INTEGRATION OF TRADITION AND INNOVATION: EXPLORING THE ROLE OF FASHION EXHIBITIONS IN THE EVOLUTION OF PLANT DYEING FROM CULTURAL CRAFTSMANSHIP TO SUSTAINABLE MODERN DESIGN

By
Miss Ting LI

A Thesis Submitted in Partial Fulfillment of the Requirements
for Doctor of Philosophy Design
Silpakorn University
Academic Year 2023
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MissTing LI

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Title	Integration of tradition and innovation: Exploring the Role of Fashion Exhibitions in the Evolution of Plant Dyeing from Cultural Craftsmanship to Sustainable Modern Design
By	Miss Ting LI
Field of Study	Design
Advisor	Associate Professor Dr. Supavee Sirinkraporn

Faculty of Decorative Arts, Silpakorn University in Partial Fulfillment of the Requirements for the Doctor of Philosophy

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M i s s T i n g L I : Integration of tradition and innovation: Exploring the Role of Fashion Exhibitions in t he Evolution of Plant Dyeing from Cultural Craftsmanship to Sustainable Modern De sign Thesis advisor : Associate Professor Dr. Supavee Sirinkraporn

This thesis explores the evolution of plant dyeing techniques from traditional craftsmanship to sustainable modern design, focusing on the role of fashion exhibitions in this process. Through an in-depth analysis of the historical origins, cultural value, and environmental potential of plant dyeing techniques, this study emphasizes how the integration of tradition and innovation can drive the application and development of plant dyeing in the modern fashion industry.

The research employs a mixed-method approach, including experimental workshops, design scheme formulation, and fashion exhibitions, to validate the feasibility and market acceptance of plant dyeing techniques in modern design. The workshops demonstrate the diverse applications of plant dyeing techniques and highlight the necessity of technological inheritance and innovation. Through hands-on operations, participants significantly enhanced their understanding and skills in plant dyeing, gaining a deeper appreciation of its environmental advantages and cultural significance.

The paper further explores how the integration of design and sustainability can stimulate market demand for plant-dyed products and analyzes the importance of education and public participation in promoting traditional crafts and environmental awareness. Utilizing fashion exhibitions as a powerful visual and educational tool, the study successfully raised public awareness and acceptance of plant dyeing techniques, showcasing their potential applications in modern design.

Centered around research objectives such as Traditional Context, Cultural Craftsmanship, and Principle of Design, the study validates the effectiveness of a sustainable innovative design model. This model not only promotes the dissemination of environmental and cultural values but also demonstrates the commercial potential and economic benefits of plant dyeing techniques in modern fashion. By integrating plant dyeing techniques with modern design, the research reveals the sustainability and practicality of plant dyeing and emphasizes the importance of promoting eco-friendly fashion globally, offering new directions and insights for future research and practice.

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This dissertation marks not just the culmination of my academic work but also a journey filled with growth and learning, made all the more memorable and meaningful by each of you. Thank you from the bottom of my heart.

Ting LI

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INTRODUCTION

1.1 RESEARCH BACKGROUND AND SIGNIFICANCE

With a sharp rise in the global environmental consciousness and the fashion industry marching towards sustainability, fashion exhibitions are helping to circulate the traditional clothing culture. Fashion exhibitions provide a new way to increase audience appeal by introducing innovative designs and the experience of traditional plant dyeing processes, which contributes to the promotion of plant-based dyeing in cultural education. Hence, this research phase is to investigate the possibility of plant dyeing technology to adapt designing for contemporary fashion and inheritance education, to offer practical suggestions and assist to the development in plant dyeing.

1.1.1 REAEARCH BACKGROUND

1.1.1.1 Demand for the Protection of Intangible Cultural Heritage

William Henry Pelkin invented chemical dyes (Ruden et al., 2019); before that, plant dyeing as a traditional hand-dyed technique has been used for thousands of years across the world. In 2006, Bai tie-dye was included in the national intangible cultural heritage protection list by the Ministry of Culture. At the same time, the "Cultural Self-Confidence of the Chinese People" has just taken shape, and China urgently needs to protect and inherit its intangible cultural heritage (Xin, 2011). Truly, as a national intangible cultural heritage, the fate of plant dyeing seems dismal due to lost skills, no successors, and weak awareness of inheritance. As a result, it is all the more important to rediscover and save traditional plant dyeing techniques. Finally, the inheritance and development of traditional plant dyeing above all has the necessity of material cultural protection, but there is also the important role of spiritual cultural inheritance.

1.1.1.2 The Necessity of Promoting and Constructing Traditional Culture

Since ancient times, China has a long-standing history in the practice of plant dyeing and is referred to as the cradle of dyeing techniques. As the tide of industrialization prevailed, low-cost chemical dyes with color permanence took over

the market, causing the traditional craft of plant dyeing to gradually fade from people's vision, and the technology gradually came to a halt. With the rapid development of science and technology in recent years, the environmental situation is constantly deteriorating, which has led to a deep reflection on the current environmental situation in the design community. This is the background of the birth of ecological design. With the enhancement of promoting the spirit of craftsmanship and advocating natural ecology concepts, plant dyeing has re-entered people's vision with environmentally friendly, healthier characteristics. Over the past few years, the world of fashion has seen a resurgence of plant dyeing. Many young designers and craftsmen have begun to explore plant dyeing from the perspective of modern society and have breathed new life into this age-old skill.

1.1.1.3 The Consumer Demand for Sustainable Products

From multiple sources, consumer demand for sustainable products is influenced by various factors. For example, Meise found that consumers are willing to pay more for products with clear sustainability-related information (2014), while Sánchez-Bravo pointed out that consumers need a better understanding of sustainability (2021). Gassler emphasized the importance of health and quality of life in consumers' expectations of sustainability (2016), while Trijp highlighted the role of social marketing in mobilizing consumer demand for sustainable products(2010). Overall, clear information, sustainability education, and a focus on health and quality of life can drive consumer demand for sustainable products.

