3.1. Research Variable

3.1.1. Independent Variable

The independent variables in this study were the type of fixation agent (Alum and tunjung) and the concentration of the fixation solution (50%) of the stock solution of 50 g/l.

3.1.2. Dependent Variable

The dependent variable in this research is the color quality (fastness and color staining) of the fabric dyed with coconut fiber extract, avocado leaves and a combination of coconut fiber extract and avocado leaves.

3.1.3. Control Variables

The control variables in this study were the extract ratio (coconut fiber: water) of 1:5 (kg/l), the extract ratio (avocado leaves: water) of 1:10 (kg/l), the frequency of dipping, namely three dips, and the duration immersion for 10 minutes 3 times.

3.2. Design of Experiment

One method that can be used to analyze product quality is experimental design. By using an appropriate experimental design, it is hoped that this research can be used to determine how the product becomes robust against the presence of disturbing factors (noise) by determining the optimal level setting. The following table 1 is the experimental design of this research.

Table 1: Experimental Design

No	Variable	Tunjung	Alum	Alum + Tunjung
1	Coconut Fiber	Coconut Fiber, Tunjung	Coconut Fiber, Alum	
2	Avocado Leaves	Avocado Leaves, Tunjung	Avocado Leaves, Alum	
3	A combination of Coconut Fiber and Avocado Leaves	A combination of Coconut Fiber and Avocado Leaves, Tunjung	A combination of Coconut Fiber and Avocado Leave, Alum	Combination of Coconut Fiber and Avocado Leaves, Alum, Tunjung

3.3. Step of Experiment

The experimental steps are shown in Figure 1 below.

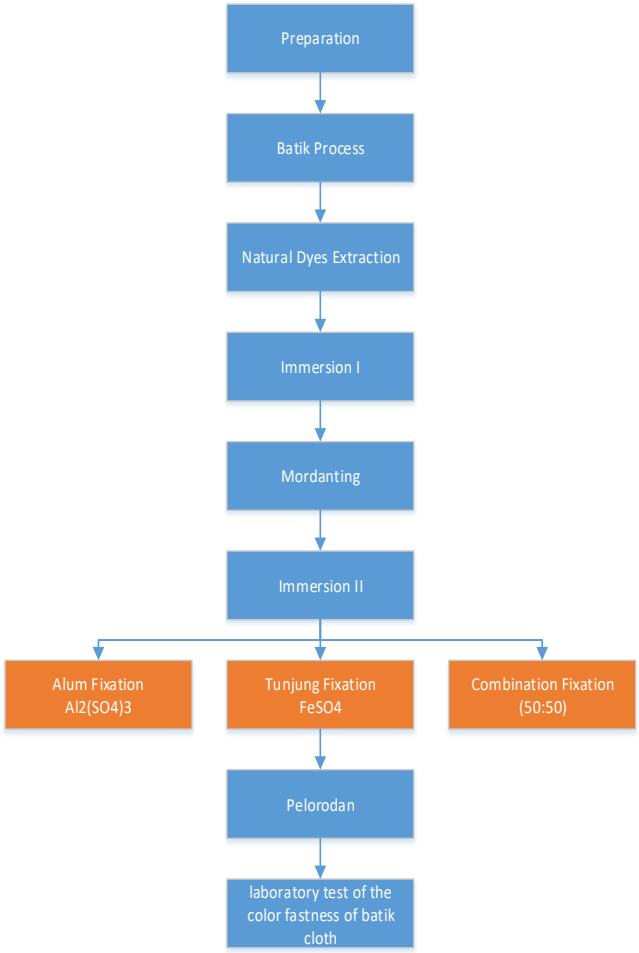

Figure 1: Step of Experiment

In the process of extracting natural dyes, the main ingredients used are coconut fiber waste and avocado leaf waste with a ratio of water, coconut fiber 1:5 and avocado leaves 1:10. The extraction process is carried out during the deposition process two times so that it will produce good extra color.

3.4. Collecting Data

The data collection method used was a laboratory test of the color fastness of batik cloth resulting from dyeing coconut fiber extract, avocado leaves and a combination of coconut fiber and avocado leaves when washed at 40 degrees Celsius in terms of color changes and color staining, of sweat in terms of changes in acid color and changes in base color, to sunlight in terms of color fastness value, to heat to iron in terms of color change and color staining. Colorfastness test based on the Indonesian National Standard (SNI), which the Indonesian government established. The overall difference or contrast between the original and the sample to be examined forms the basis of the color fastness test. The fastness to washing (40°C), perspiration (acid and alkaline), light (daylight), and iron (wet) are among the quality tests for dyeing. SNI ISO 105-C06-2010, SNI ISO 105-E04: 2010, SNI ISO 105-B01: 2010, and SNI 0288-2008 serve as the foundation for this exam.

