

Natural and Chemical Dyeing Practices in Bhairavgarh Batik: a Study of Process, Environmental Impact, and Sustainable Possibilities.

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Abstract

Batik printing is a significant textile craft tradition in India, with the Bhairavgarh cluster of Madhya Pradesh being one of its prominent centres. Historically, batik fabric dyeing in Bhairavgarh relied on natural dyes derived from plant and mineral sources such as indigo, madder root, turmeric, myrobalan, and fermented iron solutions. These practices were embedded within local knowledge systems and maintained a relatively sustainable relationship with the surrounding environment. However, over time, there has been a noticeable shift towards the extensive use of chemical dyes due to their cost-effectiveness, wide colour range, easy availability, and improved colour fastness. While chemical dyes have enhanced production efficiency and market adaptability, their prolonged and unregulated use has raised serious environmental and health concerns. The discharge of dye effluents into nearby water bodies has adversely affected river ecosystems, agricultural practices, and local water resources, while also posing potential risks to skin health and the occupational health of artisans involved in the dyeing process. This paper examines the dyeing processes involved in Bhairavgarh batik with a comparative focus on natural and chemical dyes. Through a review of existing literature and field-based observations, the study highlights the environmental implications of chemical dyeing and explores the current marginal practice of natural dyeing within the cluster. The research aims to reintroduce and systematically integrate natural dyes in batik practice as a sustainable alternative that aligns with ecological responsibility and craft preservation. The study contributes to ongoing discussions on sustainable textile practices by situating traditional knowledge within contemporary production contexts.....

Keywords: Batik printing, Bhairavgarh, natural dyes, chemical dyes, textile dyeing, sustainability, environmental impact

INTRODUCTION

Batik is a resist-dyeing technique that holds cultural, aesthetic, and economic significance in textile traditions across various regions of the world. In India, the batik tradition of Bhairavgarh, Madhya Pradesh, stands out for its distinctive patterns, hand processes, and strong association with local craft communities. Traditionally, batik dyeing practices in this region were closely connected to natural dye sources such as indigo, madder root, turmeric, and other plant- and mineral-based materials. These dyes not only reflected indigenous knowledge systems but also maintained a relatively harmonious relationship with the surrounding environment.

With the advent of industrialisation and the introduction of synthetic dyes in the textile sector, dyeing practices in Bhairavgarh have undergone a significant transformation. Chemical dyes, particularly reactive, azo, vat, and sulphur dyes, have gradually replaced natural dyes due to their economic and functional advantages. Factors such as lower cost, ease of application, availability throughout the year, and a broader range of colour shades have made chemical dyes the preferred choice among artisans. Additionally, improved colour fastness and consistency have enabled batik producers to meet contemporary market demands more efficiently.

Despite these advantages, the extensive use of chemical dyes has resulted in serious environmental and health-related challenges. Textile dye effluents, often discharged untreated into nearby rivers and open land, contribute to water pollution and soil degradation. In Bhairavgarh, river water contaminated with dye residues is frequently used for agricultural irrigation and domestic purposes, intensifying concerns related to crop quality, ecosystem balance, and public health. Moreover, prolonged exposure to chemical dyes and auxiliary substances may cause skin irritation and occupational health issues among artisans involved in dyeing and printing processes.

In contrast, natural dyes are widely recognised for their biodegradability, lower toxicity, and reduced environmental impact. However, in the contemporary Bhairavgarh batik cluster, natural dyeing is practised by only a limited number of artisans and primarily on a demand-driven basis. Challenges such as limited colour range, longer processing time, lack of standardisation, and market pressure have restricted their widespread adoption. This shift highlights a critical gap between sustainable dyeing knowledge and current production practices.

This study seeks to examine the dyeing processes used in Bhairavgarh batik by analysing both natural and chemical dyeing practices. By situating local craft practices within broader discussions on textile sustainability, the paper aims to highlight the environmental implications of chemical dye usage and explore the potential for reviving natural dyeing practices as a viable and responsible alternative. The research contributes to the discourse on sustainable craft-based textile production and emphasises the need for balancing economic viability with environmental and cultural preservation.

