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DEVELOPING A QUALITY STANDARD FOR BATIK WITH NATURAL DYES: A PROPOSAL TO IMPROVE BATIK COMPETITIVENESS

PENGEMBANGAN STANDAR UNTUK BATIK DENGAN PEWARNA ALAMI: USULAN UNTUK MENINGKATKAN DAYA SAING PRODUK

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ABSTRAK

Penelitian ini bertujuan untuk mengembangkan standar kualitas Batik dengan pewarna alami untuk meningkatkan daya saing produk. Metode yang digunakan adalah pendekatan FACTS, meliputi analisis pemangku kepentingan, perbandingan standar, dan pengujian standar. Data dikumpulkan melalui wawancara terhadap 25 responden yang terdiri dari pemerintah, produsen, konsumen, dan ahli. Analisis pemangku kepentingan meliputi penyusunan definisi Batik dengan pewarna alami, penetapan parameter kualitas, pengumpulan metode pengujian dan analisa teknis menggunakan Kerangka Kerja Zachman. Selanjutnya, dilakukan perbandingan antara standar yang diusulkan dengan standar internasional seperti OEKO-TEX® Standard 100 dan Ecological and Recycled Textile Standard (ERTS). Kemudian, dilakukan pengujian standar dengan mengintegrasikan masukan dari pemangku kepentingan terhadap standar yang disusun. Analisis kesediaan membayar dilakukan untuk mengidentifikasi tingkat kesediaan pelanggan dalam membayar lebih untuk produk batik ramah lingkungan yang bersertifikasi. Hasil survei menunjukkan bahwa dari 97 responden, sekitar 87% bersedia membayar lebih sebesar 20-25% untuk batik yang menggunakan pewarna alami bersertifikasi.

Kata kunci: batik, pewarna alami, standar kualitas, keberlanjutan, kerangka kerja Zachman

ABSTRACT

This study aimed to develop quality standards for *batik* using natural dyes to enhance the competitiveness of the product. The method used was the FACTS approach, which included stakeholder analysis, standard comparison, and standard testing. Data were collected through interviews of 25 respondents consisting of government officials, producers, consumers, and experts. The stakeholder analysis involved defining *batik* with natural dyes, setting quality parameters, gathering testing methods, and technical analysis using the Zachman Framework. Subsequently, a comparison was made between the proposed standards and international standards such as OEKO-TEX® Standard 100 and the Ecological and Recycled Textile Standard (ERTS). Standard testing was then conducted by integrating inputs from stakeholders on the drafted standards. An analysis of willingness to pay was conducted to identify the level of customer readiness to pay more for certified environmentally friendly batik products. Survey results showed that out of 97 respondents, about 87% were willing to pay an additional 20-25% for *batik* using certified natural dyes.

Keywords: *Batik*, natural dyes, quality standards, sustainability, Zachman Framework

INTRODUCTION

Batik is one of Indonesia's most iconic cultural heritages, known for its unique patterns and craftsmanship. According to the Indonesian National Standard (SNI 08-0239-1989), *Batik* is defined as textile material created through dyeing with wax resist, forming traditional motifs (Badan Standardisasi Nasional, 2014). This art holds significant cultural and economic value for Indonesia (Hengky, 2014) and gained global recognition in 2009 when UNESCO declared it a "Masterpiece of the Oral and Intangible Heritage of Humanity" (Badan Standardisasi Nasional, 2014), boosting its international popularity (Zahidi, 2017).

Historically, *Batik* was made using natural dyes derived from plants, reflecting Indonesia's biodiversity (Nuriana, 2021). However, in the early 20th century, synthetic dyes from Britain and Germany largely replaced natural dyes due to their affordability and vibrancy, despite concerns over water pollution from chemical-laden wastewater (Yoshanti and Dowaki, 2017; Elsahida, 2021). Recently, there has been a renewed interest in natural dyes, driven by environmental awareness and a preference for eco-friendly, non-toxic dyes (Saravanan *et al.*, 2021; Maulik *et al.*, 2014; Saxena and Raja, 2014). Some *Batik* producers, such as Zie Batik in Semarang, have collaborated with local farmers to cultivate plants for natural dyes, aiming to

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preserve traditional practices and minimize environmental impact (Martuti *et al.*, 2020).

Despite the benefits of natural-dyed *Batik*, defining it clearly is challenging. Some producers use harmful synthetic mordants, which can contain heavy metals (Krizova, 2015; Teli, 2013). This lack of a clear standard complicates consumer identification of genuine natural dye *Batik* and poses challenges for quality assurance among producers.