As people's consumption levels and aesthetic standards continue to improve, green, environmentally friendly, and healthy natural plant dyeing has become the personalized appeal of many consumers (Cannon & Cannon, 1994) . However, the homogeneity of plant-dyed products and the lack of design aesthetics are causing a decline in consumer demand for traditional tie-dye products. Contemporary craftsmen focus on skill exploration but lack contemporary design concepts. They do not understand how to transform their skills into products, or the products they make do not meet the emotional needs of current society. As a result, excellent traditional handicrafts may stagnate or even gradually disappear. The discussion on the construction and application of the sensory value of plant dyeing combines the complementary advantages of traditional craftsmen who lack modern design concepts and contemporary designers who lack an understanding of craft materials. This

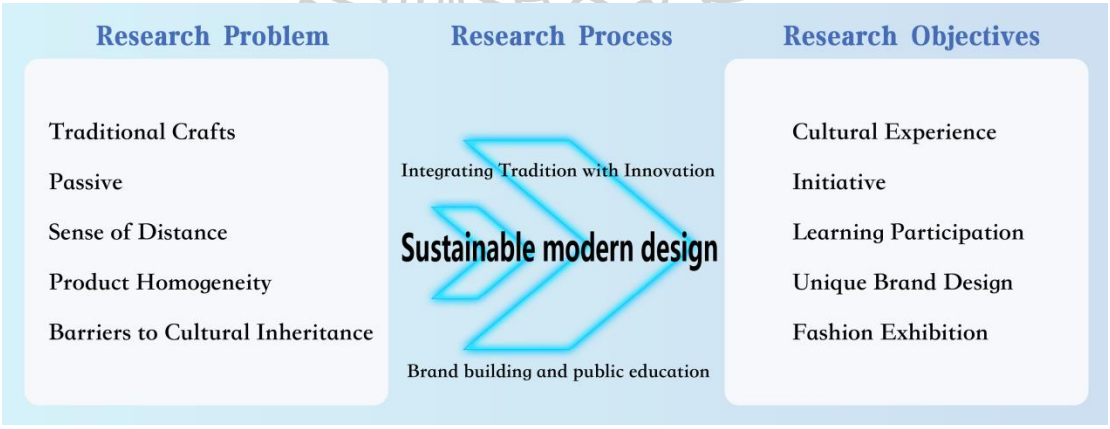
enables the transformation of traditional handicrafts into modern products and truly revitalizes traditional craftsmanship (Peijun & Wei, 2022).

1.1.1.4 The Importance of Sustainable Fashion Exhibitions

Santos (Santos & Carvalho, 2022) and Lai (2021) both highlight the potential of natural dyes, particularly those derived from plants, in addressing the environmental and health issues associated with traditional synthetic dyes. They emphasize the benefits of natural dyes, such as their biodegradability and potential health properties. Lai (2021) further explores the visual aspect of sustainable design, finding that light-colored indigo dyeing is more resource-saving and environmentally friendly. These studies collectively underscore the potential of sustainable modern design and fashion exhibitions in promoting the use of plant dyeing, which can enhance consumers' cultural experience and understanding of this eco-friendly practice.

Overall, by prioritizing consumer experience and fashion exhibitions to drive design innovation, plant dyeing techniques can offer active, participatory cultural experiences (Radice, 2014), as well as unique brand designs and fashion exhibitions, to achieve the integration of tradition and innovation.(Figure 1)

Figure 1 Design improvement integrating tradition and innovation



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1.1.2 RESEARCH SIGNIFICANCE

In recent years, with the rapid advancement of technology, environmental problems have become increasingly severe, prompting the design community to deeply reflect on the current environmental situation. Ecological design was born

under this background, and the fashion industry is also attempting to inject new creativity and vitality into this ancient craft with modern perspectives and practices. From the following four aspects, it is significant to use fashion exhibition art and sustainable design to enhance audience awareness of traditional plant dyeing.

1.1.2.1 Enhancing Understanding of Cultural Heritage and Innovation

By respecting traditional techniques while exploring innovative methods to adapt ancient crafts to modern society, cultural heritage can be protected and revitalized. This approach not only enhances public recognition and appreciation of traditional plant dyeing but also explores the possibilities and methods of combining it with modern design concepts. It provides new perspectives and strategies for cultural heritage protection and innovation, promoting economic, technological, and social development, and rescuing endangered intangible cultural heritage skills.

1.1.2.2 Promoting Sustainable Fashion Development

Plant dyeing emphasizes the use of renewable plant resources and explores how education and dissemination can enhance public awareness of sustainable fashion, thus promoting the practice of environmental protection concepts. Diverse fashion exhibitions showcasing the aesthetic value and environmental benefits of plant dyeing can encourage consumers to pay more attention to and support fashion products using eco-friendly materials and processes. Through interactive content and virtual experiences, public understanding of plant dyeing techniques and the value of sustainable fashion can be enhanced, fostering more conscious consumer behavior.

1.1.2.3 Achieving Integration of Traditional Plant Dyeing and Innovative Design

Re-examining past research and color use in plant dyeing, extracting aesthetic ideas for modern clothing design inspiration, and proposing Sustainable Innovative Design Model strategies can provide guidance for designers and brands. This helps uncover aesthetic ideas that can lead modern artistic thinking, playing a significant role in introducing designs with contemporary characteristics and national colors to the world.