LITERATURE REVIEW:

The textile dyeing industry is one of the largest consumers of synthetic dyes and also a major contributor to industrial water pollution. Benkhaya et al. provide a comprehensive classification of textile dyes, highlighting that azo, reactive, vat, sulphur, disperse, acid, basic, and direct dyes dominate textile processing due to their colour range, affordability, and fastness properties (Benkhaya, Ahmed, and Ahmed, 2017). Among these, azo dyes alone constitute nearly 70% of all dyes used globally, with a significant portion released into the environment as unfixed dye during processing, contributing to severe ecological stress (Ahmad, Sushil and Krishna, 2012).

Several studies have documented that effluents from textile dyeing units contain high levels of suspended solids, toxic heavy metals, sulphides, chlorides, and residual colour, which adversely affect surface and groundwater quality. Studies on textile effluents in Indian contexts reveal that untreated or partially treated dye wastewater increases turbidity, reduces dissolved oxygen, and disrupts aquatic ecosystems, making the water unsuitable for domestic use and agriculture (Ojha, 2018). Such findings are highly relevant to traditional craft clusters like Bhairavgarh, where dye wastewater is often discharged into open drains or nearby water bodies that are later used for crop irrigation and daily use. (Bhasin, Shukla and Shrivastava, 2015)

Beyond environmental damage, chemical dyes pose serious occupational and health risks. Synthetic dyes and associated auxiliaries contain carcinogenic amines, heavy metals such as chromium, copper, and lead, and formaldehyde-based compounds, which can cause skin irritation, allergic reactions, respiratory disorders, and long-term health complications for artisans involved in dyeing processes (Thoker, Sushil and Krishna, 2012). Prolonged skin contact with chemically dyed textiles has also been reported to cause dermatological issues among consumers, raising concerns about textile safety.

In contrast, natural dyes have been increasingly recognised for their eco-friendly and skin-safe properties. Verma and Gupta emphasise that natural dyes derived from plants, insects, and minerals are biodegradable, non-toxic, and non-carcinogenic, making them a sustainable alternative to synthetic dyes (Verma and Gupta, 2017). Plant-based natural dyes such as indigo, madder, turmeric, myrobalan, henna, and pomegranate rind - many of which are traditionally used in Indian textile practices - offer soft, harmonious shades with minimal environmental impact.

Specific to batik, Maulik et al. demonstrate that batik on handloom cotton using natural dyes not only achieves acceptable colour fastness but also enhances the environmental value of the textile product (Maulik, Bhowmik and Agarwal, 2014). Their study highlights that although synthetic dyes like naphthol and solubilised vat dyes became popular due to ease of application, renewed environmental awareness has led to a gradual revival of natural dye-based batik practices.

However, limitations of natural dyes include challenges of shade reproducibility, availability, and standardisation. Prabhu and Bhute note that while natural dyes cannot entirely replace synthetic dyes, their integration into niche, craft-based, and demand-driven production systems can significantly reduce environmental burden and support sustainable livelihoods (Prabhu and Bhute, 2012).

OBJECTIVES:

To examine the factors responsible for the shift from natural dyes to chemical dyes within the Bhairavgarh batik cluster.

To analyse the environmental and health implications associated with the use of chemical dyes in batik dyeing practices.

To identify the current status and challenges of natural dye usage in Bhairavgarh batik production.

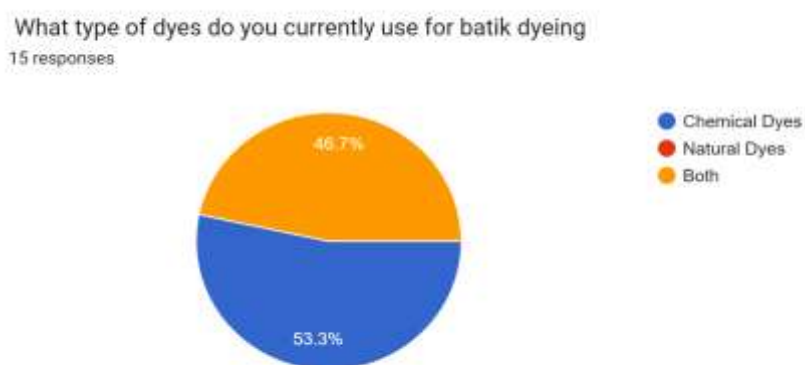
To explore the scope for reviving and integrating natural dyeing practices as a sustainable alternative in contemporary batik production.