Currently, *Batik* standards, such as SNI 8302:2016 for *Batik Tulis*, SNI 8303:2016 for *Batik Cap*, and SNI 8304:2016 for *Batik Kombinasi*, distinguish authentic *Batik* from imitation products (Badan Standardisasi Nasional, 2014). However, no specific standards exist for *Batik* with natural dyes, which this study aims to address. Developing a quality standard for natural dye *Batik* will help ensure product quality and assure consumers of product authenticity and safety.

Standardization can act as a catalyst for innovation, fostering the development of new sustainable methods and materials in *Batik* production that may offer unique commercial properties and market differentiation (Pillai and Ramakrishman, 2023). By defining rigorous quality benchmarks, it compels manufacturers to explore innovative techniques and materials that meet or exceed these standards, ensuring both the authenticity and environmental sustainability of their products. This process not only promotes higher standards of production but also encourages the adoption of green technologies and practices. Consequently, adherence to quality standards in *Batik* production not only enhances the industry's competitiveness but also aligns it with global environmental and consumer safety expectations.

Economically, effective standardization can lead to cost reductions through improved resource efficiencies (Blind, 2013) and enhanced market access for environmentally friendly products (Wang *et al.*, 2016), thereby increasing the profit margins and sustainability of businesses engaged in the production of natural dye *Batik*.

This study applies the Framework for Analysis, Comparison, and Testing of Standards (FACTS) from the National Institute of Standards and Technology (NIST) for standard development (Witherell *et al.*, 2013). FACTS, previously applied in establishing various industrial standards (Asnan *et al.*, 2020; Pratiwi *et al.*, 2018; Rahmawatie *et al.*, 2017), includes stakeholder analysis, standard comparison, and standard testing stages, systematically meeting diverse stakeholder requirements. This research is expected to support the Indonesian government's efforts in developing an SNI standard for naturally dyed *Batik* and to benefit businesses by providing a reference for quality production.

RESEARCH AND METHODS

Natural dye *Batik* industries are pivotal in Indonesia's cultural, environmental, and economic landscapes. However, their development faces particular challenges. This research has two primary objectives: to develop a standard for natural-dyed *Batik* products and to assess consumer willingness to pay for certified products. To address these objectives, a literature review focused on existing standards and regulations in the *Batik* and textile industries and consumers' behaviour toward sustainable products.

To answer each research question, the study applies three specific analyses. The first research question is tackled by developing a standard using the FACTS approach (Framework for Analysis, Comparison, and Testing of Standards) to systematically analyse the quality standards, ensuring that stakeholders' perspectives are thoroughly integrated. The second research question is answered using a willingness-to-pay analysis to determine how much consumers are willing to pay for certified natural-dyed Batik, providing insights into market potential.

FACTS Approach

The FACTS approach provides a structured framework for developing standards by analyzing, comparing, and testing (Witherell *et al.*, 2013). This study uses the FACTS approach to create standards for natural dye Batik, beginning with stakeholder analysis to identify key groups, including the governments, producers, experts, and consumers of natural dye Batik, through literature and governments' data. This process adhered to the guidelines the National Standardization Agency (BSN) set for developing the Indonesia National Standard (SNI). The determination of stakeholder composition follows the membership rules of the Technical Committee set by the National Standardization Agency (BSN). According to Regulation No. 8 of 2022 on the Development of Indonesian National Standards, Technical Committee membership consists of government and/or regional government elements; business actors and/or related associations; consumers and/or consumer associations; and experts and/or academics. Article 53, paragraph 7 states that Technical Committee membership consists of at least 9 (nine) people. In paragraph 10, it is stated that one element of the Technical Committee is independent of the other element or exceed 50% (fifty percent) of the total number of members (Badan Standardisasi Nasional, 2022).

A questionnaire is then designed to gather stakeholder input on standard needs, definitions, quality parameters, and testing methods, with responses rated on a 1–4 Likert scale. The standards referred to in the preparation of the questionnaire,

especially on the quality parameter, are SNI 8302:2016/AMD.1:2019 *Batik Tulis*, SNI 8303:2016/Amd.1:2019 *Batik Cap*, SNI 8304:2016/Amd.1:2019 *Batik Kombinasi*, SNI 7188.4:2019 *Eko Label* Textile, Indian Standards for Organic Textiles, Indian Standards for Organic Textiles, Global Organic Textiles Standard.

Interviews for the standard development study were conducted from July to August 2023 in five Indonesian cities—Bogor, Jakarta, Bandung, Yogyakarta, and Sukoharjo—and at the Gelar Batik Nusantara event in Jakarta. Targeted stakeholders included government agencies, experts, producers, and consumers of natural dye *Batik*. For quality parameters, three main variables were identified: fabric quality, colorfastness, and dye resistance, each with specific attributes. The respondents were asked to rate 1 to 4 to each statement. Those value then average of each statement. After that, those statements are sorted by 75% of high value which is 4. So, the statements with average ratings below 3 were excluded from further consideration (Kleynen *et al.*, 2014). After that, technical specifications are developed through the Zachman Framework and the 5W+1H method (What, How, When, Where, Who, and Why), translating stakeholder needs into measurable criteria. For instance, ensuring fabric integrity is a crucial requirement, verified through visual inspections by production and quality control teams.