1.1.2.4 Building and Promoting Plant Dyeing Brands

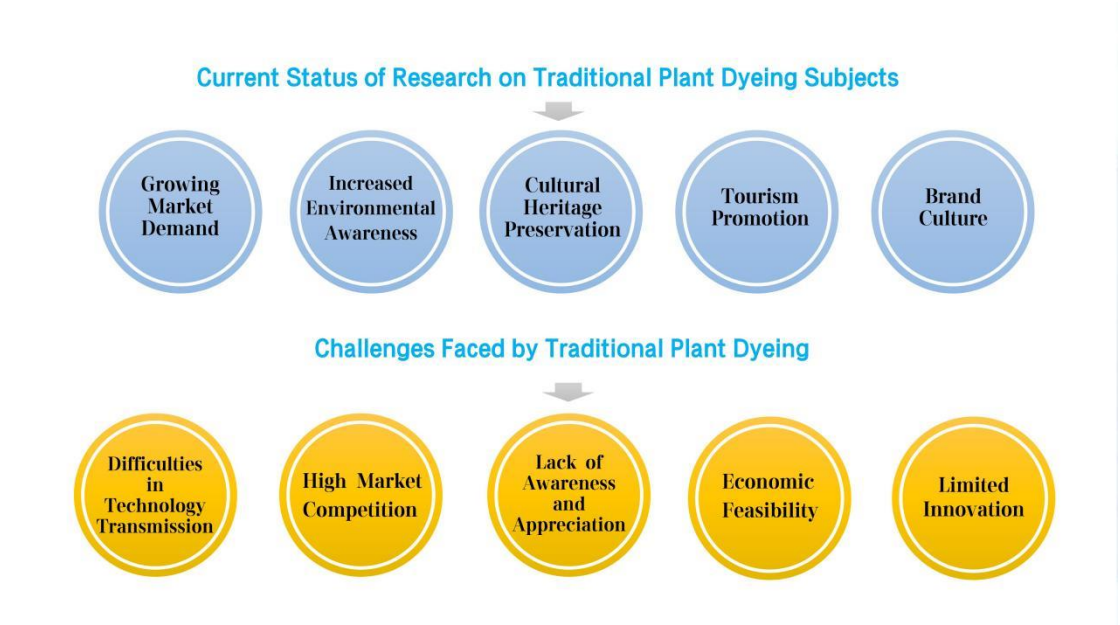
With the increasing awareness of environmental protection and health, the negative effects of some synthetic dyes on human health and the ecological environment have received more attention (Henninger et al., 2016). Recent research

shows that over a hundred commonly used dyes worldwide contain carcinogenic substances (Xin et al., 2013). Plant dyes, however, have health benefits such as antibacterial, anti-inflammatory, mosquito repellent, and breathable properties. Effective brand storytelling, digital marketing strategies, and consumer education can significantly enhance the market influence and brand value of plant dyeing products. These strategies not only provide a development blueprint for plant dyeing brands but also contribute important academic and practical value to the fields of sustainable fashion and cultural innovation.

1.2 RESEARCH OBJECTIVES

The main purpose of this study is to investigate how sustainable plant dye fashion design could boost audience cultural awareness; utilize the integration of tradition and innovation to mitigate the current growth difficulties for plant dye brands in the Chinese market (Figure 2). Sustainable innovative design from plant dye fashion design aims at combining the current traditional background in China and the cultural craft of China with the informed design principle with consumers' expectations for tradition inheritance, personal expressions, and environmental and sustainable development. This study provides an opportunity to explore a new sustainable innovative design model for Chinese cultural plant dye. This study, through a comprehensive review of literature on the subject, seeks to fill the gap in the existing body of research and explore the global trends, challenges, and opportunities of plant dyeing in modern applications to make a global effort to help achieve sustainable fashion and traditional craftsmanship in modern design.

Figure 2 Research pain points to be addressed



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1.2.1 SUSTAINABLE PLANT DYES INITIATIVE

By summarizing cultural elements and analyzing the most basic principles, approach, and background of traditional plant dye technology, recognizing the challenges and opportunities in modern applications, studying how to improve the application value and cultural inclusiveness of plant dye as sustainable fashion, and promoting sustainable plant dye practice in the field of fashion and education.

1.2.2 INTEGRATING PLANT DYEING TECHNIQUES INTO CONTEMPORARY FASHION DESIGN

Exploring integration opportunities for traditional plant dye techniques and modern design, and assessing market and sociocultural acceptance and impact. The method to integrate traditional plant dye techniques with modern design concepts can be further promoted through design practice and educational projects, resulting in design works that have both cultural depth and modern aesthetic and functional value.

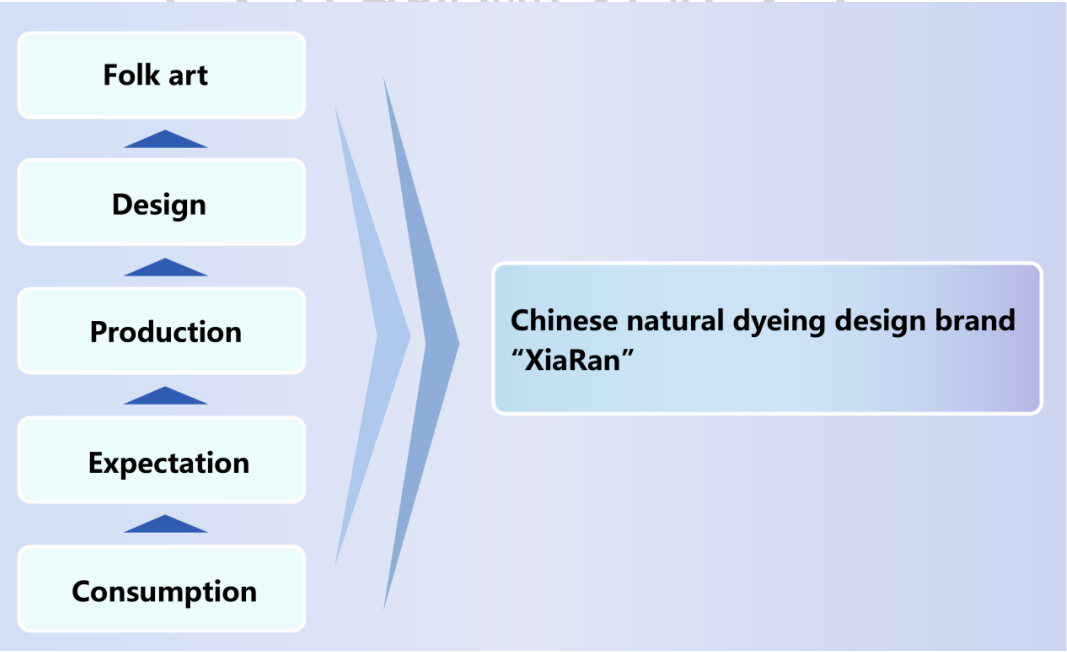
1.2.3 FASHION EXHIBITIONS AND CULTURAL HERITAGE EDUCATION

Offering an in-depth look at how fashion exhibitions educate the public in new ways that enhance ethical fashion culture. They integrate traditional craft and modern design, sparking public interest in ethical fashion as an educational effort. With cultural inclusiveness as a method and fashion exhibitions as a medium, plant dye technology serves as a bridge between old craft and new design, impacting public stakeholders.

