



# International Journal of Advanced Research in Education and Technology (IJARETY)

Volume 11, Issue 6, November-December 2024

Impact Factor: 7.394



# Threading a Sustainable Future through Eco-Printing

(A Study Exploring Aesthetic Potential and Sustainable Practices of Eco Printing on Threads)

Isha Bhopi, Prof. Dr. Rakhi Wahee

Student, Textile Design, Semester- 7, National Institute of Fashion Technology, Panchkula, Haryana, India

National Institute of Fashion Technology, Panchkula, Haryana, India

**ABSTRACT:** Eco printing is an environmentally friendly and aesthetically appealing printing technology that uses natural plant dyestuffs. Beyond its aesthetic appeal, eco-printing promotes sustainability by reducing the ecological footprint associated with traditional printing methods. It has attracted considerable interest in recent years due to the shift in customer behavior and their eco-consciousness.

Yarns, being an extensible textile medium, provide an exceptional mode for investigating the potential of eco-printing in several areas, such as weaving and surface ornamentation. While eco-printing has made significant strides in the textile industry, *its application to yarn-based materials remains an understudied area*. This untapped potential offers opportunities for innovation and advancement leading an ecological approach. The primary focus of this research is to explore the viability and efficiency of eco-printing on threads, with an emphasis on achieving a blurring or a raw and abstract effect. The outcome of secondary research, including first-hand swatch results from previously released articles, were compared to those of primary research, which comprised hands-on experimentation with an assortment of plant-based dyes and mordants. To achieve the desired blurring effect on thread, the research helped to identify efficient practices by analyzing aspects that influence dye uptake and pattern development to encourage the sustainable manufacturing of textiles.

The aim of this study is to experiment with cotton (2/10 count) yarns to determine their suitability for eco-printing, along with investigating mordanting methods to enhance color fastness and prevent fading. To start with, the study has covered a few existing research papers on eco-printing techniques used on fabrics. The study was also undertaken to examine the potential applications of these techniques with yarns, conducting laboratory tests to confirm their feasibility and effectiveness. The outcomes have given mixed results stating the suitability of eco-printing for yarn printing applications. Yet, the findings have provided significant novel data for textile artists, designers, and researchers, as well as they might help to accelerate the development of environmentally sensitive and sustainable textile printing techniques.

## I. INTRODUCTION

Eco printing offers an engaging and exclusive way to color fabrics while simultaneously being eco-friendly to the environment. It gears up renewable resources to achieve distinct and long-lasting shades when compared to more traditional methods that involve synthetic dyes, which possess harmful chemicals. It also reinforces textiles with distinctive characteristics while diminishing the negative effects on the environment by means of the application of plant-derived pigments that originate from different, naturally occurring substances such as leaves, flowers, bark, and more. Ultimately, it adopts a *closed-loop* approach, reducing waste production. To wrap up the sustainable cycle, concisely after the textile has been dyed, the residue of vegetative matter can be decomposed in order to replenish soil nutrients.

Through the use of materials that are sourced regionally while minimizing dependency on synthetic substances, this natural coloring process promotes regional economies and environmentally friendly choices. Furthermore, the relationship amongst plant-derived pigments and the textile fibers in eco-printing frequently results in unusual and spectacular patterns. Eco printing also has appeal since the process generates *one-of-a-kind* items and adds a touch of delight that renders each one distinctive.

### 1. The Origin and Evolution of Eco-Printing:

The origin of eco-printing was rooted in ancient civilizations, where people used organic and indigenous materials to color their textiles. While some details may differ across cultures, the fundamental process of eco-printing has continued to be uniform for centuries.

Natural dyes were the only reason for color on textiles before the middle of the 1800s. Typically, the plant constituents were used for brewing tea, which was strained after being put into a metal kettle. While the metal and tea integrated together, the color lasted in the fiber. To keep the colors alike, dyers would continuously stir. Even though not all plants possess remarkable dye content, natural dyeing has enhanced and assorted over demographics, directing dyers to define and sort the best plants for their use. Consumers from various regions may be acknowledged with the unfavorable effects of eco-print. The distinctive eco-print evolved during research done by Flint, India, for a Master of Visual Arts at the University of South Australia has become a defining feature of India's textile practice [2].

It has also evolved to be an internationally renowned art form that focuses on the ancient techniques of textile design while projecting to a greener and more adaptable future.