The proposed standard is then compared to existing international standards, such as the OEKO-TEX® Standard 100 and the ECOCERT Ecological & Recycled Textile Standard. OEKO-TEX® focuses on protecting textile products from harmful substances, while ECOCERT emphasizes sustainability and using recycled materials. This comparison helps identify gaps related to the sustainability of natural dyes and product safety. The aim is to evaluate whether the proposed quality parameters align with global sustainability and textile safety standards, ensuring the Indonesian *Batik* industry can meet international benchmarks.

Finally, feedback from additional stakeholder questionnaires is used to refine the standard, aligning it with stakeholder expectations (Witherell *et al.*, 2013). Four stakeholders—consumers, government representatives, producers, and experts—were selected for their expertise in naturally dyed *Batik*. Each stakeholder evaluated three core aspects of the proposed standard: the definition of naturally dyed *Batik*, quality parameters, and testing methods. Using a 4-point Likert scale, where 4 indicated "Strongly Agree" and 1 indicated "Strongly Disagree," stakeholders provided ratings and open-ended feedback for refining the standards. The standard testing phase was implemented to assess the clarity, acceptance, and practicality of the proposed quality standards for naturally dyed *Batik*.

Willingness to Pay (WTP)

The willingness-to-pay (WTP) study was conducted to assess product competitiveness, following the implementation of standards for Batik using natural dyes. This study helps determine the potential demand for specific product attributes and customer valuation of these attributes. The insights gained from WTP data can guide both producers in adopting the new standards and the government in developing these standards, ensuring they align with consumer expectations and enhance market competitiveness. An online survey was distributed to the public via WhatsApp and a statistical consultant platform. It included an introduction, demographic questions, queries on sustainable Batik awareness, a brief explanation of sustainable Batik, and willingness-to-pay (WTP) questions. The survey targeted respondents who presumably had the financial capacity to purchase relatively expensive naturally dyed Batik, such as those 18 years and older, who spent 1,000,000 rupiah or more on clothing annually, and were willing to pay over 250,000 rupiah for Batik. Awareness questions were rated on a 1–4 Likert scale, while WTP questions asked respondents the premium they would be willing to pay for sustainable Batik.

RESULTS AND DISCUSSIONS

Sample Description

There are 25 respondents who participated in this study, consisting of four consumers, 12 producers, three experts, and six governments related to *Batik* with natural dyes. There are several stakeholders from the same institution. As shown in Table 1, this identification is conducted based on each stakeholder's role and relevance to regulation in Indonesia.

The respondents come from various provinces in Indonesia, such as Jakarta, West Java, Central Java, East Java, Yogyakarta, South Sumatra, Jambi, and Lampung. The educational backgrounds of the respondents range from Elementary to Senior High School (20%), Diploma (8%), Undergraduate degree (32%), Master's degree (36%), and Doctoral degree (4%). The government respondents primarily hold Master's and Undergraduate degrees, while the experts' educational backgrounds include Diplomas, Master's, and Doctoral degrees.

Stakeholder Analysis

In developing proposed standards for *Batik* with natural dyes, it is crucial to address the needs of relevant stakeholders. The necessity of standard development was assessed, with all factors scoring above 3, indicating the inclusion of all statements. The most critical factor identified was consumer responsibility, emphasizing that natural dye producers can demonstrate their commitment to maintaining product quality, scoring 3.72.

Table 1. Stakeholders of *Batik* with natural dyes

Stakeholder Type	Institution
Consumers	Binus University
	Gitaratna
	Pesona Palembang
	Scarf.id
Experts	Balai Besar Standardisasi dan Pelayanan Jasa Industri Kerajinan dan Batik
	Politeknik STTT Bandung
Governments	Balai Besar Standardisasi dan Pelayanan Jasa Industri Kerajinan dan Batik
	Kementerian Perindustrian, Dirjen IKMA
Producers	As-syafa Batik
	Batik Genes Asri Busana
	Batik Hella
	Batik Jambi
	Batik Kebon Indah
	Batik Pancawati
	Batik Pohon
	Batik Tulis
	Batik Warna Alam RetnoAji
	Batik Gedog Sekarayu Wilujeng
	CV. Indigo Biru Baru Sukoharjo
	Museum Batik Yogyakarta

This was followed by quality and consistency and then safety, scoring 3.68 and 3.64, respectively. However, factors that burden standard development include the natural characteristics of dyes, which can be inconsistent due to environmental and production influences, scoring 3.6, and technological limitations in production and variability of raw materials, scoring 3.48 and 3.4 respectively.