3. Results and Discussion

From Table 2. Regarding the experimental results, it can be seen that the different fixing agents used produce different color directions, where Alum produces a lighter light brown color, and tunjung produces a black or dark brown color. When adding Alum, the fiber is colored well and does not affect the resulting color, whereas with the addition of FeSO4 (tunjung). Alum (Al2SO4) is a colorless chemical compound, so it only strengthens the color (Pratama & Sujatmika, 2023).

Table 2: Results of Experimental Design (Natural Dyes)

No	Results	Picture
1	Coconut Fiber + Tunjung	
2	Coconut Fiber + Alum	
3	Avocado Leaves + Tunjung	
4	Avocado Leaves + Alum	

No	Results	Picture
5	A combination of Coconut Fiber and Avocado Leaves + Tunjung	
6	A Combination of Coconut Fiber and Avocado Leaves + Alum	
7	A Combination of Coconut Fiber and Avocado Leaves + Alum + Tunjung	

3.1. Effect of Type of Variable Toward Color Fastness to Washing 40 degrees Celsius

Table 3: Color Fastness to Washing 40 degrees Celsius

No	Fixation	Full Avocado Leaves	Full Coconut Fiber	Combination Coconut Fiber and Avocado Leaves
1	Alum	4	3	3-4
2	Tunjung	3-4	4	4-5
3	Combination Alum and Tunjung	-	-	3

Source: Balai Besar Kerajinan dan Batik
Note: Score 1 = bad, 1-2 = bad, 2 = poor, 2-3 = not good, 3 = fair, 3-4 = quite good, 4 = good, 4-5 = good, 5 = very good

Results in Table. 3 regarding Color Fastness to Washing 40 degrees Celsius, it shows that material made from avocado leaf waste in the fixation treatment using Alum shows a value of 4 (good) and tunjung with a value of 3-4. Meanwhile, color fastness using coconut fiber waste with alum solution fixation gave a result of 3 and tunjung with a value of 4. Then, for the combination of natural dye solution with coconut fiber waste and avocado leaves with alum fixation, the value was 3-4, while with tunjung the value was 4- 5, and the combination of Alum and tunjung fixation shows a value of 3. From the test results, it can be seen that the color fastness to washing at 40 degrees Celsius for both types of variables with the combination shows an average value of 4 (good).

3.2. Effect of Type of Variable Toward Color Fastness to Sweat (Acid)

Table 4: Color Fastness to Sweat (Acid)

No	Fixation	Full Avocado Leaves	Full Coconut Fiber	Combination Coconut Fiber and Avocado Leaves
1	Alum	4	3-4	4
2	Tunjung	4	4	3-4
3	Combination Alum and Tunjung	-	-	3-4

Source: Balai Besar Kerajinan dan Batik
Note: Score 1 = bad, 1-2 = bad, 2 = poor, 2-3 = not good, 3 = fair, 3-4 = quite good, 4 = good, 4-5 = good, 5 = very good

Results in Table. Fourth, regarding Color Fastness Fastness to Sweat (Acid), it shows that material made from avocado leaf waste in the fixation treatment using Alum shows a value of 4 (good) and tunjung with a value of 4 also. Meanwhile, color fastness using coconut fiber waste with alum solution fixation gave a result of 3-4 and tunjung with a value of 4. Then, for the combination of natural dye solution with coconut fiber waste and avocado leaves with alum fixation, the value was 4, while with tunjung the value was 3-4, and the combination of Alum and tunjung fixation shows a value of 3-4. From the test results, it can be seen that Color Fastness Fastness to Sweat (Acid) for both types of variables with the combination shows an average value of 3-4 (quite good).