### 2. A healthier choice for consumers:

Unlike synthetic dyes, which include detrimental chemicals, they emit pollutants and degrade ecosystems. The World Bank predicted that 17% to 20% of industrial water pollution is generated by synthetic textile dyes. Additionally, around 40% of these synthetic dyes incorporate known carcinogens [4].

One important health benefit of eco-printing is the evasion of exposure to harmful chemicals. Synthetic dyes contain matters that can inflame the skin, set off an allergy, or even have chronic health complications. By selecting eco-printed fabrics, consumers can lower their risk of undergoing these adverse reactions. Additionally, natural dyes are typically biodegradable, reducing their impact on ecosystems and lowering the capacity of contact with harmful substances through the surroundings.

Moreover, it often includes locally sourced plant materials, which may possess several health benefits. Regionally sourced materials are probably fresh and free from harmful pollutants. Additionally, uplifting local agriculture can contribute to a healthier and more responsible food system, indirectly aiding consumer health.

Furthermore, an intrinsic manufacturing health concern is resolved along with its aesthetic appeal by practicing eco-print techniques on yarns. As a moral and environmentally friendly alternative to standard textile printing processes, it possesses the advantages to people and the globe throughout the manufacturing process and beyond.

## II. ARTISTIC EXPRESSION AND UNIQUENESS

**2.1. Imperfection and Organic Patterns:** The development of distinctive and organic patterns that emerge from the natural dyeing process is one of the most distinctive features of eco printing. Eco printing, in contrast to synthetic printing methods, generates unique designs that frequently exhibit variations in color, texture, and shape. Eco-printing celebrates this inherent imperfection, as it is consistent with the principles of slow fashion and sustainability. Each piece is transformed into a work of art, infused with a connection to the transient beauty of nature.

**2.2. Variations that occur naturally:** The process of eco-printing is significantly influenced by a variety of factors, such as the type of plant material, the type of fabric, the printing method, and even the weather conditions. As a consequence, the final designs exhibit variability, which can be regarded as an aesthetic advantage, as no two pieces are identical. The subtle, nuanced patterns that are produced through eco printing are frequently referred to as "alive" or "raw" in contrast to the uniform, mass-produced synthetic prints.

**2.3. Vibrancy and Color Palette:** Natural, Earthy Tones: Eco printing typically produces earthy, muted tones, including browns, yellows, oranges, reds, greens, and purples, that are derived from plants. These hues are characterized by a warm, organic quality that is in harmony with the natural world. The raw, unprocessed nature of the materials used can be reflected in the limited range of colors in eco-printing, which is seen as an aesthetic choice in comparison to synthetic dyes.

**2.4. Textural Variations:** The texture of the fabric can also be influenced by the eco printing process, as the natural materials and techniques used frequently produce a tactile surface. In addition to dye imprints, the fabrics may also

exhibit an intriguing texture or raised pattern as a result of steaming or pressing with plant material. This tactile quality contributes an additional layer of aesthetic value, as eco-printed textiles are not only visually appealing but also offer a sensory experience.

### III. OBJECTIVE

- To scrutinize the feasibility of employing eco-printing methods on threads, keeping all the factors such as thread composition, dye uptake, and pattern creation, and analyzing whether it is compatible for commercial textile production.
- To explore the possibility of eco-printing to generate unique and aesthetically appealing patterns on threads, similar to traditional textile techniques that possess blurring effects.
- To investigate the influence of various mordants on the colorfastness and durability of eco-printed threads.
- To study the prospect of eco printing to produce modern and innovative textile products, such as fashion accessories, home decor items, or art pieces.

### IV. LITERATURE REVIEW

[1.] **“Yukta Dixit, *The Path to Sustainability: Anticipating the Acceptance of the Eco-Printing Method in the Upcoming Markets, 2023*”**: This research paper investigates the rising support for eco printing in the fashion and textile industry, underscoring its function in uplifting sustainability by all means of natural dyes and green practices. The principal findings point towards the consumers who are not only increasing in number but are conscious and are inclined towards eco-friendly products, with many willing to settle for a premium for eco-printed items as a result of the labor-intensive method and sustainable benefits. The study highlights the significance of well-introduced brands in propelling industry consents to eco-printing and nurturing sustainable trends.