METHODOLOGY:

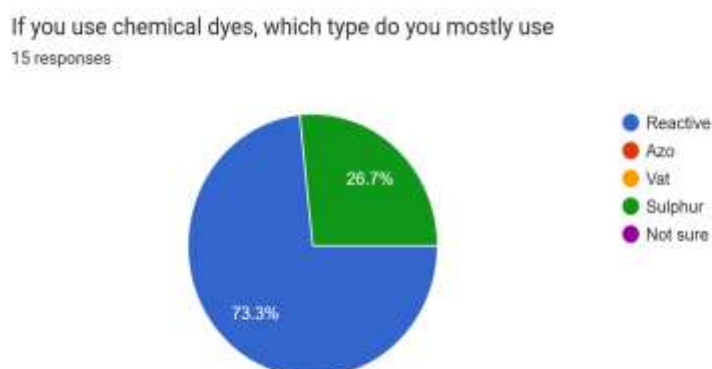
The present study adopts a descriptive and exploratory research design to examine dyeing practices in the Bhairavgarh batik cluster, with specific reference to the use of natural and chemical dyes and their associated environmental and health implications. Both primary and secondary data sources were used to achieve the research objectives.

Primary data was collected through a field-based survey conducted among batik artisans working in the Bhairavgarh cluster. A structured questionnaire was designed to document dyeing processes, types of dyes used, reasons for the shift from natural to chemical dyes, methods of dye wastewater disposal, and self-reported health issues related to dye handling. The questionnaire consisted of closed-ended and descriptive questions and was administered through direct interaction with artisans to ensure clarity and accuracy of responses.

Secondary data was sourced from published research papers, journals, and reports related to textile dye classification, environmental impacts of chemical dyes, health hazards associated with textile dyeing, and the application of natural dyes in batik and handloom textiles. These sources provided a theoretical framework and supported the interpretation of field data.

RESULTS AND DISCUSSIONS:

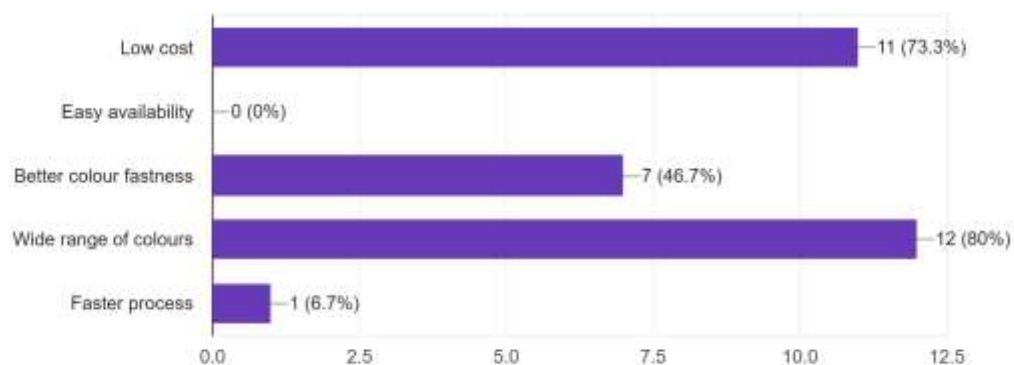
The data shows that a majority of artisans use chemical dyes for batik dyeing. While some artisans reported using both chemical and natural dyes, none rely exclusively on natural dyes for regular production. This clearly reflects the dominance of chemical dyes in contemporary batik practices in Bhairavgarh.



Among the artisans using chemical dyes, reactive dyes are the most commonly used, followed by sulphur dyes. Reactive dyes are preferred due to their strong bonding with cotton fabric and better colour fastness, making them suitable for batik production intended for the commercial market.

What are the main reasons for using chemical dyes?

