# Sustainable Design Translation of Plant Dyeing in Contemporary Fashion: A Practice-Based Study of the Traces of Dyeing Series

Jiahao Song, Junying Wang*

School of Fashion, Dalian Polytechnic University, Dalian 116034, China

*974292209@qq.com

**Abstract.** Plant dyeing has re-entered contemporary fashion as an ecological technique and craft-based visual language, yet its link with material selection, garment structure, and wearing context remains underexplored. Taking the *Traces of Dyeing* womenswear series as a practice-based case, this paper proposes a design translation framework connecting dyestuff, color hierarchy, resist-dyeing texture, garment zone, and final presentation. The process includes theme definition, image abstraction, color and material planning, dyeing experiment, and garment validation. The results show that plant-dyeing traces become more controllable when assigned to structural areas such as the shoulder, neckline, hem, overlay, and garment edge. This study offers a concise workflow for transforming traditional dyeing craft into a contemporary fashion design method with sustainability awareness, visual coherence, and practical applicability.

**Keywords:** plant dyeing; sustainable fashion; fashion design; craft translation; textile coloration

## 1 Introduction

The fashion industry is increasingly required to connect aesthetic innovation with environmental responsibility. Recent sustainable fashion research emphasizes design-led strategies that coordinate material choice, production methods, product use, and cultural value[1]. In this context, plant dyeing offers a relevant design resource because it links renewable colorants, manual processes, and visible material traces that cannot be fully reproduced by standard industrial printing.

For contemporary fashion design, the value of plant dyeing is not limited to ecological symbolism. Its uneven color layers, blurred boundaries, resist-dyeing marks, and time-related fading can also become garment language. Nevertheless, this value is often weakened when natural dyeing is used only as a cultural symbol, decorative pattern, or visual label of tradition. A common problem in design practice is that the dyed textile is completed first and the garment structure is considered later, resulting in weak correspondence among pattern position, silhouette, and wearing scenario.


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This paper therefore focuses on design translation rather than historical review alone. Recent research on natural dyes for textile applications shows that sustainable dyeing depends not only on dye sources, but also on extraction, substrate preparation, mordanting, dyeing procedure, fastness, and reproducibility[2]. Using the Traces of Dyeing series as a case study, this paper asks how plant-dyeing traces can be transformed into a controllable garment design process. The contribution is threefold: first, it compresses the cultural and technical discussion of plant dyeing into issues relevant to design practice; second, it proposes a five-stage workflow connecting dyeing tests with garment generation; third, it identifies control criteria for applying plant-dyeing textures to contemporary womenswear.

## 2 Research Methodology

This study adopts a practice-based design research approach, As shown in Table 1. In this research type, design practice is not only the object of description but also the means through which design knowledge is generated. The design process produces material evidence, such as samples, drawings, and garments, while the written analysis explains how these outputs answer the research question. Design practice research requires a clear research situation, a connection with existing scholarship, and communicable outcomes rather than the simple presentation of a personal design project.[3]

**Table 1.** Methodological framework and verification criteria.

| Research component | Operational definition | Evidence used in this study | Verification focus |
|---|---|---|---|
| Research type | Practice-based design research | Design process, samples, drawings, garments | Whether practice generates transferable design knowledge |
| Case selection | Complete womenswear series using plant-dyeing logic | Traces of Dyeing series | Whether the case includes theme, experiment, structure, and presentation |
| Process documentation | Sequential recording of design decisions | Boards, palettes, samples, technical drawings, photos | Whether design reasoning can be traced |
| Verification | Preliminary design evaluation | Visual, structural, and presentation criteria | Whether dyeing traces function as design elements |

The case selected for this paper is the Traces of Dyeing womenswear series. The case was chosen because it contains a complete and traceable process: inspiration collection, image abstraction, color planning, fabric selection, resist-dyeing experiments, garment-zone assignment, technical drawing, styling, and finished-garment photography. Such a process allows design action to function as an investigative method, which is consistent with research-through-design discussions that emphasize planned design activity, process documentation, and knowledge production through designing.[4]

The design process was documented through five types of evidence: inspiration boards, color palettes, textile samples, technical drawings, and final garment photographs. These materials were used to build a visual reasoning chain from image source to abstract element, from abstract element to dyeing experiment, and from dyeing experiment to garment structure. The outcome was verified through three criteria: visual coherence, structural correspondence, and presentation effect. Visual coherence examines whether the blue-white palette and dyeing textures form a unified series. Structural correspondence examines whether dyed textures are assigned to meaningful garment zones. Presentation effect examines whether the finished garments retain the material features of plant dyeing while remaining suitable for contemporary womenswear styling.

