Mapping Knowledge of Sustainable Technologies for Batik Research: A Bibliometric Study

Donna Carollina[1], Mita Purbasari Wahidiyat[2], Vera Jenny Basiroen[3], Fanny Marcellina Suhendra[4], Andhika Pramalystianto[5]
[2]Visual Communication Design, School of Design Department, Bina Nusantara University, Jakarta, Indonesia 11480
[1]Graphic Design & New Media Program, Visual Communication Design Department, School of Computing and Creative Arts, Bina Nusantara University, Jakarta, Indonesia 11480
[3]Graphic Design & New Media Program, Visual Communication Design Department, Bina Nusantara University, Jakarta, Indonesia 11480
[4]Communication Design Swinburne University of Technology, Melbourne, Australia
[5] Interior Design Department, School of Design, Bina Nusantara University, Jakarta, Indonesia 11480
Email: mitawahid@binus.edu (CA)

Received	Accepted	Published
17.11.2023	27.01.2024	31.01.2024

https://doi.org/10.61275/ISVSej-2024-11-01-20

Abstract

Traditional Indonesian art known as batik has a profound cultural and historical significance. Technologies used in the batik industry has become a major problem that contribute to issues of environmental sustainability at a large scale. A field study related to issues concerning batik production using printing methods has found that the batik industry currently employs various hazardous chemicals, high water consumption, and increases air pollution, and other factors, contributing to environmental pollution. Therefore, solutions are needed to address these issues. These solutions are explored through basic research to use sustainable technologies in batik production.

This research examines the use of sustainable technologies in the batik industry in Indonesia. It determines research trends, institutional partnerships, and significant contributors to this research by using bibliometric methodologies with data collected based on the Scopus database. It examines frequently used keywords, article citation networks, and popular study topics.

The results show that there are 18 related documents indexed by Scopus since 2012. The dominant type is articles with 4 documents at 44.4%. The most productive year for sustainable technology for batik research is 2020 with 6 documents. The dominant publication source is the Earth and Environmental Science IoP Conference Series with 6 documents. The dominant country is Indonesia with 14 documents. The most prolific affiliate is Universiti Technologi Malaysia with 4 documents.

It concludes that in terms of batik research for sustainable technology has two dominant terms: sustainable development and wastewater treatment. In the future, sustainable technology for batik research can be carried out on different topics such as the theme of sustainable batik making technology, sustainable and environmentally-friendly dyeing techniques, and other themes that are still related to this research.

Keywords: sustainable, technology, batik, research, bibliometric

Introduction

Batik is a traditional fabric of Indonesian cultural heritage (Azhar et al., 2015). Batik itself has become a cultural identity for Indonesia so it is very valuable (Kustiyah, 2017). In the intricate tapestry of artisanal heritage, the batik industry stands as an eloquent testament to cultural richness and artistic finesse. In tandem with the progression of time and the escalating intricacies posed by environmental exigencies, the incorporation of sustainable technology within the batik industry has emerged as a pivotal concern of utmost significance. Research on sustainable technology for batik itself has been done before. This is as done by Sirait in his research which discusses cleaner production options for improving the environmental performance during the production of batik industry (Sirait, 2018). Or research that discusses wastewater quality management strategies as conducted by Sulthonuddin and Herdiansyah. This research discusses wastewater quality management strategies in the process of making industrial-scale batik (Sulthonuddin & Herdiansyah, 2021).

As the complexities of contemporary environmental challenges unfold, the imperative to scrutinize, assess, and comprehensively comprehend the intersection of sustainable technology and the venerable art of batik becomes increasingly paramount. Through the lens of bibliometric analysis, this paper endeavors to trace the intellectual footprints within the scholarly community, discerning patterns, influences, and pivotal contributions that have shaped the trajectory of sustainable technology in the batik industry. Rooted in the noble pursuit of knowledge, this research aims to meticulously unravel and map the scholarly contributions that have shaped the discourse surrounding sustainable technology within the intricate realm of batik production.The objectives of this studies are:

(1) Conduct a comprehensive bibliometric analysis to discern the existing scholarly landscape on sustainable technology within the batik industry;
(2) Mapping intellectual influences;
(3) Identifying emerging trends;
(4) Assessment of Knowledge Gaps;
(5) Synthesis of Key Findings.

The results of this bibliometric analysis provides valuable insights for researchers, batik industry practitioners, and decision makers in understanding sustainable technological developments in batik research. This research also provides an important reference source for future researchers interested in developing further research in this field. With a better understanding of sustainable technology trends and developments in batik research, it is expected to encourage innovation and further implementation in the sustainable batik industry.

Theoretical Framework

Batik is a traditional fabric of Indonesian cultural heritage (Azhar et al., 2015). Batik itself has become a cultural identity for Indonesia so it is very valuable (Kustiyah, 2017). Batik is one of Indonesia's cultural heritages recognized by UNESCO as Masterpieces of the Oral and Intangible Heritage of Humanity on October 2, 2009 (Hakim, 2018). Definitively, batik is a technique, symbol, and cultural practice related to hand-dyeing fabrics and silk originating from Indonesia. The batik technique involves the process of coloring fabric using wax to prevent dye from adhering to unwanted areas of the fabric (Apriyani et al., 2021). Batik motifs themselves are diverse, ranging from geometric, flora, fauna, to figurative designs. These motifs carry specific meanings and philosophies, depending on their origin, history, and cultural context of the community that creates them (Kusrianto, 2014).

In the realm of textile techniques, Indonesia boasts several distinctive batik methods, namely *batik tulis* (hand-drawn batik), batik cap (stamped batik), and batik printing. Batik tulis and batik cap are predominantly found in regions renowned for batik craftsmanship such as Jawa Barta, Jawa Tengah, Jawa Timur, and Madura. Conversely, batik printing or textile batik is commonly encountered and produced in the batik centers within the Java Island region. Unlike *batik cap* and *batik tulis*, which involve human expertise and artistic craftsmanship, batik printing utilizes textile machinery with substantial production capacities, either through large-scale automated processes or manual printing machines (Meliono, 2014).