3.3. Effect of Type of Variable Toward Color Fastness to Sweat (Alkaline)

Table 5: Color Fastness to Sweat (Alkaline)

No	Fixation	Full Avocado Leaves	Full Coconut Fiber	Combination Coconut Fiber and Avocado Leaves
1	Alum	4	3-4	4
2	Tunjung	4	4	3-4
3	Combination Alum and Tunjung	-	-	3-4

Source: Balai Besar Kerajinan dan Batik
Note: Score 1 = bad, 1-2 = bad, 2 = poor, 2-3 = not good, 3 = fair, 3-4 = quite good, 4 = good, 4-5 = good, 5 = very good

Results in Table. Five regarding Color Fastness to Sweat (Alkaline) shows that material made from avocado leaf waste in the fixation treatment using Alum shows a value of 4 (good) and tunjung with a value of 4. Meanwhile, color fastness using coconut fiber waste with alum solution

fixation gave a result of 3-4 and tunjung with a value of 4. Then, for the combination of natural dye solution with coconut fiber waste and avocado leaves with alum fixation, the value was 4 while with tunjung the value was 3-4, and the combination of Alum and tunjung fixation shows a value of 3-4. From the test results it can be seen that the Color Fastness to Sweat (Alkaline) for both types of variables with the combination shows an average value of 4 (good).

3.4. Effect of Type of Variable Toward Color Fastness to Light: Daylight

Table 6: Color Fastness to Light: Daylight

No	Fixation	Full Avocado Leaves	Full Coconut Fiber	Combination Coconut Fiber and Avocado Leaves
1	Alum	4	3	4
2	Tunjung	4-5	4	4-5
3	Combination Alum and Tunjung	-	-	4

Source: Balai Besar Kerajinan dan Batik
Note: Score 1 = bad, 1-2 = bad, 2 = poor, 2-3 = not good, 3 = fair, 3-4 = quite good, 4 = good, 4-5 = good, 5 = very good

Results in Table. 6 regarding Color Fastness to Light: Daylight, it shown that material made from avocado leaf waste in the fixation treatment using Alum, it shows a value of 4 (good) and for tunjung with a value of 4-5. Meanwhile, color fastness using coconut fiber waste with alum solution fixation gave a result of 3 and tunjung with a value of 4. Then for the combination of natural dye solution with coconut fiber waste and avocado leaves with alum fixation the value was 4 while with tunjung the value was 4-5, and the combination of Alum and tunjung fixation shows a value of 4. From the test results, it can be seen that the Color Fastness to Light: Daylight for both types of variables with the combination shows an average value of 4 (good).

3.5. Effect of Type of Variable toward Color Fastness to Dry Ironing Heat

Table 7: Color Fastness to Dry Ironing Heat

No	Fixation	Full Avocado Leaves	Full Coconut Fiber	Combination Coconut Fiber and Avocado Leaves
1	Alum	4-5	4-5	4-5
2	Tunjung	4-5	4-5	4-5
3	Combination Alum and Tunjung	-	-	4-5

Source: Balai Besar Kerajinan dan Batik
Note: Score 1 = bad, 1-2 = bad, 2 = poor, 2-3 = not good, 3 = fair, 3-4 = quite good, 4 = good, 4-5 = good, 5 = very good

Results in Table. 7 regarding Color Fastness to Dry Ironing Heat, it shows that material made from avocado leaf waste in the fixation treatment using Alum shows a value of 4-5 (good) and tunjung with a value of 4-5. Meanwhile, color fastness using coconut fiber waste with alum solution fixation gave a result of 4-5 and tunjung with a value of 4-5. Then, for the combination of natural dye solution with coconut fiber waste and avocado leaves with alum fixation, the value was 4-5, while with tunjung the value was 4-5, and the combination of Alum and tunjung fixation shows a value of 4-5. From the test results, it can be seen that the Color Fastness to Dry Ironing Heat for both types of variables with the combination shows an average value of 4-5 (good).

3.6. Discussion

Differences in color change values are caused by various factors, including less than optimal extraction, unstable dyeing process treatment, different dyeing times, unstable weather, material conditions and the fixation factors used. The fixation of Alum and tunjung affects the binding of dyes which are able to enter the fabric fibers to the maximum, thus providing a strong bond with the fabric fibers. Therefore, it isn't easy to decide on the most appropriate coloring technique because all-natural dyes produce unique colors and tend to be brown and dark, which, in this case, is avocado leaf and coconut fiber waste.

The direction of the color obtained from the two types of natural dyes is influenced by the substances present in each ingredient. Coconut fiber is known to contain tannin compounds in the fiber particles amounting to 3.12% (Setiawati et al., 2014). Tannin is also a coloring agent which will produce a brown or brownish color. Avocado leaves can also produce brown colors because they also contain tannins.