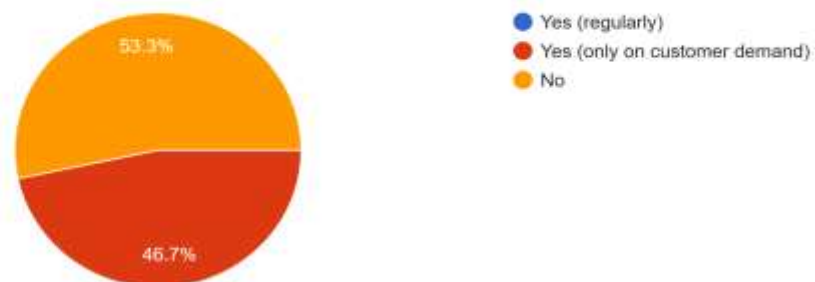
15 responses



The primary reasons for using chemical dyes include low cost, better colour fastness, and a wide range of colour options. Many artisans selected multiple reasons, indicating that affordability combined with market-driven colour demands strongly influences dye selection.

Have you ever practiced natural dyeing in batik?

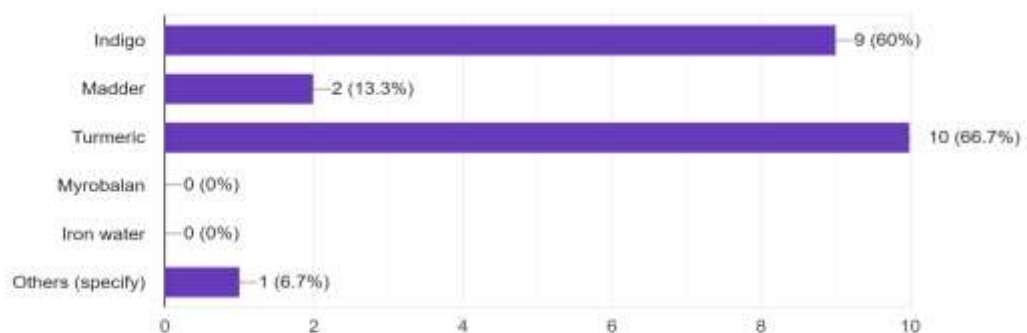
15 responses



The survey reveals that natural dyeing is not a regular practice among most artisans. A small number of respondents stated that they have practiced natural dyeing only on customer demand, while the rest have never practiced natural dyeing. This highlights the limited integration of natural dyes in routine batik production.

If natural dyes are used, which ones have you worked with?

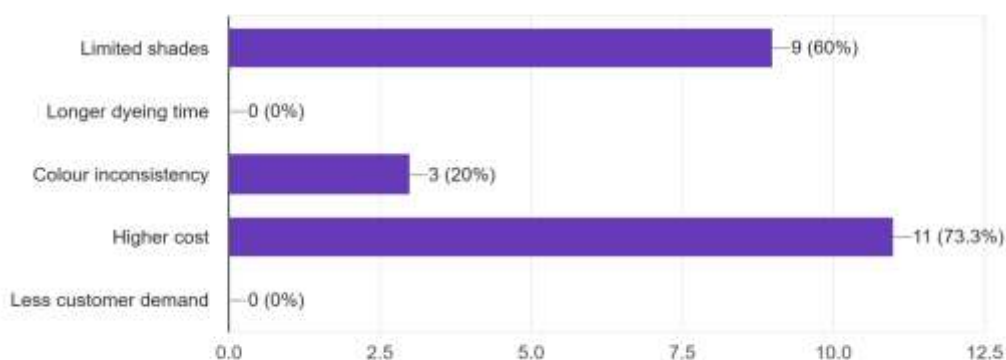
15 responses



Among artisans who have experience with natural dyes, indigo and turmeric were the most commonly used, followed by madder. This suggests that artisans are familiar with a few traditional natural dyes, but the range of materials used remains limited.

What challenges do you face in using natural dyes?