1.2.4 DISCUSSION ON THE MARKETING STRATEGY OF THE SUSTAINABLE FASHION BRAND

Consumption stimulates demand, demand drives production, and design promotes decent folk artwork. A comprehensive analysis of the design results is necessary to develop a complete brand design plan and construction strategy, creating a plant dye design brand unique to China. This provides theoretical and practical references for China's plant dye design and branding, increasing the market value of plant dye. (Figure 3).

Figure 3 Plant dye brand building model



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1.3 RESEARCH QUESTIONS

1.3.1 TRADITION AND INNOVATION OF PLANT DYE

What role does plant dyeing technology play in traditional culture? How is its history and development?

What are the innovative applications of plant dyeing technology in modern design? How were those innovations achieved?

1.3.2 THE FUNCTION AND INFLUENCE OF FASHION EXHIBITION

How does the fashion exhibition platform manifest the innovation and artistry of plant dyeing technology?

What is the influence of fashion exhibitions on the spread and public understanding of plant dyeing culture?

1.3.3 INTEGRATION OF TRADITIONAL AND MODERN DESIGN

What are the challenges and restrictions faced by the integration of traditional plant dyeing techniques and modern design concepts?

How can the integration of traditional plant dyeing craftsmanship and modern design concepts be promoted through design practice and education projects?

1.3.4 BRANDING STRATEGY OF PLANT DYE

What unique brand images should the plant dye brand build through market segmentation, brand story, and consumer education?

What is the role of digital marketing and social media in promoting plant dye products and expanding market influence?

1.3.5 SUSTAINABILITY AND MARKET DEMAND

How does plant dyeing technology meet the demand of the current and future market as advancements in sustainable fashion are made?

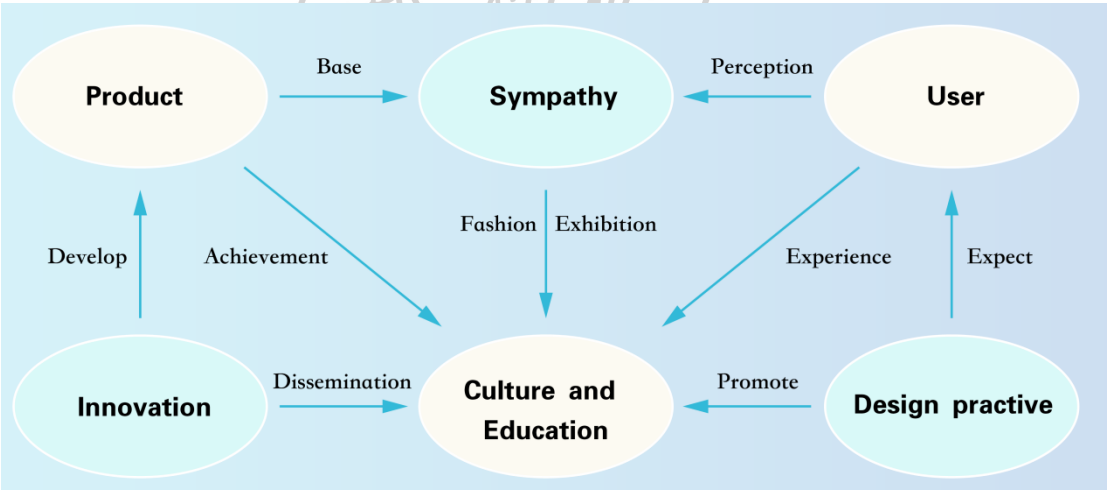
What do consumers expect and prefer in fashion products created with plant dyeing?

1.4 IMPORTANCE OF THE RESEARCH

The research will focus on three aspects: innovation, cultural education, and design practice (Figure 4).

It explores how traditional plant dyeing techniques can meet the expectations of the modern fashion industry, especially in sustainable and eco-friendly fashion product innovation. It investigates how fashion exhibitions can serve as educational and cultural dissemination platforms to increase public awareness and empathy for plant dyeing and culture. Ultimately, it brings new perspectives and patterns to the field of sustainable fashion and fashion exhibitions through innovation and design, enhancing product development and user expectations over time, and promoting the cultural dissemination and education of traditional plant dyeing.

Figure 4 Conceptual model for improving traditional plant dyeing culture and education



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1.5 RESEARCH SCOPE

This research focuses on Chinese traditional plant dyeing, investigating how innovative designs can enhance the integration of traditional culture with modern culture for consumers, the younger generation, and through fashion exhibition exposure. To achieve this, the scope of the research is divided into the following four areas: content, population, area, and design.

1.5.1 CONTENT SCOPE

The content scope includes plant dyeing technologies, the development and inheritance of plant dye culture, the role of fashion exhibitions, the integration of traditional and modern elements, and modern sustainable plant dye brands:

1. Review academic literature on the current status of plant dye development.

2. Conduct a comprehensive study and summary of the history, regional characteristics, cultural connotations, and significance of traditional Chinese plant dye crafts, including the origins, development, and evolution of plant dyeing techniques.

3. Perform dyeing tests on multiple plant materials using different media, presenting results on cotton, linen, silk, and wool to create a plant dye system color card.