[2.] **“Ms. Deepshikha Sahu, *Eco-Printing, 2022*”**: This research paper focuses on important aspects of eco-printing in the role of sustainable fashion and printing methods that apply natural plant dyes for eco-conscious fabric designs. Unlike synthetic dyes, which contend to balance fashion trends with sustainability and durability, eco-printing fosters a shift towards natural alternatives. The research highlights the colorfastness of natural dyes, assessed through standard testing. Additionally, it highlights eco-printing's potential to uplift skill development and “rural entrepreneurship,” adding on to sustainable growth. The document warns against “greenwashing” and stimulates companies to openly put forth their sustainability efforts across various environmental indicators. Overall, eco-printing is presented as a crucial practice for enhancing environmental sustainability in textile and print design.

[3.] **“K. SANGAMITHIRAI, *ECO-FRIENDLY PRINTING ON COTTON WITH NATURAL MORDANTS, 2019*”**: This article especially highlights the use of natural dyes, particularly marigold flowers, for printing on cotton fabric, underscoring the environmental advantages of natural over synthetic dyes. The study stressed the significant pollution caused by synthetic dyes, which account for 17%-20% of industrial water pollution and contain carcinogens. This has led to a renewed interest in natural dyes, which have been used historically in textile production. Marigold flowers (*Tagetes erecta* Linn.) were selected because of the ample supply and the capacity to yield vibrant colors. Natural mordants such as myrobalan and pomegranate rinds were utilized, along with alum, to enhance dye uptake and color fastness. The research involved preparing printing pastes using combinations of marigold dye, natural mordants, and gum arabic. The printed samples exhibited moderate to good fastness to various conditions, including sunlight, washing, and crocking (both wet and dry). The staining tests showed very good fastness across all samples and The unique shades produced by the natural dyes were noted to be aesthetically pleasing, providing a soothing effect compared to synthetic dyes. The study concluded that marigold flowers, along with natural mordants and thickeners, can be effectively used for large-scale printing on cotton fabric, promoting eco-friendly textile production. The findings suggest that the use of natural dyes and mordants not only supports environmental sustainability but also opens up new avenues for eco-textiles in the market, potentially enhancing export opportunities.

[4.] **“Dr. Rashmi Srivastava and Neetu Singh, *Importance of natural dye over synthetic dye: a critical review*”**: This article discusses the significant environmental and health concerns associated with synthetic dyes, which are responsible for a substantial portion of industrial water pollution and often contain carcinogenic substances. These dyes can accumulate in water bodies, leading to toxic effects on aquatic life and posing risks to human health. In contrast, natural dyes, derived from plants, insects, and minerals, are biodegradable, non-toxic, and often possess medicinal properties. The resurgence of eco-printing and natural dyeing practices is essential as they offer a sustainable alternative that minimizes environmental impact, supports biodiversity, and revives traditional craftsmanship. By

shifting towards natural dyes and eco-printing practices, the textile industry can reduce pollution, promote healthier ecosystems, and provide economic opportunities in rural areas, making eco-printing not just a trend but a necessary step towards a more sustainable future.

## V. RESEARCH METHODOLOGY

A practical and exploratory approach was undertaken to examine eco-printing techniques on an unexplored medium, i.e., on yarns. Through hands-on exploration, the study sought to understand the visual outcomes and assess the technique's potential for application in the fashion and textile industry. The primary goal was to evaluate the value and viability of eco-printing on cotton yarns as a contemporary design using the traditional application method.

## VI. THE PROCESS

The eco-printing process involved four fundamental steps: sourcing plant materials, fabric mordanting, hammering, and steaming.

- **Sourcing leaves:** Based on the inherent dye content and accessibility, wildflowers and hibiscus leaves of different sizes were chosen for the experiment.
- **Fabric mordanting:** The threads were pre-mordanted with two types of mordants, Harda (*chebulic myrobalan*) and alum.
- **Hammering:** The pressure applied during hammering helped extract and transfer natural pigments from the plant materials to the yarns.
- **Steaming:** The steaming process sets the natural pigments, preventing fading. The heat from the steam helps to bind the pigments to the fibers.

### Sample 1:



A 5-gram bundle of parallel yarns was prepared as a substrate for eco printing. The yarns were subsequently pre-mordanted with harda (*chebulic myrobalan*).

Calculations:

Weight of yarns= 5 grams

Harda= 10 gpl

Thus, Amount of water= weight of yarns  $\times$  30

= 5  $\times$  30

= 150 ml

Amount of Harda in gms = 10gpl

= 10/1000  $\times$  1500

= 15 g

After pre-mordanting, the yarns were wrapped around a wooden stick with an abundance of wildflowers. The bundle was then hammered to extract pigments and steamed for 30 minutes at 200 degrees Celsius on an induction stove.