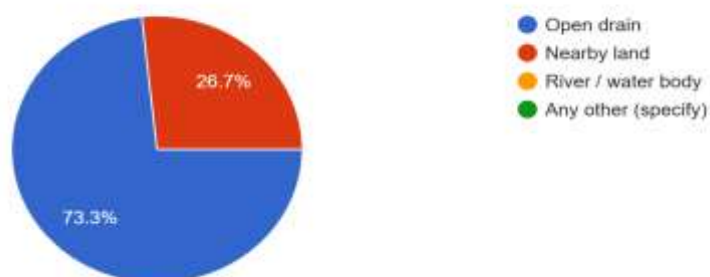
15 responses



Artisans identified higher cost, limited colour shades, and colour inconsistency as the major challenges associated with natural dyeing. These constraints make natural dyes less feasible for large-scale or time-bound production, particularly in comparison to chemical dyes.

Where is the dye wastewater usually disposed?

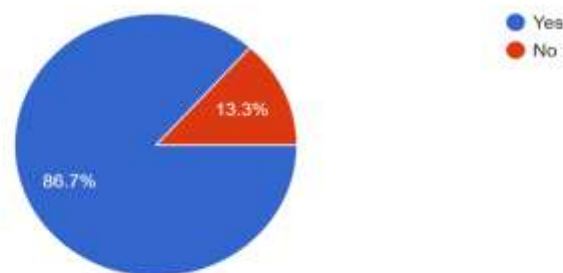
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The data indicates that dye wastewater is primarily disposed of through open drains or nearby land. This practice raises serious environmental concerns, as untreated dye effluents may contaminate soil and water resources, especially in areas connected to agricultural activities.

Do you experience any discomfort while working with chemical dyes?

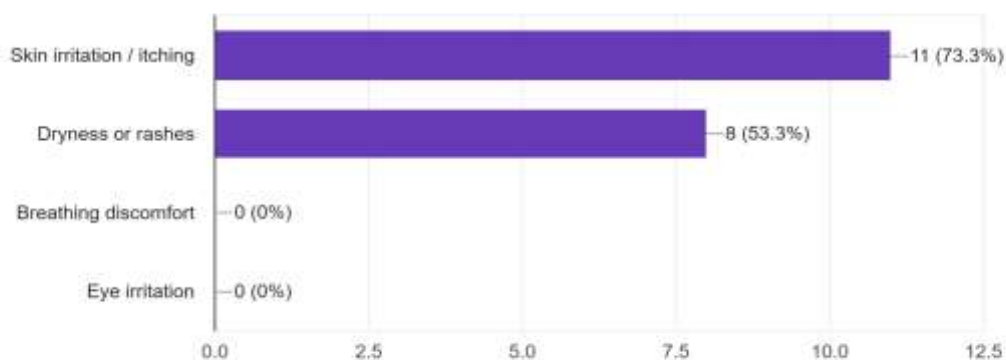
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A large proportion of artisans reported experiencing discomfort while working with chemical dyes. These observations suggest occupational exposure issues associated with prolonged handling of chemical dyes.

If yes, what type of issues have you noticed?

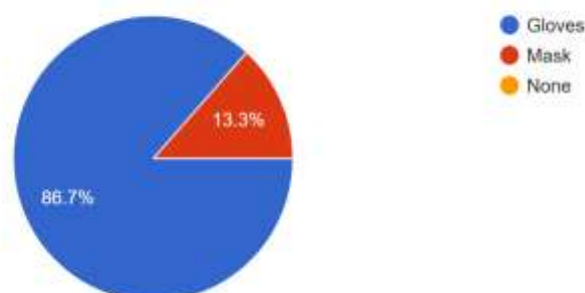
15 responses



The commonly reported problems include skin irritation, itching, and dryness or rashes. These are self-reported conditions and not medical diagnoses; however, they indicate possible adverse effects of frequent contact with chemical dyes during batik dyeing.

Do you use any protective measures while dyeing?

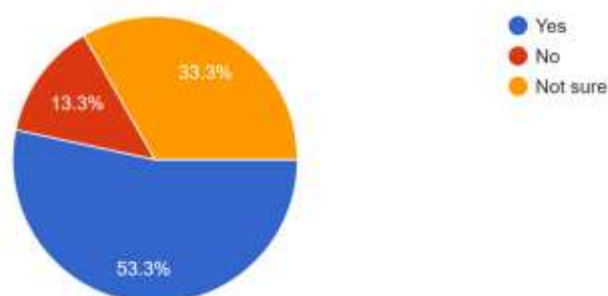
15 responses



Most artisans reported using basic protective measures, primarily gloves, while a smaller number use masks. The limited use of comprehensive protective equipment suggests a lack of awareness or access to occupational safety practices.