4. Investigate the role and significance of plant dyeing techniques in China, including their application and development in the clothing market.

5. Compare and analyze the similarities and differences between plant dyeing brands and other Chinese plant dye brands.

6. Analyze the challenges and opportunities in promoting and developing plant dyeing brands.

7. Explore sustainable design methods for plant-dyed clothing, including market, exhibition, and contemporary art design applications.

8. Study contemporary consumer interest, attitudes, and expectations regarding plant dyeing.

9. Conduct an analysis of consumer expectations for Chinese natural dyes based on the Kano Model to define the positioning and culture of the XiaRan plant dye brand, and establish a brand image design model, excluding brand marketing and commercial operations.

10.Develop a Sustainable Innovative Design Model to study how fashion exhibitions can facilitate cultural exchange and design integration between fabric dyeing technology and modern design theory, and analyze the exhibition's impact on traditional craft researchers, new generations, designers, brands, and consumers.

This research aims to provide new insights and strategies for sustainable fashion development, cultural heritage protection, and innovative design practices, promoting traditional culture towards sustainable fashion industry and cultural diversity.

1.5.2 POPULATION SCOPE

The target group includes multiple key roles in the fashion supply chain:

1. In the early stage of the research, a Chinese Natural Dyes Based on the Kano Model survey was conducted, and the following groups were selected for interviews and questionnaire distribution: designers, manufacturers, consumers, and research experts. Through the analysis of the needs, expectations, and contributions of these different groups , put forward targeted strategies and suggestions.

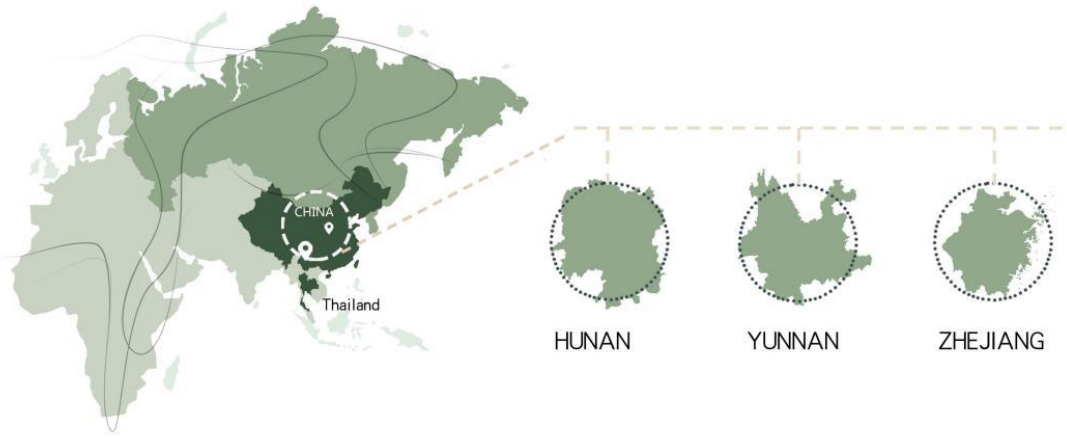
2. During the presentation of the Sustainable Innovative Design Model, XiaRan fashion exhibition visitors and experts will be invited to provide feedback, and data collection and analysis will be conducted.

3. Age of brank target Group: 25-45 years old.

1.5.3 AREA SCOPE

The location scope focuses on China, particularly Yunnan, Hunan, and Zhejiang provinces. Additionally, it includes a comparative study of plant dyeing practices in Thailand from a global perspective, exploring the innovative transformation of traditional techniques in a globalized context (Figure 5).

Figure 5 Study area scope



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1.5.4 DESIGN SCOPE

1. Analysis of user expectations for the plant dye brand using the Kano model: analyze user expectations and study how to better meet the audience's expectations.

2. Apply new knowledge to clarify XiaRan brand image design and launch a series of innovative plant dyeing product designs.

3. Increase public awareness and participation in plant dyeing technology through innovative designs that incorporate storytelling, step visualization, and creative fashion elements.

4.. Conduct cultural seminars, cultural exhibitions and digital fashion exhibition experiments to enhance the audience’s fashion exhibition experience.

5. Display the Sustainable Innovative Design Model, completing the extraction, integration, innovation, and evaluation of plant dyeing technology in four steps, and showcasing the impact of modern and innovative design on traditional plant dyeing techniques.