Meanwhile, based on its manufacturing materials, batik primarily employs fabric as its main substrate. In the case of *batik tulis*, additional materials include wax and dyes. The initial step in the batik production process involves creating patterns or motifs on a piece of fabric. Traditionally, the dyeing process for batik fabric begins by applying wax as a color barrier using either *canting t*ulis (a traditional wax applicator), cap (stamp), or a combination of both. This dyeing process has evolved, with the advent of silk screen printing, and even digital silk screen printing, eliminating the direct application of wax onto the fabric. Consequently, the batik production process has shifted from the dyeing process of immersing the fabric into a batik dye solution to a screen printing or coloring process by applying dye to one side of the fabric background, preventing color penetration to the opposite side (Widadi, 2019).

After the recognition of Indonesian batik as one of the 76 intangible cultural heritages by UNESCO, there has been a significant impact on the development of the batik industry, leading to a boost in batik production both in the domestic and export markets. Building on this progress, the government has officially designated batik as a reliable commodity within the realm of creative industries (Media Industri, 2011). This development also has implications for the environment. The production processes of *batik t*ulis, batik cap, and batik printing inevitably involve the use of dyes. In everyday practice, chemical dyes are widely employed, causing negative impacts on both the natural environment and human health, particularly concerning the production waste generated (Hunga, 2014). Batik waste is characterized by high levels of oil and fat content, along with toxic chemicals such as lead (Pb), chromium (Cr), copper (Cu), and manganese (Mn), all of which fall under the category of heavy metals (Hakika et al., 2021). In the final stages of the batik production process, a significant amount of water is utilized, falling within the criteria of water wastage (Apriyani, 2018).

Such are the impacts of the batik production process that necessitate the exploration of solutions, particularly addressing issues related to environmental pollution. A crucial step in addressing these concerns involves mapping out previous research efforts, focusing on the topic of Sustainable Technology for Batik. This endeavor can be undertaken through the application of a bibliometric analysis methodology. Bibliometrics, stemming from the words "biblio" or bibliography and "metrics," involves the measurement of literature using mathematical and statistical approaches. In essence, it becomes a quantitative study within the field of library science. By employing bibliometric analysis, a comprehensive understanding of the existing body of knowledge on Sustainable Technology for Batik can be achieved, paving the way for informed solutions to mitigate the environmental and ecological impact of the batik production process (Pritchard, 1969). Although in Indonesia bibliometrics is often only recognized as a reference list, a thorough examination reveals that bibliometrics can serve as a lens for a scientific discipline or as a map for a research endeavor.

Fig. 1: Theoretical framework.
Source: Wahidiyat, 2023

Review of Literature

This study utilizes previous research as a literature review.

No	Author	Year	Title	Method	Results
1	Nur Fathin Luaylik, Rina Nur Azizah, & Erina Saputri	2022	*Strategi Pemberdayaan UMKM Batik Desa Klampar Kabupaten Pamekasan*	Qualitative	This research reveal that each indicator of the theoretical framework indicates a generally effective empowerment strategy. However, there is an ongoing need for sustained regulations (policies) from the Pamekasan Regency government to enhance the opportunities for artisans to market their products in a sustainable manner.
2	Dian Yanuarita Purwaningsih, Indah Arista Wulandari, & Alif Wahyu Aditya	2021	*Pemanfaatan Cangkang Telur Ayam Sebagai Biosorben Untuk Penurunan COD Pada Limbah Cari Pabrik Batik*	Experiment	This research indicates that the optimal mass of biosorbent addition is 5%, resulting in a COD removal efficiency of 87% within a 60-minute timeframe.
3	Dian Lestari, Nurul Primayanti, Ezra Peranginangin, Boike Janus Anshory, & Baskoro Junianto	2019	*Metodologi Praktis Berkelanjutan Sosialisasi Batik Dingin di Desa Eko Wisata*	Qualitative	The outcomes of this training reveal that the community has the capacity for creativity and entrepreneurship.
4	Rochmat Aldy Purnomo, Rahmawati, Siti Arifah, M. Rudianto, Adi Prananto, Endang Dwi Amperawati, Rita Noviani, Sarah Rum Handayani, & Siti Nurlaela	2024	*Batik Ciprat Pewarna Alam: Ekonomi Kreatif Sebagai Solusi Pembangunan Berkelanjutan*	Qualitative	This research indicates that the use of natural materials for batik dyeing does not generate hazardous waste for the environment or living organisms.
5	Kusuma Wijaya, Siska Dewi, & Anni Safitri	2022	*Pengaruh Pengetahuan Lingkungan, Persepsi dan Perilaku UMKM Batik di Pekalongan Dalam Mengimplementasikan Green Economy*	Quantitative	The research results demonstrate that knowledge influences the perception of Micro, Small, and Medium Enterprises (UMKM) in implementing the green economy. Perception, in turn, influences the behavior of UMKM in implementing the green economy. Knowledge directly affects the behavior of UMKM in implementing the green economy through the mediation of UMKM perceptions.

Research Methodology

Data Collection and Method

The data source used in this study was Scopus. The keyword search was "sustainable technology for batik". The search was conducted without including the year 2023. From the results of this search, 18 research documents related to keywords were found. So, the advanced search used in this study is (sustainable AND technology AND for AND batik) AND (EXCLUDE (PUBYEAR, 2023).

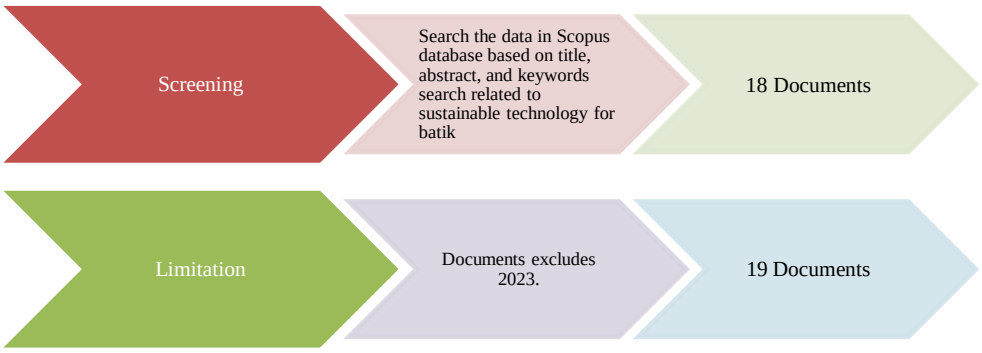


Fig. 1: The data collection process.
Source: Scopus, 2023

The data that has been found is then extracted into metadata into Bibtex format. This is done so the data can be processed, visualized, and analyzed. The software assistance referred to analyze and visualize keywords, publications, themes, trends, and other related to the sustainable technology for batik research. The analysis was carried out based on statistical and quantitative results found later. Software used to help with this research is the R Studio and Biblioshiny.