From the concept evaluation, 68% of respondents agreed that Batik with natural dyes has distinct, lower-brightness colors and is produced sustainably. Additionally, 64% identified natural dyes as originating from natural sources, and 56% supported that Batik should be produced in line with SNI provisions. These criteria shaped the working definition of naturally dyed Batik as "Batik Tulis, Batik Cap, or Batik Kombinasi by SNI provisions, produced with environmentally friendly principles and sustainable, using environmentally friendly supporting materials and have tended to have more distinctive colours, with lower brightness than Batik with synthetic dyes".

From calculation process, all of the attributes values are above 3, so that all of these attributes are included on the standard. Detailed quality parameter data is provided in Table 2. The testing methods for each quality parameter were also collected from stakeholders through the questionnaire, and results are summarized in Table 3. After that, the Zachman Framework is applied to analyze quality parameters. The framework focuses on defining key elements such as needs, what, why, who, when, where, and how throughout the quality assurance process. For example in Table 4, for quality parameter number 1 – no tears in the fabric, emphasizing durability and quality in natural-dyed Batik standards. It identifies the need for tear-free fabric as a key stakeholder requirement. Testing is necessary to maintain product durability and meet quality expectations, ensuring customer satisfaction. The process involves the Quality Control and Production teams, who are responsible for conducting visual inspections during the production process and final quality checks. These evaluations are performed at the production site and in quality control laboratories, using visual observation as the primary method to detect and address any issues.

Comparison Standard

This section compares Batik's quality parameters using natural dyes against two international textile standards: OEKO-TEX® Standard 100 and the Ecological and Recycled Textile Standard (ERTS). The initial parameters, such as no tears or holes in the fabric, are not covered by OEKO-TEX® or ERTS, which focus instead on chemical safety and sustainable practices, leaving physical defect checks to manufacturers' internal processes. Similarly, dimensional stability after washing is only indirectly covered by OEKO-TEX® through ISO 6330 testing standards, which assess washing performance but do not specify Batik's unique needs for dimensional stability. ERTS also does not provide specific metrics for this, focusing broadly on sustainability rather than precise physical quality control

In contrast, colorfastness parameters align closely with both OEKO-TEX® and ERTS. OEKO-TEX® addresses colorfastness across various conditions such as washing and light exposure, ensuring fabrics meet established performance standards. ERTS includes similar provisions for maintaining textile appearance over time.

Table 2. Quality Parameters of *Batik* with Natural Dyes

Attributes	Parameters	Source	Average Score
Fabric Quality	There are no tears in the fabric	SNI 8302:2016/Amd.1:2019 *Batik Tulis* SNI 8303:2016/Amd 1 2019 *Batik Cap* SNI 8304:2016/Amd.1:2019 *Batik Kombinasi*	3.4
	There are no holes in the fabric	SNI 8302:2016/Amd.1:2019 *Batik Tulis* SNI 8303:2016/Amd 1 2019 *Batik Cap* SNI 8304:2016/Amd.1:2019 *Batik Kombinasi*	3.6
	There is no change in the fabric dimensions after washing.	Indian Standards for Organic Textiles Global Organic Textiles Standard	3.48
Color Fastness	The color is resistant to fading during washing (minimum of 4 times).	SNI 8302:2016/Amd.1:2019 *Batik Tulis* SNI 8303:2016/Amd 1 2019 *Batik Cap* SNI 8304:2016/Amd.1:2019 *Batik Kombinasi* SNI 7188.4:2019 Eko Label Textile Indian Standards for Organic Textiles	3.36
	Resistant to fading from sweat (minimum of 4 times).	SNI 8302:2016/Amd.1:2019 *Batik Tulis* SNI 8303:2016/Amd 1 2019 *Batik Cap* SNI 8304:2016/Amd.1:2019 *Batik Kombinasi* SNI 7188.4:2019 Eko Label Textile Indian Standards for Organic Textiles	3.2
	Resistant to fading from dry rubbing (minimum of 4 times).	SNI 8302:2016/Amd.1:2019 *Batik Tulis* SNI 8303:2016/Amd 1 2019 *Batik Cap* SNI 8304:2016/Amd.1:2019 *Batik Kombinasi* SNI 7188.4:2019 Eko Label Textile Indian Standards for Organic Textiles	3.36
	Resistant to fading from wet rubbing (minimum of 4 times).	Indian Standards for Organic Textiles	3.84
	The color is resistant to fading from light (minimum of 4 times).	SNI 8302:2016/Amd.1:2019 *Batik Tulis* SNI 8303:2016/Amd 1 2019 *Batik Cap* SNI 8304:2016/Amd.1:2019 *Batik Kombinasi* SNI 7188.4:2019 Eko Label Textile Indian Standards for Organic Textiles	3.72
	Resistant to fading from saliva (minimum of 5 times) (for baby clothing)	Indian Standards for Organic Textiles Global Organic Textiles Standard	3.38
Dye Resistance	Does not contain substances classified as sensitive/allergenic.	Indian Standards for Organic Textiles Global Organic Textiles Standard EU Ecolabel Textile Products	3.52
	Does not use dyes classified as or suspected to be carcinogenic.	Indian Standards for Organic Textiles Global Organic Textiles Standard EU Ecolabel Textile Products	3.52
	Does not use textile auxiliaries that contain heavy metals.	Indian Standards for Organic Textiles Global Organic Textiles Standard EU Ecolabel Textile Products	3.44