## 3 Visual Semantic Analysis and Element Extraction

To support the extraction of abstract elements, this study introduces visual semantic analysis. The selected images are analyzed from three dimensions: visual form, semantic meaning, and design translation. Visual form refers to observable features such as line direction, color transition, texture boundary, blank space, and spatial rhythm. Semantic meaning refers to the concepts suggested by these features, including flow, diffusion, trace, transparency, and layering. Design translation refers to transforming these meanings into color hierarchy, textile texture, garment structure, and styling method. A visualization-based design process is useful here because it helps convert abstract visual information into design elements that can be organized and evaluated.[5]

The inspiration sources and element transformation are shown in Table 2 and Figure 1. Water surfaces, moonlight, mountain shadows, and plant silhouettes were not copied as decorative motifs. They were abstracted into flowing lines, diffused boundaries, blue-white tonal transitions, and irregular edges. Flowing lines were translated into oblique cutting and layered garment structures. Diffused boundaries were translated into resist-dyeing and over-dyeing textures. Blue-white tonal transitions were translated into the main color hierarchy of the series. Irregular edges were assigned to the neckline, hem, overlay, and garment edge.

**Table 2.** Visual semantic analysis and design translation.

| Visual source | Semantic keyword | Abstract element | Textile translation | Garment translation |
|---|---|---|---|---|
| Water surface | Flow | Curved and oblique line | Soft dyeing trace | Oblique panel and skirt movement |
| Moonlight | Transparency | Light-dark transition | Pale blue and white layers | Sheer overlay and light fabric |
| Mountain shadow | Layering | Gradual depth | Tonal gradation | Layered silhouette |
| Plant silhouette | Trace | Irregular edge | Resist-dyeing boundary | Neckline, hem, and garment edge |


**Fig. 1.** Sources of Inspiration and Extraction of Design Elements.

## 4 Design Translation Process

The Traces of Dyeing series uses plant dyeing as a process system rather than a decorative technique. The color system is based on indigo blue, lake blue, pale blue, gray white, and undyed white. This restrained palette reduces visual disorder and allows small differences in dye concentration and fabric absorption to become visible. Cotton, linen, and light translucent fabrics were selected because their absorbency, drape, and layering potential can strengthen the relationship between dyeing trace and garment movement. Experimental studies on natural dye adsorption and mordanting also indicate that fiber surface, mordant type, and process conditions influence dye uptake and final color expression.[6]

The main experiments involved tie-dyeing, over-dyeing, resist-dyeing, and local diffusion. Natural dyeing often faces issues of reproducibility, colorfastness, and large-scale stability, so this practice did not attempt to use unlimited texture types. Instead, it limited the number of textures and assigned each type to a garment zone. Dense blue traces were placed on the shoulder, hem, and outer overlay, while pale diffusion was placed in the middle body and transitional areas. Reviews of eco-friendly dyes and bio-mordants show that technical improvement is necessary for wider textile application, but design-level control can first be achieved through sample selection, scale adjustment, and placement planning.[7]

Figure 2 shows the material and texture references used for color and fabric planning. The chromatic range of plant dyes is not only a technical issue but also a design resource. Studies on eucalyptus, weld, madder, annatto, indigo, and woad show that

natural dyes differ in hue, color strength, dyeing process, and fastness. In this series, blue-white transitions were chosen to reduce chromatic complexity and to make texture boundaries more legible.[8]