Analysis

The analysis method used in this study is bibliometric analysis. Bibliometric is a quantitative approach to publication with the focus being examine publications relevant to a phenomenon (Pritchard, 1969).

After the data is extracted into metadata in Bibtex format, it is processed using the R Studio and Biblioshiny programs to obtain statistical results as well as data visualization. The results of bibliographic metadata completeness obtained based on data processing with Biblioshiny as in the Fig. 2.

Metadata	Description	Missing Counts	Missing %	Status
AB	Abstract	0	0.00	Excellent
AU	Author	0	0.00	Excellent
DT	Document Type	0	0.00	Excellent
SO	Journal	0	0.00	Excellent
LA	Language	0	0.00	Excellent
PY	Publication Year	0	0.00	Excellent
TI	Title	0	0.00	Excellent
TC	Total Citation	0	0.00	Excellent
C1	Affiliation	3	16.67	Acceptable
DI	DOI	6	33.33	Poor
DE	Keywords	6	33.33	Poor
RP	Corresponding Author	7	38.89	Poor
ID	Keywords Plus	8	44.44	Poor
CR	Cited References	18	100.00	Completely missing
NR	Number of Cited References	18	100.00	Completely missing
WC	Science Categories	18	100.00	Completely missing

Fig. 2: The completeness of biblographic data.
Source: Biblioshiny, 2023

Findings

Research related to sustainable technology for Batik research based on Scopus began in 2012. The annual growth rate is 11.61%. The document types spread with a total of 18 documents including article 8 documents, conference paper 7 documents, and conference review 3 documents (Fig. 3). The main detailed information is displayed as shown in Table 1.

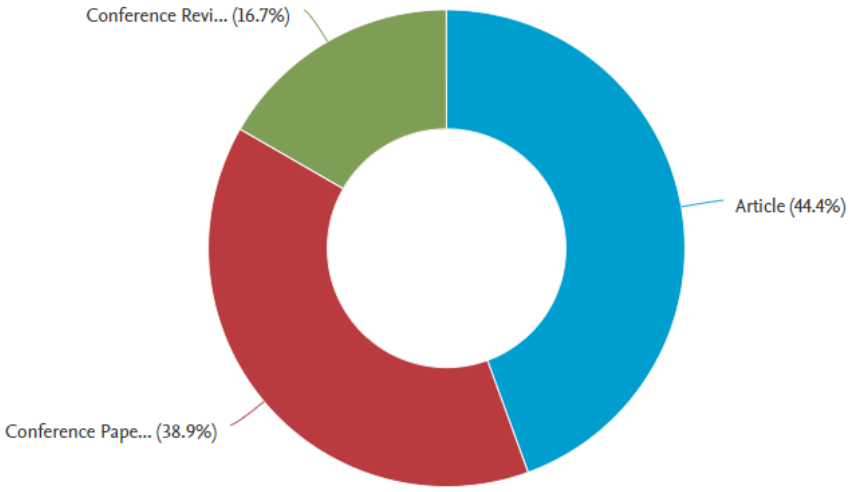


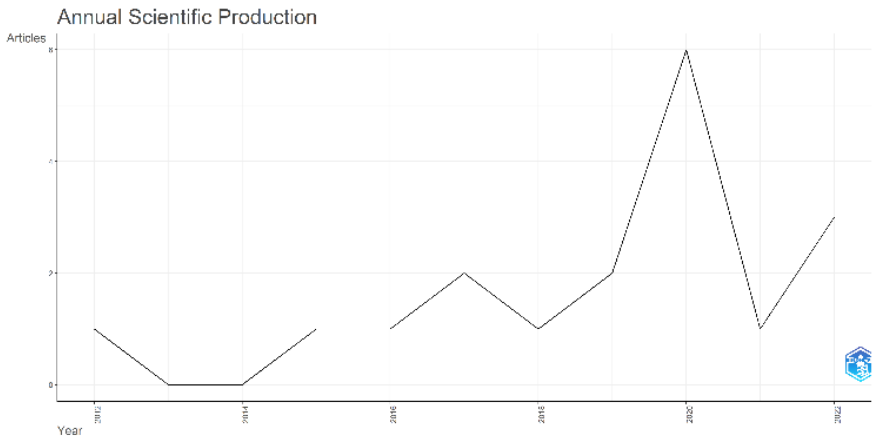
Fig. 3: The documents type of sustainable technology for batik research
Source: Scopus, 2023

Table 1. Main information of data
Source: Biblioshiny, 2023

Description	Results
Main Information About Data	
Timespan	2012:2022
Source (Journals, Books, etc)	13
Documents	18
Annual Growth Rate %	11.61
Document Average Age	4.11
Average citations per doc	2.389
References	1
Document Contents	
Keyword Plus (ID)	133
Author's Keywords (DE)	43
Authors	
Authors	39
Authors of single-authored docs	4
Author Collaboration	
Single-authored dcos	6
Co-Authors per Doc	2.28
International co-authorship %	0
Document Types	
Article	8
Conference paper	7
Conference review	3

Based on the data, it was found that the growth trend of sustainable technology for batik research tends to be dynamic. The number of document production each year includes 2012 (N=1), 2013 (N=0), 2014 (N=0), 2015 (N=1), 2016 (N=1), 2017 (N=2), 2018 (N=1), 2019 (N=2), 2020 (N=6), 2021 (N=1), and 2022 (N=3). 2020 became the year with the dominant growth rate compared to the year before and after with the highest citation trend in 2018 with average citations per year 2.3 (Fig. 4).

Based on the graph presented in Fig. 4, it is evident that research on sustainable technology for batik exhibits a declining trend over the years. This observation underscores the noteworthy point that there is an opportunity for an increased focus on research pertaining to sustainable technology for batik, particularly within the context of Indonesia.