Additionally, both standards thoroughly cover safety and chemical parameters relevant to Batik, such as the exclusion of allergenic substances, carcinogenic dyes, and heavy metals, which are detailed in various sections of both OEKO-TEX® and ERTS. This demonstrates a strong alignment with Batik's safety and environmental goals, confirming the relevance of these international standards to maintaining Batik's integrity and safety as seen in Table 5 of the comparison.

Willingness to Pay

The validity and reliability test results show that each item in the questionnaire is valid (item-test correlation > 0.3) and reliable, with a Cronbach's Alpha value of 0.9055, exceeding the threshold of

0.7. The validity test using Principal Component Analysis (PCA) identified four main components with eigenvalues > 1, collectively explaining 70.75% of the total variance. The first component explains 41.86% of the variance (general awareness about *Batik*), the second 13.61% (purchase preference), the third 8.05% (technical knowledge), and the fourth 7.23% (environmental awareness).

The KMO value of 0.8675 indicates excellent suitability for factor analysis, with individual KMO values above 0.8 for most variables. The reliability test shows that all items have item-test correlations > 0.5, with the lowest correlation at 0.5011, confirming their validity. No item needs to be removed, as removing any item does not significantly improve the Cronbach's Alpha value. The complete validity and reliability test results are presented in Table 6.

The 79 respondents of the WTP Research exhibit a diverse demographic profile and purchasing behavior. Most of them are within the 26-41 age range, accounting for 56 of the participants, indicating that the majority are likely in stable phases of their careers. The gender distribution is relatively balanced, with 56% male and 44% female participants, predominantly residing in West Java (27 respondents) and Jakarta (12 respondents). Professionally, the largest group consists of private sector employees (24 respondents), and a significant number are students (10 respondents). Educationally, the bulk holds a bachelor's degree (42 respondents), which suggests a well-educated cohort. In terms of shopping habits, most respondents buy clothes less than six times annually, with a significant number spending between Rp 1,000,000 and Rp 5,000,000 on clothing per year, showcasing moderate consumer activity with a conscientious budget. This profile provides a solid base for understanding consumer preferences towards *Batik*, particularly in terms of sustainability and willingness to pay for environmentally friendly products.

The survey responses reveal consumer awareness and preferences regarding different aspects of *Batik*. A majority of respondents, 61%, understand the various types of *Batik* and similarly, 64% pay attention to the type of *Batik* when making a purchase. Knowledge about environmentally friendly *Batik* and the differences between natural and synthetic dyes is less pronounced, with only 43% either agreeing or strongly agreeing on their understanding in each category.

While 63% of participants acknowledge the negative impacts of synthetic dyes on health and the environment, and 61% understand the benefits of natural dyes, only 32% pay attention to the type of dye used when purchasing *Batik*. Environmental and health considerations are important for 51% of respondents when choosing *Batik*. Awareness of the Green Industry Standard (SIH) is relatively low, with only 29% understanding it and 31% paying attention to its presence on products, indicating a need for increased consumer education on sustainable practices in *Batik* production. Detailed information can be found in Table 7.