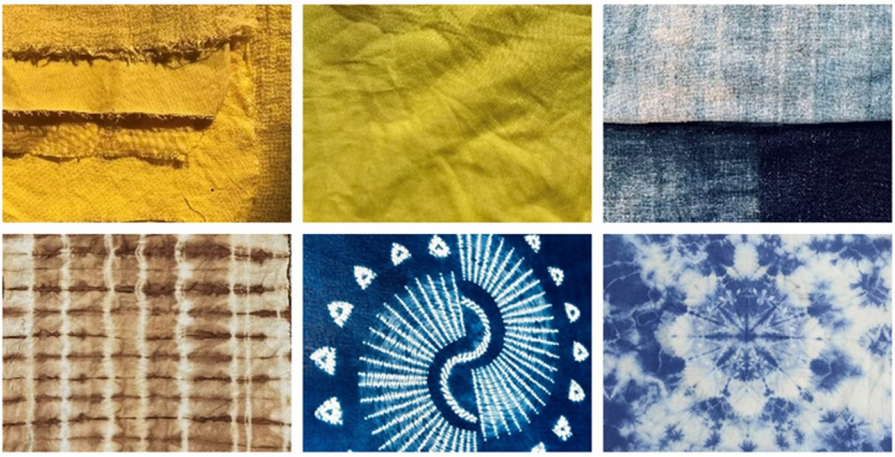

**Fig. 2.** Material and texture references used for color and fabric planning.

Garment generation was organized around three groups of looks. The first group uses diagonal blue-white traces and a long-skirt structure to suggest flowing direction. The second group uses a pale dress and local blue diffusion to create lightness and transparency. The third group combines scarf-like overlay, blue skirt, and white upper garment to create adjustable layering. Figure 3 presents the expected design renderings and the logic of the corresponding technical drawings. Recent industrial-scale studies of natural dyeing suggest that material application must consider repeatability and garment production conditions; therefore, this series treats dyed texture as a garment-zone decision rather than a free all-over surface.[9]


**Fig. 3.** Expected design renderings and technical drawings.

The finished garment effect is shown in Figure 4. The outcome was evaluated through preliminary design verification rather than laboratory testing. Visual coherence was confirmed by the repeated use of blue-white hierarchy, soft diffusion, and layered transparent fabric. Structural correspondence was confirmed by the placement of

dyeing traces on the shoulder, neckline, overlay, hem, and garment edge instead of random distribution across the surface. Presentation effect was confirmed through photography, which allowed the relationship among pattern position, drape, body movement, and styling scenario to be observed.

**Fig. 4.** Finished garment presentation used to verify pattern position, drape, and wearing scenario.

The verification indicates that plant dyeing can support sustainable fashion design when treated as a process system. Its uncertainty is valuable only when managed through design decisions, including palette limitation, texture reduction, and garment-zone assignment. The study also clarifies the boundary between cultural translation and surface appropriation. Historical references and traditional dyeing knowledge provide cultural depth, but the design argument depends on an operational model: dyestuff selection, color hierarchy, textile testing, structure matching, and presentation validation, The design verification is shown in Table 3

**Table 3.** Design verification items and supplementary validation plan.

| Verification item | Evaluation question | Current evidence | Further validation |
|---|---|---|---|
| Visual coherence | Is the series unified by color and texture? | Blue-white palette, repeated diffusion and layering | Expert scoring on series coherence |
| Structural correspondence | Are dyeing traces placed in garment zones? | Shoulder, neckline, overlay, hem, and edge planning | Expert interview on structural logic |
| Presentation effect | Does the garment work in a wearing scenario? | Final styling and photography | User testing on wearability and visual perception |
| Technical reliability | Can the process be stabilized? | Sample selection and reduced texture types | Future fastness and life-cycle tests |

## 5 Discussion

This case shows that plant dyeing should not be understood only as a traditional symbol. Its value lies in the way dyeing traces can generate color, texture, and structural decisions. Research on contemporary natural-dye practice also indicates that designers value ecological meaning, handwork, and cultural connection, while facing limitations in color stability and production control.[10]The present study discusses sustainability as a design strategy and material direction rather than as a quantified environmental claim. It evaluates design coherence, not laboratory fastness, toxicity, or life-cycle performance. Future research should include colorfastness testing, user evaluation, expert interviews, and life-cycle comparison between plant-dyed and industrially printed garments. These data would strengthen the empirical validity and technical credibility of this practice-based study.

## 6 Conclusion

This paper proposes a practice-based design translation framework for integrating plant dyeing into contemporary fashion design. By combining visual semantic analysis, process documentation, textile experimentation, garment-zone planning, and preliminary verification, the study demonstrates how plant-dyeing traces can move from craft resource to design method. The Traces of Dyeing series shows that effective transformation requires four linked operations: material experimentation, texture control, structural matching, and garment validation. Only when dyeing effects become part of style generation, rather than surface decoration added after garment completion, can traditional craft be transformed into contemporary fashion design language.

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