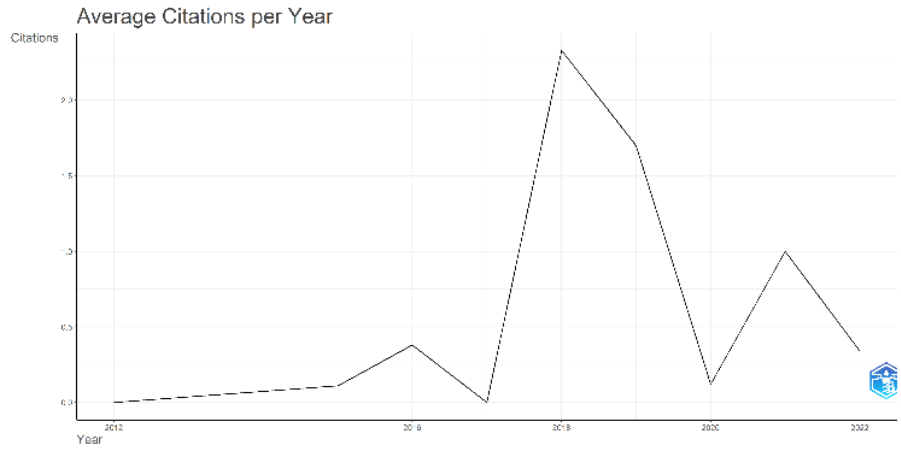


Fig. 4: The graph of documents and citations trend in each year of sustainable technology for batik research based on Scopus.
Source: Biblioshiny, 2023

Relevant publication sources related to sustainable technology for batik research include IoP Conference Series Earth And Environmental Science (N=6); Advanced Science Letters (N=1); Applied Water Science (N=1); Environment Development and Sustainability (N=1); and International Business Management (N=1) (Fig. 5). Based on the graph, it is known that 2020 is a productive year for sustainable technology for batik research in the publication of the Earth And Environmental Science IoP Conference Series, which is 4 documents compared to the year before (2018 N = 1) and after (2022 N = 1). Based on the analysis of publication sources, it is noted that Earth and Environmental Science IoP Conference Series dominates the landscape of publications in this field. This observation is understandable given the focus and scope of this publication, which aligns with environmental concerns. However, it is crucial to acknowledge that the number of research studies available for reference remains relatively limited. Consequently, Indonesian researchers seeking references on sustainable technology for batik research may utilize the four articles found within this publication. Moreover, those engaged in research on the aforementioned topic can consider Earth and Environmental Science IoP Conference Series as a valuable source for scholarly publications in this domain.

Fig. 5: The graph of source documents per year in sustainable technology for batik research based on Scopus.
Source: Biblioshiny, 2023

Related to countries in sustainable technology for batik research dominated by Indonesia (N = 14) and Malaysia (N = 4), with the trend of production growth of each country tends to increase every year (Fig. 6). Meanwhile, the affiliation is dominated by Universiti Technologi Malaysia (N=4), followed by Jenderal Soedirman University (N=3), Airlangga University (N=2), Satya Wacana Christian University (N=2), and Universiti Teknologi Mara (N=2) (Fig. 7).

From the presented data on countries involved in sustainable technology for batik research, it is evident that Indonesia emerges as the leading nation with a dominant number of research publications. Undoubtedly, this underscores the significance of the topic as a pressing issue within the Indonesian context. However, despite its dominance, the total number of publications in reputable databases such as Scopus amounts to only 14 documents. This indicates that research on this topic still offers ample opportunities for dissemination from diverse perspectives.

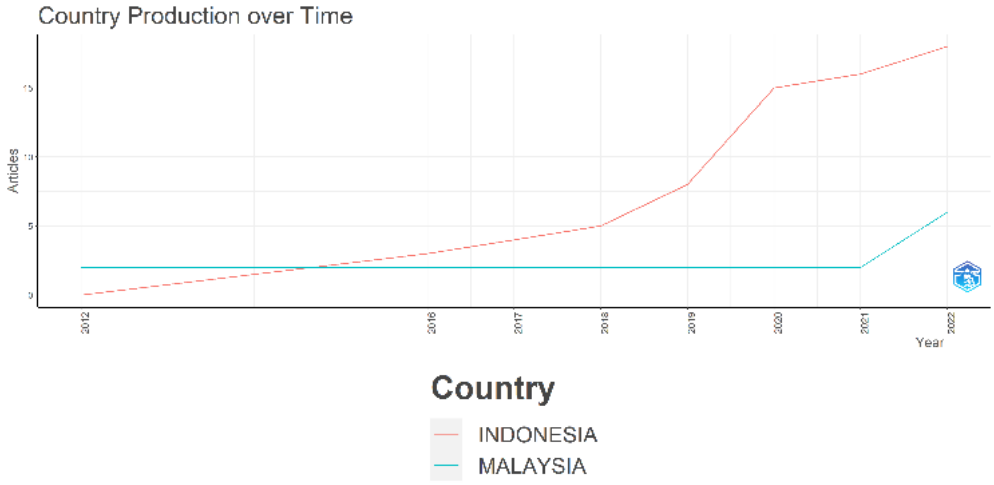


Fig. 6: The graph of country production documents per year in sustainable technology for batik research based on Scopus.
Source: Biblioshiny, 2023

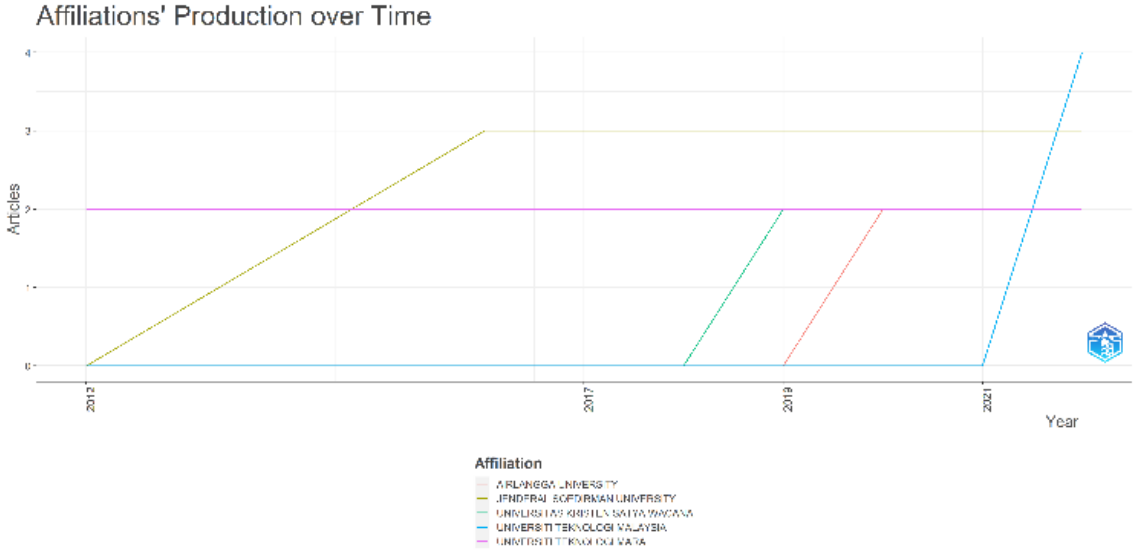


Fig. 7: The graph of affiliations' production documents per year in sustainable technology for batik research based on Scopus.
Source: Biblioshiny, 2023