Table 3. Testing Methods of *Batik* with Natural Dyes

Attributes	Parameter	Testing Methods
Fabric Quality	There are no tears in the fabric	Visual Observation
	There are no holes in the fabric	Visual Observation
	There is no change in the fabric dimensions after washing.	Visual Observation and Measurement
Color Fastness	The color is resistant to fading during washing (minimum of 4 times).	Visual Observation and Laboratory Testing
	Resistant to fading from sweat (minimum of 4 times).	Visual Observation and Laboratory Testing
	Resistant to fading from dry rubbing (minimum of 4 times).	Visual Observation and Laboratory Testing
	Resistant to fading from wet rubbing (minimum of 4 times).	Visual Observation and Laboratory Testing
	The color is resistant to fading from light (minimum of 4 times).	Visual Observation and Laboratory Testing
	Resistant to fading from saliva (minimum of 5 times) (for baby clothing)	Visual Observation and Laboratory Testing
Dye Resistance	Does not contain substances classified as sensitive/allergenic.	Tracing or with instrument testing (must be a combined method), such as GCMS, FTIR, NMR, etc.
	Does not use dyes classified as or suspected to be carcinogenic.	Tracing and instrumental analysis
	Does not use textile auxiliaries that contain heavy metals.	Tracing and elemental analysis

Table 4. Zachman framework of naturally dyed *Batik*

Needs	**What** **What characteristics are required by stakeholders in the development of natural-dyed *Batik* standards?**	**Why** **Why is the measurement/testing necessary?**	**Who** **Who is involved in determining the measurement/ testing**	**When** **When should we determine/ensure the measurement/ testing?**	**Where** **Where do we determine the measurement/ testing?**	**How** **How do we determine the measurement/ testing?**
C1: No tears in the fabric	The fabric should be free from any tears	To ensure durability and quality	Quality Control, Production Team	During the production process and final inspection	Production site and quality control lab	Visual Observation
C2: No holes in the fabric	The fabric must not have holes	To maintain fabric integrity and usability	Quality Control, Production Team	During production and quality check	Production site	Visual Observation
C3: No dimensional change after washing	Fabric dimensions must remain stable after washing	To ensure product longevity and consumer satisfaction	R&D, Quality Control	During product development and quality assurance	Laboratory	Visual Observation and Measurement
D1: Color fastness to washing	Colors should not bleed during washing	To maintain appearance and prevent damage to other clothes	Quality Control, R&D	During product testing	Laboratory	Visual Observation and Laboratory Testing
D2: Color fastness to sweat	Colors must not change with exposure to sweat	To avoid discoloration from wear	R&D, Quality Control	During product testing	Laboratory	Visual Observation and Laboratory Testing
D3: Color fastness to dry rubbing	Fabric colors must not transfer when rubbed	To maintain fabric color when worn	Quality Control	During product testing	Laboratory	Visual Observation and Laboratory Testing
D4: Color fastness to wet rubbing	Fabric colors must not transfer when wet	To ensure color stability during use	R&D, Quality Control	During product testing	Laboratory	Visual Observation and Laboratory Testing
D5: Color fastness to light	Fabric colors should not fade under light exposure	To maintain color when exposed to sunlight	R&D, Quality Control	During product testing	Laboratory	Visual Observation and Laboratory Testing
D6: Color fastness to saliva (for baby clothing)	Colors must not bleed when exposed to saliva	To ensure safety for babies	R&D, Quality Control	During product testing	Laboratory	Visual Observation and Laboratory Testing

Needs	**What** **What characteristics are required by stakeholders in the development of natural-dyed *Batik* standards?**	**Why** **Why is the measurement/testing necessary?**	**Who** **Who is involved in determining the measurement/ testing**	**When** **When should we determine/ensure the measurement/ testing?**	**Where** **Where do we determine the measurement/ testing?**	**How** **How do we determine the measurement/ testing?**
E1: No use of allergenic substances	Fabric must be free of allergens	To prevent allergic reactions	R&D, Quality Control	During material sourcing and product testing	Laboratory	Tracing or with instrument testing (must be a combined method), such as GCMS, FTIR, NMR, etc.
E2: No carcinogenic dyes used	Carcinogenic dyes must not be used	To ensure safety and compliance with regulations	R&D, Quality Control	During material sourcing and product development	Laboratory	Tracing and instrumental analysis
E3: No use of heavy metals	Heavy metals must not be present in the fabric	To meet safety standards and environmental compliance	R&D, Quality Control	During material sourcing and testing	Laboratory	Tracing and elemental analysis

Table 5. Standard comparison of naturally dyed *Batik*

Parameter	OEKO-TEX® Standard 100	Recycled Textile Standard (ERTS)	Alignment
C1: No tears in the fabric	-	-	Not aligned
C2: No holes in the fabric	-	-	Not aligned
C3: No dimensional change after washing	-	-	Not aligned
D1: Color fastness to washing	Appendix 4	Section 7.1 (General Criteria)	Aligned
D2: Color fastness to sweat	Appendix 4	Section 7.1 (General Criteria)	Aligned
D3: Color fastness to dry rubbing	Appendix 4	Section 8.3 (Quality Criteria – Technical Performance)	Aligned
D4: Color fastness to wet rubbing	Appendix 4	Section 8.3 (Color Fastness)	Aligned
D5: Color fastness to light	Appendix 4	Section 8.3 (Color Fastness)	Aligned
D6: Color fastness to saliva (for baby clothing)	Appendix 4	Section 8.3 (Color Fastness – Baby Clothing)	Aligned
E1: No use of allergenic substances	Appendix 4	Appendix 1 (Banned Substances – Allergen List)	Aligned
E2: No carcinogenic dyes used	Appendix 4	Section 7.3 (Dyeing and Printing Criteria)	Aligned
E3: No use of heavy metals	Appendix 4	Section 8.2 (Chemical Residues)	Aligned