Do you think natural dyes are safer for health and the environment?

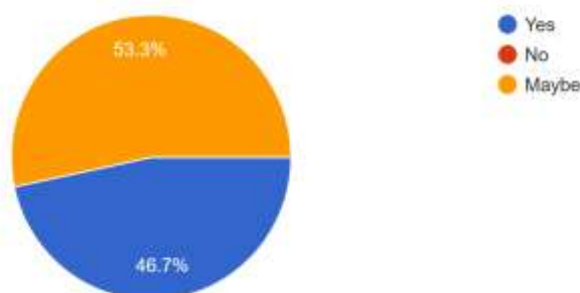
15 responses



A majority of respondents believe that natural dyes are safer for health and the environment, though some artisans expressed uncertainty. This reflects growing awareness, alongside practical concerns related to production feasibility.

Would you be willing to use natural dyes more regularly if training, support, and market demand increase?

15 responses



Many artisans expressed willingness to use natural dyes more regularly if adequate training, institutional support, and market demand are provided. This indicates potential for reintroducing natural dye practices through structured interventions.

FINDINGS:

The study documents that batik dyeing in the Bhairavgarh cluster is currently dominated by chemical dyeing processes, with reactive and sulphur dyes being the most widely used. These dyes are primarily applied on cotton fabrics due to their strong colour fixation, wide shade range, and suitability for repeated waxing and dyeing stages inherent to batik production. The use of natural dyes such as indigo, madder, and turmeric was found to be limited and largely demand-driven rather than a regular practice. The shift from natural dyes to chemical dyes has occurred mainly due to economic and practical factors. Artisans identified lower cost, easy availability, reduced processing time, and better colour fastness as key reasons for adopting chemical dyes. Market expectations for bright and consistent colours further reinforce this transition, making natural dyes less viable for regular commercial production.

Environmental analysis highlights significant concerns related to dye wastewater disposal. The findings indicate that untreated dye effluents are released into open drainage systems, which ultimately flow into the Shipra River. This river water is used for irrigation and crop cultivation, suggesting potential risks of chemical contamination of agricultural land and water resources. The absence of formal effluent treatment mechanisms within the cluster intensifies the environmental impact of chemical dyeing practices. From a health perspective, prolonged exposure to chemical dyes has resulted in self-reported skin-related issues among artisans, including itching, rashes, and irritation. The study also notes the limited use of protective measures during dye handling, increasing occupational health risks. Although artisans are aware of these adverse effects, economic constraints limit their ability to adopt safer alternatives. The study further finds that the practice of natural dyeing faces multiple challenges, including lack of consistent raw material supply, longer processing time, colour variability, and insufficient technical support. However, the continued presence of a few artisans practising natural dyeing on customer demand indicates a potential scope for revival, especially in niche, eco-conscious markets.

SUGGESTIONS:

Based on the findings of the study, the following measures are suggested to promote sustainable dyeing practices in the Bhairavgarh batik cluster:

Promotion of Natural Dyeing Practices:

Structured training programmes and workshops should be conducted to enhance artisans' skills in natural dyeing, focusing on shade development, consistency, and efficient application in batik.

Environmental Management:

Small-scale and affordable wastewater management solutions suitable for craft clusters should be introduced to minimise the environmental impact of chemical dye effluents.

Health and Safety Awareness:

Awareness programmes on occupational health should be implemented, encouraging the use of basic protective equipment and safer dye-handling practices.

Market Support and Awareness:

Consumer awareness regarding eco-friendly and skin-safe batik products can help create demand for naturally dyed textiles, making sustainable practices economically viable for artisans.

Institutional and Policy Support:

Support from government agencies, design institutions, and non-governmental organisations can facilitate access to resources, subsidies, and technical expertise to encourage a gradual shift towards sustainable dyeing methods.