Based on authorship, relevant authors were found with each having 1 document related to sustainable technology for batik research (Fig. 8). With local impact, each author is worth 1 (Fig. 9). Meanwhile, from each study produced by the author, no documents have been cited to date (July, 2023) (Fig. 10). Documents related to sustainable technology for batik with the highest number of citations can be seen in Table 2.

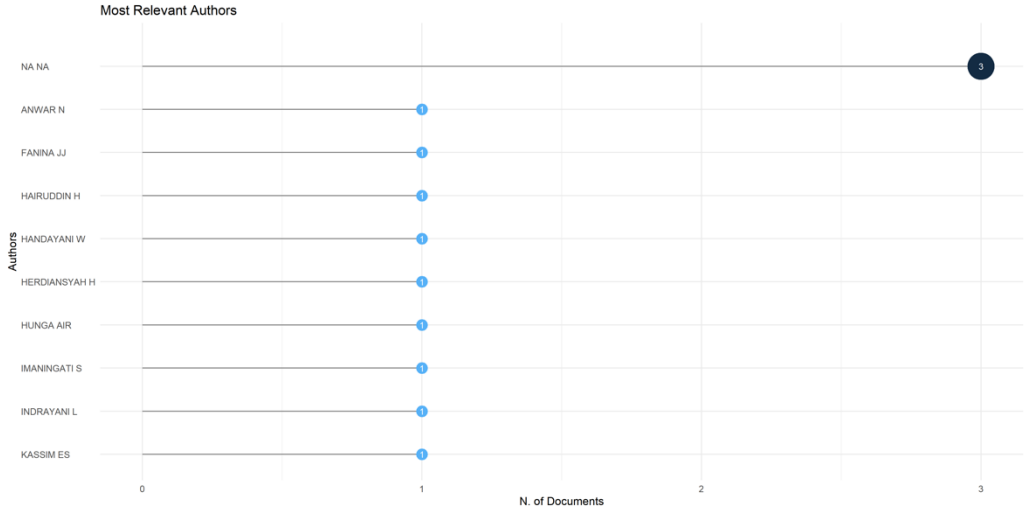


Fig. 8: The relevant authors documents related to sustainable technology for batik research based on Scopus.
Source: Biblioshiny, 2023

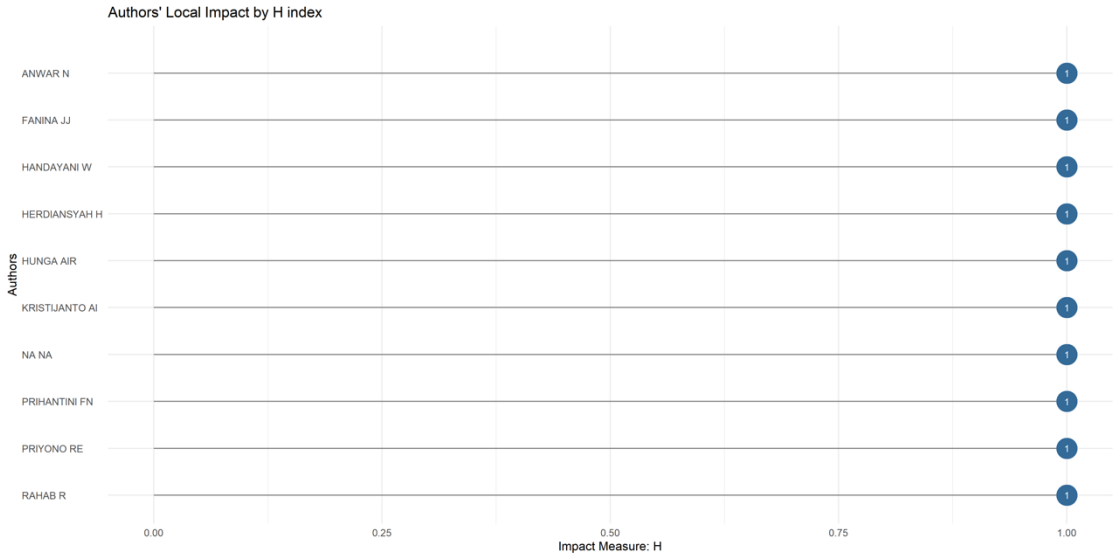


Fig. 9: The authors' local impact related to sustainable technology for batik research based on Scopus.
Source: Biblioshiny, 2023