Table 6. Validity and reliability test for WTP Questionnaire

Questions	r	Decision	Alpha if Deleted
Q1 - I understand the difference between *Batik Tulis, Batik Cap, Batik Kombinasi*, and *Batik Print* (fabric with *Batik* motifs).	0.5107	Valid	0.9043
Q2 - I pay attention to the type of *Batik* (*Batik Tulis, Batik Cap, Batik Kombinasi*, and *Batik Print*) when purchasing *Batik*.	0.6033	Valid	0.9013
Q3 - I understand environmentally friendly *Batik*.	0.6844	Valid	0.8985
Q4 - I understand the difference between natural-dyed *Batik* and synthetic-dyed *Batik*.	0.6914	Valid	0.8982
Q5 - - I can distinguish natural-dyed *Batik* from synthetic-dyed *Batik* based on the characteristics or appearance of the product.	0.7101	Valid	0.8974
Q6 - - I understand the negative impact of synthetic-dyed *Batik* on the environment and health.	0.6069	Valid	0.9011
Q7 - I understand the benefits of natural-dyed *Batik* for the environment and health.	0.6504	Valid	0.8995
Q8 - I pay attention to the type of dye used when purchasing *Batik*.	0.7274	Valid	0.8965
Q9 - Environmental and health factors are important considerations when choosing *Batik*.	0.6151	Valid	0.9010
Q10 - I pay attention to the presence of a Green Industry Standard (SIH) on products when purchasing *Batik*.	0.7596	Valid	0.8952
Q11 - I understand the Green Industry Standard (SIH) on products.	0.7525	Valid	0.8955
Q12 - I prefer buying *Batik Tulis, Batik Cap*, or *Batik Kombinasi* over *Batik* Print (fabric with *Batik* motifs).	0.5011	Valid	0.9050
Q13 - I prefer purchasing natural-dyed *Batik* over synthetic-dyed *Batik*.	0.5879	Valid	0.9015
Q14 - I will choose environmentally friendly *Batik* for the value it offers, even if the price is higher.	0.6351	Valid	0.9000
Q15 - I prefer to buy *Batik* certified with the Green Industry Standard (SIH) because it guarantees the product is environmentally friendly.	0.5764	Valid	0.9020
Q16 - I am willing to pay more for environmentally friendly *Batik*.	0.6619	Valid	0.8992

Table 7. Respondent awareness of sustainable Batik

Statement	Value	%
Q1 - I understand the difference between *Batik Tulis, Batik Cap, Batik Kombinasi*, and *Batik Print* (fabric with *Batik* motifs).		
Strongly disagree	4	5
Disagree	14	18
Agree	22	28
Strongly Agree	39	49
Q2 - I pay attention to the type of *Batik* (*Batik Tulis, Batik Cap, Batik Kombinasi*, and *Batik Print*) when purchasing *Batik.*		
Strongly disagree	3	4
Disagree	12	15
Agree	22	28
Strongly Agree	42	53
Q3 - I understand environmentally friendly *Batik*.		
Strongly disagree	14	18
Disagree	22	28
Agree	23	29
Strongly Agree	20	25
Q4 - I understand the difference between natural-dyed *Batik* and synthetic-dyed *Batik.*		
Strongly disagree	16	20
Disagree	20	25
Agree	25	32
Strongly Agree	18	23
Q5 - I can distinguish natural-dyed *Batik* from synthetic-dyed *Batik* based on the characteristics or appearance of the product.		
Strongly disagree	21	27
Disagree	24	30
Agree	19	24
Strongly Agree	15	19
Q6 - I understand the negative impact of synthetic-dyed *Batik* on the environment and health.		
Strongly disagree	6	8
Disagree	10	13
Agree	31	39
Strongly Agree	32	41
Q7 - I understand the benefits of natural-dyed *Batik* for the environment and health.		
Strongly disagree	6	8
Disagree	12	15
Agree	33	42
Strongly Agree	28	35
Q8 - I pay attention to the type of dye used when purchasing *Batik.*		
Strongly disagree	19	24
Disagree	28	35
Agree	21	27
Strongly Agree	11	14
Q9 - Environmental and health factors are important considerations when choosing *Batik*.		
Strongly disagree	6	8
Disagree	22	28
Agree	32	41
Strongly Agree	19	24
Q10 - I pay attention to the presence of a Green Industry Standard (SIH) on products when purchasing *Batik.*		
Strongly disagree	17	22
Disagree	31	39
Agree	17	22
Strongly Agree	14	18
Q11 - I understand the Green Industry Standard (SIH) on products.		
Strongly disagree	25	32
Disagree	25	32
Agree	17	22
Strongly Agree	12	15