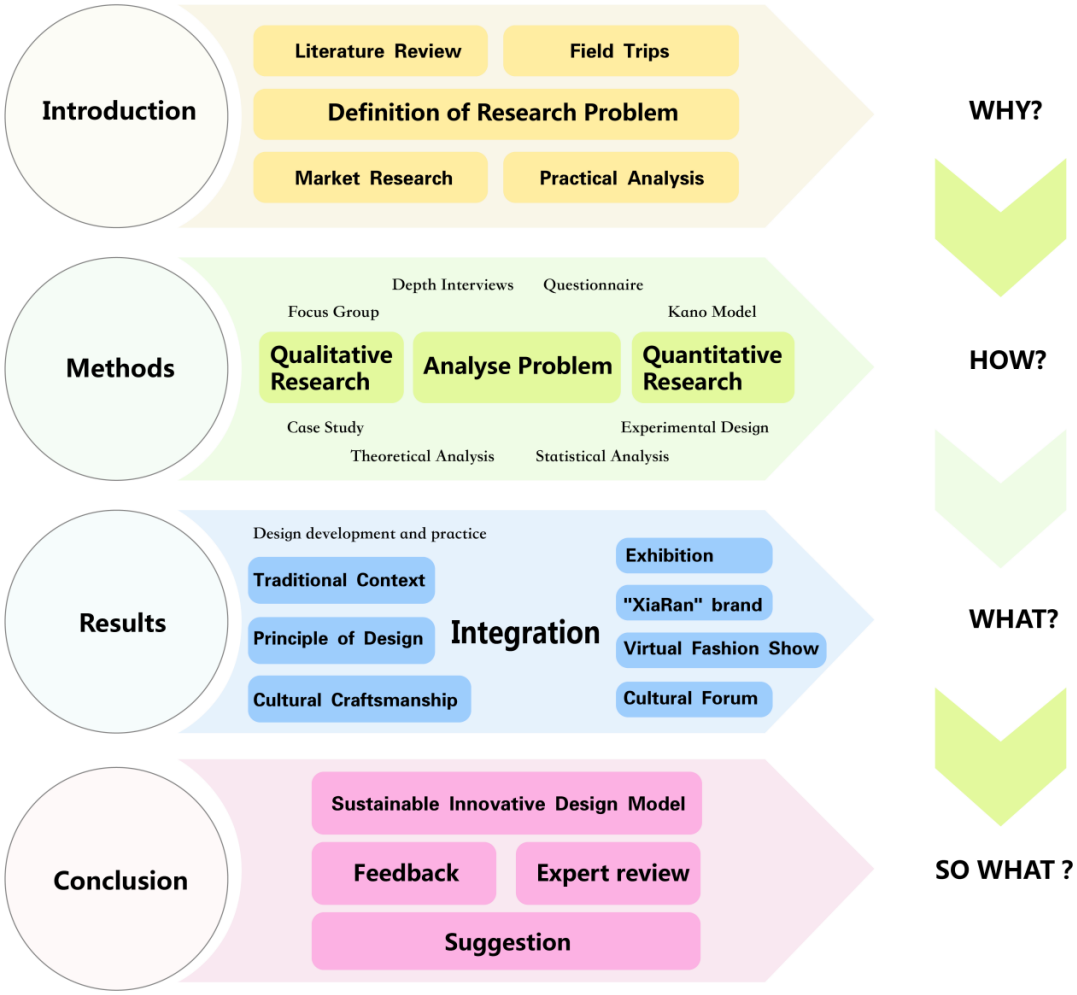
1.6 RESEARCH FRAMEWORK

In an ever-evolving market, consumer demands for brand design, style, craftsmanship, and cultural connotations are constantly changing. Therefore, this study examines the role of fashion exhibitions in the evolution of plant dyeing from cultural craft to sustainable design. Researchers analyze the history and development of traditional plant dyeing, commonly used dyes, and techniques. Through investigating the impact factors of traditional craft and modern aesthetics, consumer expectations, and product design, a method of integrating traditional culture with modern innovation is proposed. This method transitions traditional plant dyeing from "abstract culture" to "concrete heritage," and from "passive learning" to "active dissemination." This approach is crucial for the development of traditional culture and brand strategic planning (Figure 6).

Given the current state of traditional plant dyeing and the opportunities provided by fashion exhibitions, researchers employ quantitative and qualitative analysis methods to explore the integration methods and processes of tradition and modernity. Using expert interviews and visitor surveys as research tools, the validity and reliability of the research findings are verified. The study summarizes and develops

the creative principles, methods, and means involved in a sustainable innovative design model for traditional plant dyeing.

Figure 6 Research framework



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1.7 RESEARCH METHODS AND RESEARCH PROCESS

This research adopts a mixed-method approach, combining field investigations and literature collection as the foundation for design practice. Through literature reviews, data collection, and plant dye art creation, branding, and exhibitions, it aims to enhance cultural communication with the audience.

1.7.1 PROBLEM DEFINITION

Traditional static cultural exhibitions often struggle to captivate and maintain audience engagement and effective cultural dissemination. Additionally, the market is saturated with homogenized plant dye products that no longer meet the aesthetic expectations and desires of customers. Consequently, researchers propose utilizing fashion exhibitions to facilitate the evolution of plant dyeing from a cultural craft to sustainable modern design, thereby fulfilling customer expectations and achieving innovation and cultural promotion in plant dye design.

1.7.2 DEFINING OBJECTIVES

Clearly define research objectives, deeply understand traditional plant dye culture and techniques, identify its development and inheritance issues, propose ideas for integrating tradition and modernity, and formulate specific research plans and methods.

1.7.3 LITERATURE REVIEW AND FIELD INVESTIGATION

1. Literature review: Collect and analyze literature related to plant dyeing, fashion exhibitions, sustainable design, and modern clothing design.

2. Field investigation: Conduct field investigations in Yunnan and Hunan provinces, which are representative of plant dyeing technology, and record and analyze the technology, techniques, and dyes.

3. In-depth interviews: Conduct in-depth interviews with local craftsmen, residents, cultural scholars, and designers in plant-dyed areas, and obtain first-hand information on plant-dyed dyeing through on-site observation and collection of interview information.

1.7.4 DATA COLLECTION AND ANALYSIS

1. Conduct questionnaire surveys on design expectations for plant dye brands and analyze brand expectations using the Kano model to clarify brand positioning.

2. Observe the development status of plant dyeing and collect necessary information.

3. Conduct questionnaire surveys on the opinions, feelings and feedback of designers, manufacturers, consumers, research experts and others on plant dyeing culture.

4. Through theoretical research and field investigation, the methods and theories on the integration of traditional and modern plant dyeing are summarized.

5. Study audience needs and propose design solutions based on the differences among various groups.

6. Analyze data and validate design solutions using audience and expert feedback, summarizing the Sustainable Innovative Design Model.

1.7.5 COGNITION, EXPERIENCE, EDUCATION AND DISSEMINATION OF TRADITIONAL PLANT DYEING CULTURE

1. Cultural static exhibition: By displaying physical exhibits, artworks, plant dyeing color cards, texts, etc., it emphasizes the interaction between physical space and real exhibits, and popularizes the culture and craftsmanship of traditional plant dyeing through observation, reading, touching, and experience.

2. Virtual dynamic exhibition: Because static exhibitions are limited by physical space, virtual technology is integrated and used to build an Internet platform to enhance the interactivity and experience of the exhibition.