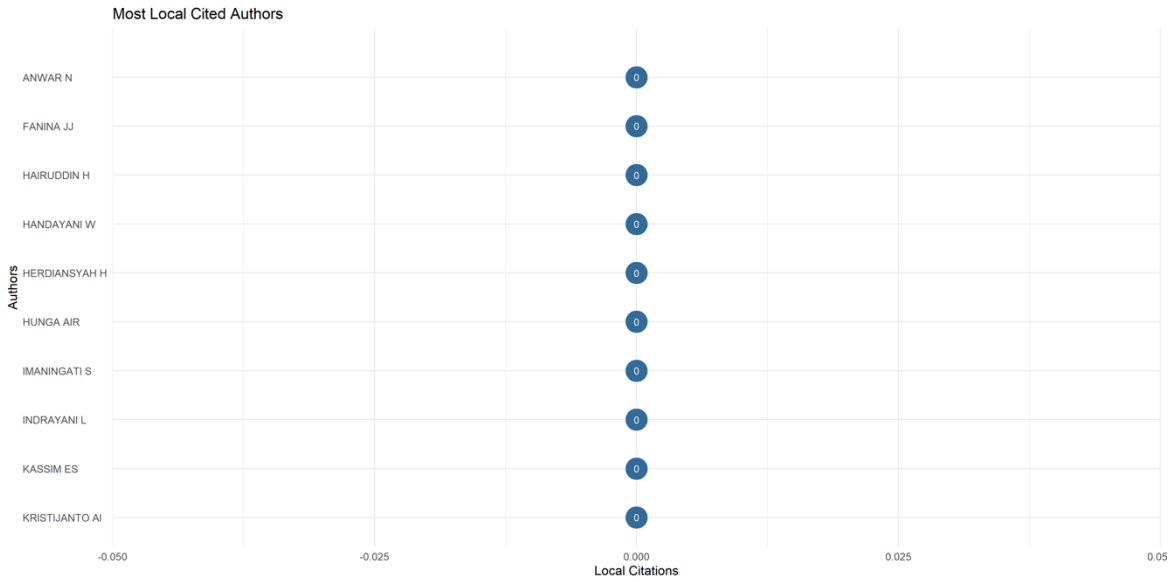


Fig. 10: The local cited authors related to sustainable technology for batik research based on Scopus. Source: Biblioshiny, 2023

Table 2. The Most Cited Documents in Sustainable Technology for Batik Research Based on Scopus

Document Title	Authors	Year	Source	Cited by
"A water footprint case study in Jarum village, Klaten, Indonesia: The production of natural-colored batik" (Handayani et al., 2019)	Handayani, Kristijanto, & Hunga	2019	*Environment, Development and Sustainability* *21(4), pp. 1919-1932*	17
"Cleaner production options for reducing industrial waste: The case of batik industry in Malang, East Java-Indonesi" (Sirait, 2018).	Sirait	2018	*IOP Conference Series: Earth and Environmental Science* *106(1),012069*	14
"Sustainability of Batik wastewater quality management strategies: analytical hierarchy process" (Sulthonuddin & Herdiansyah, 2021).	Sulthonuddin & Herdiansyah	2021	*Applied Water Science* *11(2),31*	3
"Sustainable development of Batik Banyumas as creative industry: A-B-G community-based Triple Helix Model" (Rahab et al., 2016).	Rahab, Anwar, & Priyono	2016	*International Business Management* *10(4), pp. 446-450*	3

"Sustainable Development of Business with Canvas Business Model Approach: Empirical Study on MSMEs Batik Blora, Indonesia" (Widjajanti et al., 2022).	Widjajanti, Prihantini, & Wijayanti	2022	*International Journal of Sustainable Development and Planning* *17(3), pp. 1025-103*	2
"Challenges in preserving batik as indonesia's cultural identity facing global demand of sustainable eco-friendly fabric" (Fanina & Suaedi, 2020).	Fanina & Suaedi	2020	*Vlakna a Textil* *27(2), pp. 37-42*	2
"Development of Aerobic Microbial Granules to Enhance the Performance of Activated Sludge Technology for Wastewater Treatment Application" (Setianingsih & Yuliasni, 2020).	Setianingsih & Yuliasni	2020	*IOP Conference Series: Earth and Environmental Science* *477(1),012001*	1

And the most frequent words used related to sustainable technology for batik research is "sustainable development" (N=7), "wastewater treatment" (N=5), "textile industry" (N=4), "indonesia" (N=3), "analytical hierarchy process" (N=2), "economic growths" (N=2), "environmental technology" (N=2), "wastewater" (N=2), "activated sludge" (N=1), and "activated sludge process" (N=1) (Fig. 11). The frequency words' over time can be seen in Fig. 12.

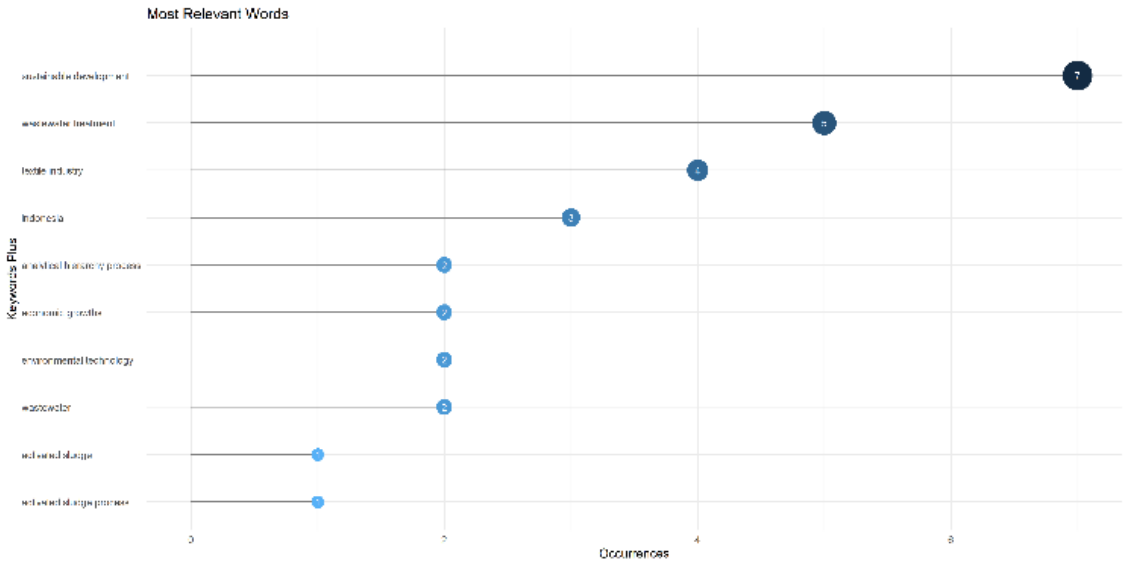


Fig. 11: The most relevant words used related to sustainable technology for batik research in Scopus. Source: Biblioshiny, 2023