The survey results highlight a strong preference among respondents for certain types of Batik and their dye processes. A significant majority, 68%, either agree or strongly agree that they prefer buying Batik Tulis, Batik Cap, or Batik Kombinasi over Batik Print. Similarly, 67% of respondents favor natural-dyed Batik over synthetic-dyed options. When it comes to environmentally friendly Batik, 71% are willing to pay a higher price for the value it offers in terms of sustainability. In addition, 64% of respondents prefer to purchase Batik that is certified with the Green Industry Standard (SIH), viewing the certification as a guarantee that the product is environmentally friendly. These preferences indicate a growing consumer inclination towards sustainable and ethically produced Batik, reflecting a broader trend of environmentally conscious buying behaviors. Detailed information can be found in Table 8.

The survey shows a strong inclination towards environmentally friendly Batik, with 70% of respondents indicating they are willing to pay more for such products. In terms of the price increase, a vast majority, 69%, consider a 25%-30% price increase reasonable for Batik that adheres to environmentally friendly standards. This suggests a significant acceptance of higher costs in exchange for sustainability, reflecting a commitment to environmental consciousness among consumers. Fewer respondents find smaller (3% for less than 20%) or larger (5% for 30%-35%) price increments acceptable. Detailed information can be found in Table 9.

Table 8. Respondent preference to buy certified *Batik* with natural dyes

Statement	**Value**	**%**
Q12 - I prefer buying *Batik Tulis, Batik Cap,* or *Batik Kombinasi* over Batik Print (fabric with *Batik* motifs).		
Strongly disagree	1	1
Disagree	10	13
Agree	29	37
Strongly Agree	39	49
Q13 - I prefer purchasing natural-dyed *Batik* over synthetic-dyed *Batik*.		
Strongly disagree	2	3
Disagree	10	13
Agree	43	54
Strongly Agree	24	30
Q14 - I will choose environmentally friendly *Batik* for the value it offers, even if the price is higher.		
Strongly disagree	1	1
Disagree	7	9
Agree	43	54
Strongly Agree	28	35
Q15 - I prefer to buy *Batik* certified with the Green Industry Standard (SIH) because it guarantees the product is environmentally friendly.		
Strongly disagree	4	5
Disagree	11	14
Agree	37	47
Strongly Agree	27	34

Table 9. Respondent willingness to pay more on certified Batik with natural dyes

Statement	**Value**	**%**
Q16 - I am willing to pay more for environmentally friendly *Batik*.		
Strongly disagree	3	4
Disagree	6	8
Agree	43	54
Strongly Agree	27	34
Below is the percentage of price increase I consider reasonable for environmentally friendly *Batik*.		
< 20%	4	5
20%-25%	69	87
25%-30%	5	6
30%-35%	1	1

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study developed proposed quality standards for *Batik* with natural dyes based on SNI *Batik* and eco-label and international standards for organic textile. The proposed standard consists of a definition and quality parameters such as fabric quality, colour fastness, and chemical safety. Fabric quality consists of three parameters, colour fastness consists of six parameters, while dye resistance consists of three parameters. This study also collected the testing methods used for each quality parameter.

This study also highlights a strong consumer preference for natural-dyed *Batik* and sustainability, with 67% of respondents favoring natural dyes over synthetic and 71% willing to pay more for environmentally friendly options. However, there's a notable gap in awareness and understanding of sustainable practices and standards, with only 32% paying attention to dye types and 29% familiar with the Green Industry Standard (SIH). This indicates a significant opportunity for increasing consumer education to enhance the alignment of preferences with informed, sustainable purchasing decisions.

Recommendations

Based on the outcomes of this study, it is recommended that future research focus on two primary areas. First, explore the long-term impacts of sustainable certification, which includes assessing changes in revenue growth, market access, and environmental benefits. Understanding these impacts can help gauge the overall effectiveness and wider consequences of implementing standards for Batik with natural dyes, thus supporting more informed decisions in policy and business practices. Second, investigate effective strategies for consumer education that can bridge the gap in understanding and awareness of sustainable practices and standards such as the Green Industry Standard (SIH). Future research should focus on the development and evaluation of targeted educational campaigns or materials that explicitly communicate the benefits and importance of these standards.

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