3. Plant dyeing experience workshop: allow the audience to participate in and experience the process and steps of the plant dyeing process, while collecting their feelings and feedback.

4. Plant Dyeing Culture Forum and Interpretation Session: Help the public gain a deeper understanding of Chinese traditional plant dye culture through lectures and interactive sessions.

1.7.6 TRADITION AND INNOVATION

1. Concept Analysis: Construct the framework for design models and fashion exhibition modes.

2. Design strategy research and development: Based on an in-depth understanding of traditional plant dyeing culture, formulate design strategies such as style, design, performance, preference, and culture.

3. Design prototype production and testing: Based on the above strategies, create a modern plant dye brand design prototype, evaluate the prototype among the target user groups, and collect feedback.

1.7.7 MARKET AWARENESS AND CULTURAL INHERITANCE

1. Market analysis: Analyze the customer expectations of the modern plant dye design market, understand its trends and potential opportunities, and conduct an expectation analysis of the Kano model.

2. Cultural inheritance and awareness promotion: Promote the fusion design of tradition and innovation of plant dyeing through exhibitions, workshops, online platforms, social media and other methods, and disseminate its cultural value and importance to the public.

1.7.8 EVALUATION AND FEEDBACK

1. Validity and reliability evaluation: Evaluate whether the research results meet the needs of the audience and whether they are effective and reliable in promoting the development of modern plant dye brands, protecting cultural heritage, and promoting the design and development of traditional plant dyes.

2. Feedback and optimization: Collect feedback from designers, manufacturers, consumers, research experts, exhibition participants, and volunteers through surveys, interviews, observation, and prototype analysis, summarizing and refining information to continuously optimize research methods and results.

3. Summarize the research process, findings, and new knowledge to structure the thesis.

This research overview provides researchers with a complete process from problem definition, analysis, preliminary design, implementation, feedback and evaluation, ensuring that the research can be effectively implemented and conducted, and providing valuable empirical research for the design integration of traditional plant dyes.

1.8 RESEARCH RESULTS

This study proposes the Sustainable Innovative Design Model to explore the potential of traditional plant dyeing technology in modern fashion design. Addressing the development and inheritance issues of plant dyeing, the model creates a cultural experience for the audience through visual cultural dissemination, fashion design, and sustainable fashion exhibitions (both online and offline). Additionally, it incorporates workshops, cultural talks, and plant dye branding. The proposed design model

prioritizes cultural experience, exhibition effects, and audience expectations. By integrating tradition and innovation, it emphasizes the transmission and recreation of cultural significance, providing new perspectives and solutions for sustainable fashion. Specifically:

1. Plant Dye Culture Research Report: A detailed Chinese plant dye culture research report for the academic community.

2. Innovation and Design Strategy for Integration of Tradition and Modernity: A reference for designers and brands to push traditional plant dyeing towards a more personalized and diverse future.

3. Client Expectation Analysis for Chinese Plant Dye Brands Using the Kano Model: Provides brand researchers with brand positioning and marketing strategy references.

4. Contemporary Plant Dye Culture Cognition Report: Offers data support for cultural inheritance and promotion through surveys and data analysis.

5. Suggestions for Inheriting and Developing Traditional Plant Dye Culture: Provides decision-making references for cultural institutions, local governments, and enterprises.

6. Strategy for Traditional Plant Dye Market Economic Development: Supports tourism and cultural industries related to plant dye sites, offering strategic advice for market economic development.

7. Sustainable Innovative Design Model: Serves as a reference for other cultural and design fields.

8. Enhancing Public Understanding and Resonance of Traditional Plant Dye Culture: Attracts attention to traditional culture, promotes cultural exchange and respect, and stimulates industrial development.

Overall, the theoretical framework and design model proposed in this study aim to provide valuable theoretical and practical contributions to traditional plant dyeing in market development, cultural inheritance, contemporary design applications, and local economic development, bringing tradition and modernity closer. , the emotional connection and design resonance between craftsmanship and culture, brand and consumers. Therefore, this study holds significant academic and practical value.

1.9 DEFINITION OF TERMS

1.9.1 INTEGRATION OF TRADITION AND INNOVATION

Integrating tradition and innovation means introducing modern design concepts and technological innovation on the basis of respecting and protecting traditional cultural craftsmanship, thereby achieving an organic combination of the two. This process involves not only the material preservation of traditional skills, but also the inheritance and re-creation of their spiritual and cultural values.

1.9.2 FASHION EXHIBITION

A platform specifically designed to showcase fashion creativity and craftsmanship, also serving as an important venue for dissemination, promotion, education, and learning through various multidimensional display methods such as exhibitions, interactions, experiences, and immersive displays.

1.9.3 PLANT DYEING

An ancient dyeing technique that uses natural materials from the roots, leaves, flowers, or fruits of plants. It is a sustainable and environmentally friendly dyeing method that carries rich cultural and historical value.

1.9.4 CULTURAL CRAFTSMANSHIP

Cultural craftsmanship refers to those traditional handcraft arts and techniques that possess unique cultural characteristics and historical significance. They not only embody the skills and creativity of specific social and cultural groups but also represent the cultural identity and heritage of those groups.

1.9.5 SUSTAINABLE MODERN DESIGN

Sustainable modern design is a design concept and practice method that emphasizes comprehensive consideration of environmental protection, social responsibility and economic benefits in the design process, and promotes social development and economic sustainability by reducing negative impacts on the environment.

1.10 CHAPTER SUMMARY

This research aims to explore how innovative design can enhance the value and potential of traditional plant dyeing techniques in modern society, addressing issues of inheritance, dissemination, and development. Specifically, this chapter sets the foundational framework for the research, detailing the background, significance, goals, problems, scope, framework, methods, process, results, and related term definitions. It comprehensively summarizes how plant dyeing techniques, as cultural heritage, apply new knowledge and proposes the Sustainable Innovative Design Model to promote cultural transmission, innovation, and sustainable fashion development. The Sustainable Innovative Design Model verifies the relevance of traditional tie-dye creation principles, explores diverse paths and practices for integrating cultural craftsmanship with modern design concepts, and provides theoretical bases for creations in art design and fashion exhibitions. This enhances the audience's experience, perception, interest, and respect for traditional culture.