Test results from washing at 40 degrees Celsius in terms of color changes and color staining, from sweat in terms of changes in acid color and changes in base color, to sunlight in terms of color fastness value, to heat to iron in terms of color change and color staining shows a value of 3-4 (quite good) and 4-5 (good), meaning that coconut fiber and avocado leaves waste can be used as natural batik dye.

Based on the conducted color fastness tests, it can be inferred that natural dyes derived from trash are comparable in quality to other natural dyes, including those obtained from actively produced plant stems.

3.6.1. MSMEs on the Natural Dye Processing and the Green Economy

The transition from utilizing synthetic dyes to natural dyes can greatly influence the business operations of MSMEs (Micro, Small and Medium Enterprises). The reasons for the impact of this transformation encompass economic, environmental, and market factors. There are

multiple reasons associated with this influence: To begin with, cost adjustments, various technological advancements and distinct raw materials may be necessary for natural dye processes. Micro, Small, and Medium Enterprises (MSMEs) must make adaptations to their machinery and manufacturing procedures, which might have an impact on the total expenses of production. Furthermore, the utilization of natural dyes in product manufacturing can enhance the distinctiveness of the product, augment its worth in terms of quality, and attract consumers. Nevertheless, this alteration necessitates a profound comprehension of the use of natural dyes to uphold product excellence, which in turn will stimulate market demand. Furthermore, if there is a growing inclination among customers to select environmentally conscious and sustainable items, adopting natural dyes can enhance the appeal of MSME products in the market. Furthermore, while considering environmental impact, it is worth noting that the production of natural dyes tends to be more ecologically sustainable compared to synthetic colors. MSMEs can capitalize on sustainability trends to enhance their corporate image and garner backing from environmentally-conscious consumers by transitioning their operations. Furthermore, the establishment of alliances and commercial networks is another crucial aspect. The adoption of natural dyes can create possibilities for collaborations with producers of natural raw materials or industry participants specializing in the advancement and exploration of natural dye technology.

It should be emphasized that these modifications are contingent and can differ based on the industry, target audience, and other variables. Hence, it is imperative for MSMEs to do meticulous market analysis and develop business strategies in order to transition to natural dye processing.

4. Conclusions

Color change values in natural dyes like avocado leaf and coconut fiber waste can vary due to factors like extraction, treatment, time, weather, material conditions, and fixation factors. These dyes produce unique brown and dark colors, with coconut fiber and avocado leaves containing tannin compounds. Test results show that these natural dyes can be used as natural batik dyes, with values of 3-4 (quite good) and 4-5 (good), depending on the dyeing process and material conditions. Therefore, this waste-based natural dye can be used to increase economic value and also increase environmental value, especially in the batik industry.

In addition, studying natural batik dyes has the capacity to expedite the growth of the environmentally friendly economy, bolster Micro, Small and Medium Enterprises (MSMEs), and enhance the worldwide market for Indonesian batik. Utilizing natural resources, such as flora, fauna, or minerals, enables the production of organic dyes, hence diminishing reliance on artificial constituents and mitigating ecological repercussions. This research has the potential to stimulate innovation in the methods of extracting and formulating colors, leading to the development of novel and distinctive hues. Consequently, it will enhance the artistic worth and ingenuity of Indonesian batik. Enhancing the comprehension of optimal utilization of natural dyes can result in the advancement of product quality, particularly in the production of batik items. This development can lead to international acclaim and heightened competitiveness in the global market. Empowering micro, small, and medium enterprises (MSMEs) can be accomplished through the utilization of eco-friendly techniques in batik production, which will not only capture the attention of the global market but also contribute to sustainable economic growth and facilitate international collaborations. The growing global consumer preference for sustainable products might enhance the attractiveness of Indonesian batik. This is due to ongoing research on natural dyes, which presents chances for industry participants to tap into a global market that values ecologically conscious products. Regulatory and regulatory measures can facilitate the transition to a green economy. Indonesia can enhance its leadership in the batik industry, promote the green economy, and foster the sustainable growth of MSMEs by prioritizing research and innovation in the natural batik dye sector.

To conduct more comprehensive research, it would be advisable to investigate consumers' purchasing inclination towards natural dye batik produced from waste materials. Through the implementation of this research, we can thoroughly investigate the whole capabilities of this sustainable method and promote the expansion of a batik sector that is both ecologically conscious and financially advantageous for all stakeholders.

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