Results: The interaction between the harda and the natural pigments from the leaves has resulted in a more complex and nuanced color palette, including the brown background. It has also resulted in the plant pigments that influenced the print's appearance, which have led to an overflow of pigment and a less controlled pattern.

**Sample 2:**



Following the same procedure as the first sample, a 6-gram bundle of parallel yarns was used as a substrate for eco-printing and pre-mordanted by using 2 types of mordants, i.e., harda (chebulic myrobalan) as well as alum.

Calculations:

Weight of yarns= 5 grams

Harda= 10 gpl

Alum= 20 gpl

Thus, Amount of water= weight of yarns  $\times$  30

= 5  $\times$  30

= 150 ml

Amount of Harda in gms = 10gpl

= 10/1000  $\times$  1500

= 15 g

Amount of Alum in gms = 20gpl

= 20/1000  $\times$  1500

= 30 g

Once the pre-mordanting stage was complete, varied sizes of hibiscus leaves were carefully positioned around the yarns and subjected to a hammering process to release their color. The yarn bundle was subsequently rolled onto a wooden stick using plastic as a support and then steamed for 30 minutes at 200 degrees Celsius on an induction stove.

Result: As demonstrated in Figure 1, the combination of harda and natural leaf pigments yielded a complex and nuanced color palette, including a brown background. In contrast, Figure 2, a sample of alum pre-mordanting, exhibits a more defined and crisp print, making it visually appealing and identical.

## VII. CONCLUSION

The eco-printing experiments on threads produced aesthetically pleasing results while potentially achieving the desired blurring effect. The usage of natural plant dyestuffs and the careful application of techniques resulted in unique and visually appealing, raw and nurtured patterns. These visually appealing and sustainable threads open a direction for creating uniquely abstract works of art. The research findings also demonstrate the potential of eco printing as a sustainable and creative textile dyeing method, offering a wide range of aesthetic possibilities.

Additional research is currently underway to investigate the impact of these eco-printed threads on the surface through sampling and weaving.

**7.1 Future Directions of Eco Printing on Threads:** One of the main challenges of eco printing is the limited durability and colorfastness of natural dyes. Future research could focus on developing new plant-based mordants, methods, and formulations that make eco-printed textiles more resistant to fading over time, exposure to sunlight, and repeated washing. This would make eco-printed fabrics more practical for both fashion and commercial use.

The push for zero waste in the fashion industry is likely to influence eco printing, leading to the development of techniques that maximize the use of every part of a textile. For example, using offcuts, scraps, and waste fibers for regeneration of fibers or threads and creating prints with natural dyes that can be recycled or composted at the end of their lives. This would tie into circular economy models where textiles are regenerated rather than discarded.

Eco printing could be integrated into textile recycling processes, where discarded fabrics can undergo advancements and turned into renewable fibers, giving them a second life. This could help reduce the demand for virgin materials and the environmental impact of textile waste. The use of biodegradable dyes and eco-friendly printing techniques could make the process of recycling fabrics more feasible and sustainable.

#### REFERENCES

1. Dixit, Y., (2023) *The path to sustainability: Anticipating the acceptance of the eco-printing method in the upcoming markets*. International Journal of Humanities & Social Science: Insights & Transformations- Vol. 8, Issue 1 – 2023, Eureka Journals.
2. Sahu, D., (2022) *Eco printing*. International Journal of Creative Research Thoughts, Volume 10.
3. Sangamithirai, K., (2019) *Eco- friendly printing on cotton with natural mordants*. J. Res. ANGRAU 47(2) 54-59.
4. Rashmi, S. and Neetu, S., (2019) *Importance of natural dye over synthetic dye: a critical review*. International Journal of Home Science 2019; 5(2): 148-150.
5. Boruah, S. and Kalita, B. (2016) *Utilization of natural printing paste for textile application*. Asian Journal of Home Science. 11 (1): 136-141.
6. Prabhu K.H and Bhute, A.S. (2012) *Plant- based natural dyes and mordants: A review*. Journal of Natural Product and Plant Resources. 2(16): 649-664.
7. Klaichoi, C., Mongkholrattanasit, R. and Sarikanon, C. (2012) *Eco-friendly printing of cotton fabric using natural dye from acacia catechu willd* , RMUTP International Conference: Textile & Fashion 2012, Corpus Id-55311327.



## International Journal of Advanced Research in Education and Technology

ISSN: 2394-2975

Impact Factor: 7.394