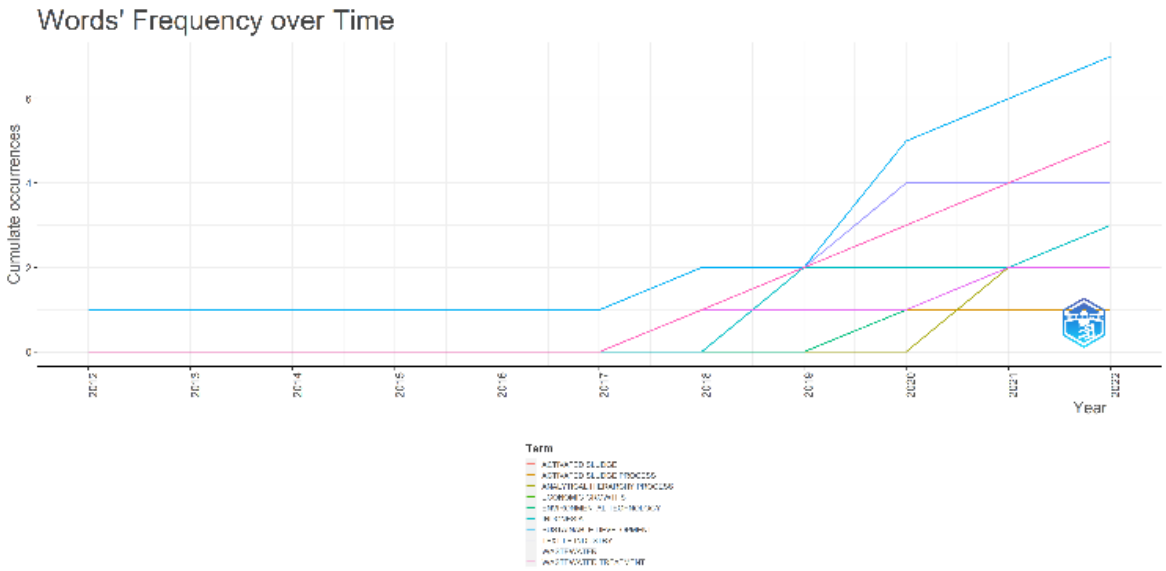


Fig. 12: The most relevant words used related to sustainable technology for batik research in Scopus. Source: Biblioshiny, 2023

Based on the bibliographic data above, we can see a map of the development of topics and themes used related to sustainable technology for batik research. The results of data visualization related to sustainable technology for batik research show 10 clusters with 2 dominant clusters, namely the red cluster (sustainable development) and the blue cluster (Indonesia) (Fig. 13). Meanwhile, there are 2 term trend topics formed from 2012 to 2021 from sustainable technology for batik research, namely sustainable development with term frequency 7 and wastewater treatment with term frequency 5 (Fig. 14). Related to the co-occurrence network between topics, it was found that sustainable technology for batik research is interrelated with sustainable development, wastewater treatment, textile industry, environmental technology, etc. However, the largest occurrence network is formed in terms of sustainable development (Fig. 14).

Based on the visualized data matrix, it can be analyzed that the field of research related to sustainable technology for batik encompasses various research categories. However, from the clustering, it is observed that sustainable development in batik is interconnected with other dominant clusters, such as textile industry and wastewater treatment. The prevailing concern revolves around finding ways to enhance sustainability in batik production. Nevertheless, the data reveals a predominant focus on the themes related to textile industry and wastewater treatment. Consequently, it is evident from the presented data that research on sustainable technology for batik has predominantly centered around the needs of the textile industry and wastewater treatment.

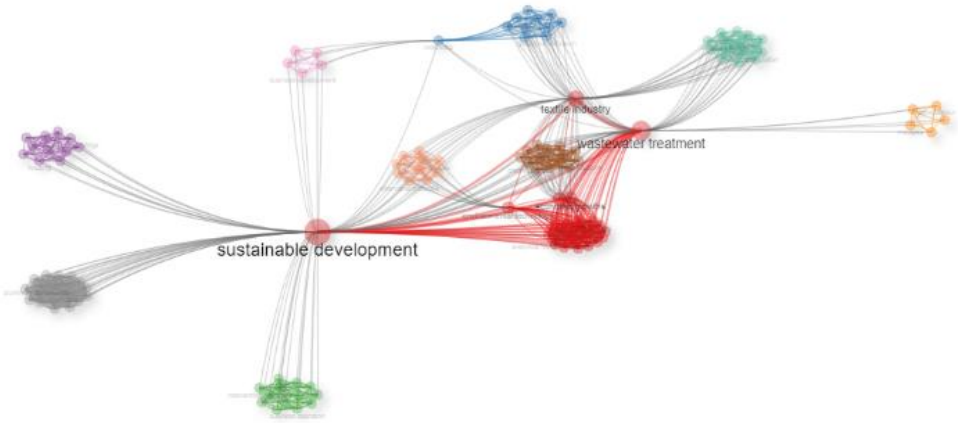


Fig. 13: The clusters related to sustainable technology for batik research based on Scopus.
Source: Biblioshiny, 2023

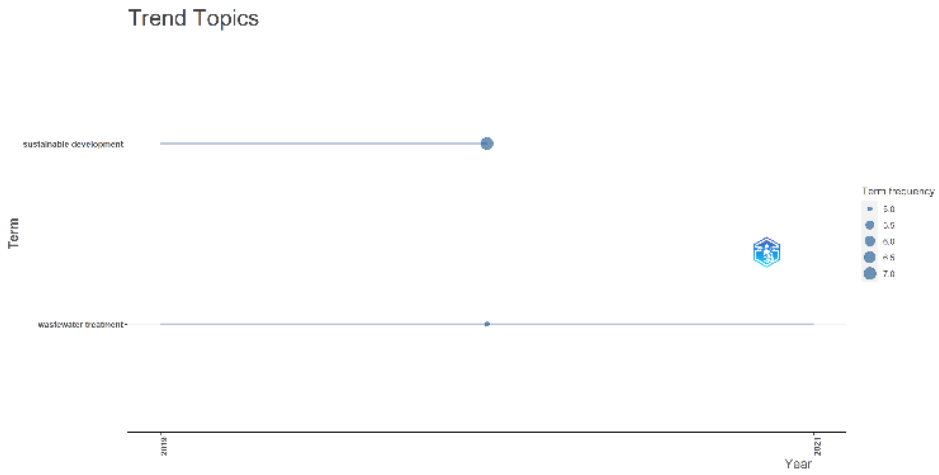


Fig. 14: The trend topic terms related to sustainable technology for batik research based on Scopus.
Source: Biblioshiny, 2023

Fig. 15: The co-occurrence network related to sustainable technology for batik research in Scopus.
Source: Biblioshiny, 2023

The findings indicate direction for further research. It could relate to emerging sustainable technologies for batik. Moreover, they can involve the following.