CONCLUSION:

This research highlights a clear transformation in Bhairavgarh batik dyeing practices from traditional natural dyes to chemical dyes, driven largely by economic feasibility and market demands. While chemical dyes, particularly reactive and sulphur dyes, support mass production and commercial viability, their continued use has resulted in notable environmental degradation and occupational health concerns. The discharge of untreated dye effluents into the Shipra River and the associated risks to agriculture and artisan health underline the unsustainability of current practices.

At the same time, the study establishes that natural dyeing, though marginalised, remains technically feasible within the cluster. With appropriate interventions such as awareness programmes, technical training, improved access to raw materials, and small-scale wastewater management systems, natural dyes can be reintroduced as a sustainable alternative. Integrating natural dyeing practices selectively, rather than as a complete replacement, offers a balanced approach that supports both environmental responsibility and artisan livelihoods.

Overall, the study underscores the need for context-specific sustainable dyeing strategies that address environmental protection, artisan health, and economic realities, thereby contributing to the long-term sustainability of Bhairavgarh batik production....

REFERENCES

1. . Sankar Roy Maulik, Bhowmik, L., & Agarwal, K. (2014). Batik on handloom cotton fabric with natural dye. Indian Journal of Traditional Knowledge, 13(4), 788–794. https://www.researchgate.net/publication/288214332_Batik_on_handloom_cotton_fabric_with_natural_dye
2. Bansal, & Yadav. (2016). Occupational Health Hazards And Awareness Of Occupational Safety Among Workers Of Textile Dyeing Industries In Jaipur, India, 2(2), 30-38, <https://api.semanticscholar.org/CorpusID:37596329>
3. Bhasin, S., Shukla, A. N., & Shrivastava, S. (2015). Observations On In Kshipra River With Relation To Anthropogenic Activities. Indian J. L. Sci., 4(2), 11–18. https://ijls.in/upload/1861844893CHAPTER_2.pdf
4. Thoker F. A., Sushil M., & Krishna M. (2012). Impact of Dye Industrial Effluent on Physicochemical Characteristics of Kshipra River, Ujjain City, India. International Research Journal of Environmental Sciences, 1(2), 41–45. <https://www.isca.in/IJENS/Archive/v1/i2/8.ISCA-IRJEvsS-2012-041.php>.
5. Mir T. A., Sushil M. and Krishna M. (2012). Influence of dye industrial effluent on physico chemical characteristics properties of soil at Bhairavgarh, Ujjain, MP, India. Journal of Environmental Sciences, 1(2), 50-53. <https://www.isca.in/IJENS/Archive/v1/i2/8.ISCA-IRJEvsS-2012-041.php>.
6. Abha Ojha. (2018). Impact of Textile Dyes on Workers. International Journal of Innovative Research in Science, Engineering and Technology, 7(2), 1651-1654. <https://www.isca.in/IJENS/Archive/v1/i2/8.ISCA-IRJEvsS-2012-041.php>.
7. Ashis K. S., Priti A. (2009). Application of natural dyes on textiles. Indian Journal of Fibre & Textile Research. Indian Journal of Traditional Knowledge. 34(4), 384–399. https://www.researchgate.net/publication/279573040_Application_of_natural_dyes_on_textiles
8. Sankar R. M., Lina B., & Khusbu A. (2014). Batik on handloom cotton fabric with natural dye. Indian Journal of Traditional Knowledge. Indian Journal of Traditional Knowledge. 13(4). 788-794. https://www.researchgate.net/publication/288214332_Batik_on_handloom_cotton_fabric_with_natural_dye
9. S. Benkhaya, S. E. Harfi, & A. E. Harfi. (2017). Classifications, properties and applications of textile dyes: A review. Applied Journal of Environmental Engineering Science. 311-320. https://www.researchgate.net/publication/323960391_Classifications_properties_and_applications_of_textile_dyes_A_review
10. S. Verma and G. Gupta. (2017). Natural dyes and its applications: A brief review. International Journal of Research and Analytical Reviews. 4(4). 57-60. https://ijrar.com/upload_issue/ijrar_issue_490.pdf
11. K. H. Prabhu, & Aniket S Bhute. (2012). Plant based natural dyes and mordants: A Review. Scholars Research Library. 2(6). 649-664. <https://www.scholarsresearchlibrary.com/articles/plant-based-natural-dyes-and-mordants-a-review.pdf>