(1) Productive countries and affiliates: currently, there are only two dominant countries. Thus, there are still opportunities for other countries to conduct research on similar topics. This can be realized with research collaboration between affiliates and countries so that research in the field of sustainable technology for batik can develop and be widely recognized;
(2) Topics: Thus far, the terms topic with high co-occurrence only refer to two terms, namely sustainable development and wastewater treatment. From these two terms, it can be stated that there are still great opportunities for sustainable technology for batik research such as the theme of sustainable batik making technologies, sustainable and environmentally-friendly dyeing techniques, and other themes that are still related to this research.

Conclusion

Based on the findings above, it can be concluded that sustainable technologies for batik research is still relatively new to be done. This research began to be indexed by Scopus since 2012. and by 2022 there are 18 related documents. The dominant type of document is article with 4 documents or 44.4%. The productive year for sustainable technology for batik research is 2020 with 6 documents. While the dominant publication source is the Earth and Environmental Science IoP Conference Series with 6 documents. While the country with the dominant number of related studies is Indonesia with 14 documents. The most prolific affiliate is Universiti Technologi Malaysia with 4 documents. Related to the development map in sustainable technology for batik research based on the terms co-occurrence obtained, two dominant terms were found, namely sustainable development and wastewater treatment. In the future sustainable technology for batik research can be carried out on different topics such as the theme of sustainable batik making technology, sustainable and environmentally friendly dyeing techniques, and other themes that are still related to this research.

Acknowledgment

This title was submitted as the output of the PIB (Binus International Research) research internal grant funded by Bina Nusantara University for the academic year 2022-2023.

References

Apriyani, K. T., Setyobudi, I. & Dwiatmini, S. (2021) Motif Batik Sebagai Ikon dan Mitos Baru Identitas Kabupaten Lebak. *Jurnal Budaya Etnika, 5*(1), 57–72.

Apriyani, N. (2018) Industri Batik: Kandungan Limbah cari dan Metode Pengolahannya. *Media Ilmiah Teknik Lingkungan*, 3(1).

Azhar, R., Tuwohingide, D., Kamudi, D., Sarimuddin, & Suciati, N. (2015) Batik Image Classification Using SIFT Feature Extraction, Bag of Features and Support Vector Machine. *Procedia Computer Science*, 72, 24–30. https://doi.org/10.1016/j.procs.2015.12.101

Fanina, J. J. & Suaedi, F. (2020) Challenges in preserving batik as indonesia's cultural identity facing global demand of sustainable eco-friendly fabric. *Vlakna a Textil*, *27*(2), 37–42. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85091908033&partnerID=40&md5=a2f43a1c4dab8936e8c34cc26cbeccd6

Hakika, D. C., Mufrodi, Z., Evitasari, R. T., Bhakti, C. P. & Robi'in, B. (2021) Peningkatan Pengetahuan Peserta Training of Trainer (ToT) "Pelatihan Batik dengan Pewarnaan Alami" dengan Penyuluhan Mengenai Pengolahan Limbah Cair industri Batik. *Abdimas*, *25*(2).

Hakim, L. M. (2018) Batik Sebagai Warisan Budaya Bangsa dan Nation Brand Indonesia. *Nation State: Journal of International Studies*, 1(1), 61–90.

Handayani, W., Kristijanto, A. I., & Hunga, A. I. R. (2019) A water footprint case study in Jarum village, Klaten, Indonesia: The production of natural-colored batik. *Environment, Development and Sustainability*, *21*(4), 1919–1932. https://doi.org/10.1007/s10668-018-0111-5

Hunga, A. I. R. (2014) Ancaman Kerusakan Ekologis Produksi Batik Rumahan: Narasi Perlindungan Ruang Domestik. In *Ekofeminisme II: Narasi Iman, Mitos, Air & Tanah*. Jalasutra.

Kusrianto, A. (2014) *Batik, Filosofi, Motif, dan Kegunaannya*. Penerbit Andi.

Kustiyah, I. E. (2017). *BATIK SEBAGAI IDENTITAS KULTURAL BANGSA INDONESIA DI ERA GLOBALISASI*.

Media Industri. (2011). *Kebangkitan Industri Nasional. Media Menuju Kehidupan yang Lebih Baik*.

Meliono, I. (2014) *Batik dan Industri Kreatif: Sebuah Proses Kreatifitas Manusia dalam Kajian Studi Humaniora*. 4(2).

Pritchard, A. (1969) Statistical bibliography or bibliometrics. *Journal of Documentation*, *25*, 348.

Rahab, Anwar, N., & Priyono, R. E. (2016) Sustainable development of Batik Banyumas as creative industry: A-B-G community-based Triple Helix Model. *International Business Management*, 10(4), 446–450. https://doi.org/10.3923/ibm.2016.446.450

Setianingsih, N. I. & Yuliasni, R. (2020) *Development of Aerobic Microbial Granules to Enhance the Performance of Activated Sludge Technology for Wastewater Treatment Application* (C. T. Nugraheni, A. Widiyanti, & A. B. Shahra, Eds.; Vol. 477, Issue 1). Institute of Physics Publishing. https://doi.org/10.1088/1755-1315/477/1/012001

Sirait, M. (2018) *Cleaner production options for reducing industrial waste: The case of batik industry in Malang, East Java-Indonesia* (R. Hadisoebroto, A. G. Abdullah, A. Rinanti, & A. B. D. Nandiyanto, Eds.; Vol. 106, Issue 1). Institute of Physics Publishing. https://doi.org/10.1088/1755-1315/106/1/012069

Sulthonuddin, I. & Herdiansyah, H. (2021) Sustainability of Batik wastewater quality management strategies: analytical hierarchy process. *Applied Water Science*, 11(2). https://doi.org/10.1007/s13201-021-01360-1

Widadi, Z. (2019) *Pemaknaan Batik Sebagai Warisan Budaya TakBenda*. *33*(2).

Widjajanti, K., Prihantini, F. N., & Wijayanti, R. (2022) Sustainable Development of Business with Canvas Business Model Approach: Empirical Study on MSMEs Batik Blora, Indonesia. *International Journal of Sustainable Development and Planning*, 17(3), 1025–1032. https://doi.org/10.18280/ijsdp.170334