In summary, the research framework and design model proposed in this study provide valuable academic contributions and practical value for cultural heritage and sustainable fashion industries. Revealing the key role of fashion exhibitions in promoting cultural exchange, innovation and sustainable design.

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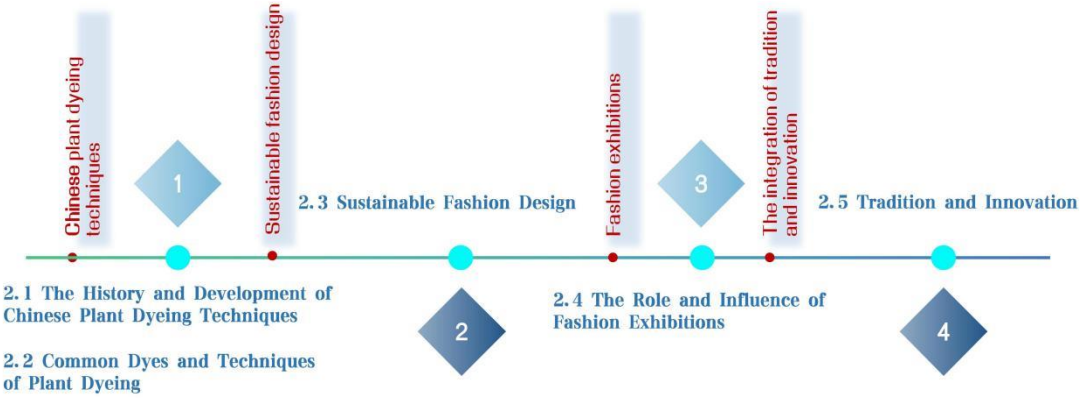
CHAPTER 2

LITERATURE REVIEW

In contemporary society, the craft of plant dyeing faces the crisis of being lost, and how to inherit traditional Chinese handicrafts has become a societal issue. This study aims to explore the current situation of cultural value transformation of plant dyeing in the modern era, and to investigate design strategies and methods for integrating tradition with innovation in plant dyeing to promote the inheritance of intangible cultural heritage and the innovation of sustainable fashion products. This research will provide a theoretical and empirical foundation through the review, organization, and analysis of relevant studies. The literature review will focus on four main areas (Figure 7).

Figure 7 Literature Review Framework



Note. Illustrated by the researcher.

2.1 THE HISTORY AND DEVELOPMENT OF CHINESE PLANT DYEING TECHNIQUES

2.1.1 THE EMERGENCE OF PLANT DYEING

According to existing data, stone dyeing is likely the earliest form of coloring. These pigments are easy to obtain and can be used directly without complex

processing, such as hematite and cinnabar. Examples of natural dye usage date back to the Old Stone Age in China. It has been discovered that the Peking Man living in Zhoukoudian's cave dwellings began using dyes extracted from the roots, stems, leaves, and slices of plants to color stone beads as early as that time. At the Yangshao culture site in Huaxian, Shaanxi, remnants of reddish-brown linen from the Neolithic period were found, indicating the capability of artificial dyeing at that time.

Regarding how our ancestors discovered that plant pigments could be used as coloring materials, Mr. Zhao Feng's research suggests that while there were many intuitive and accidental opportunities to discover plant pigments, the most important methods of discovery mainly include four ways (Table 1) (Hansheng, 2020).

Table 1 Origins of Plant Dyes

Number	**Discovery Path**	**Origin**	**Plant - Scientific Name**
1	Visual Discovery	Our ancestors, out of an affection for the red flowers and green leaves of nature, would pick and extract their juices to use in dyeing fabrics.	Safflower - Carthamus tinctorius, Pagoda tree flower - Sophora japonica, Woodland strawberry - Fragaria vesca, European buckthorn - Rhamnus cathartica, Spurge, and others.
2	Edible Discovery	The legend of Shennong tasting a hundred plants to discern the flavors of sour and bitterness, teaching the people to use grains as their daily meals, reflects that the discovery of agricultural production was through a practical process of tasting and flavor analysis. During this process, our ancestors discovered the pigments contained in some plants.	Foxtail grass - Setaria viridis, Turmeric - Curcuma longa, Luffa - Luffa aegyptiaca, and others.
3	Pharmaceutical Discovery	Some special plant pigments produced rich and vivid colors during the boiling process, hence they were also selected for use as dyes, and possessed	Madder - Rubia cordifolia, Gromwell - Lithospermum erythrorhizon, Japanese Clover - Lespedeza bicolor,

		for their medicinal value.	and others.
4	Spice Discovery	Since ancient times, aromatic plants have been utilized, such as turmeric with its strong fragrance and golden color. During the Zhou dynasty, turmeric was mixed into wine to enhance its aroma and color.	Turmeric - Curcuma longa, Gardenia - Gardenia jasminoides, Vanilla - Vanilla planifolia, and others.

Note. Compiled and analyzed by the researcher.

The practice of plant dyeing in China not only reflects the human utilization of natural resources but also demonstrates the importance of plant dyeing in early societies and cultures. Moreover, plant dyeing technology played a significant role in the trade along the ancient Silk Road, facilitating cultural and technological exchanges. Therefore, organizing and summarizing the history and development of Chinese plant dyeing techniques will lay a solid theoretical foundation for the following research.

2.1.2 ANCIENT CHINESE PLANT DYEING

The history of plant dyeing in China can be traced back to the Zhou dynasty. According to historical records from the Zhou dynasty, such as "Zhou Li: Di Guan," there were official and professional duties designated as " dyeing plants," specifically managing the dye plants harvesting in spring and autumn. Official institutions dedicated to handling plant dyeing affairs, such as "*Si Ran Shu*," "Ran Yuan," and "*Lan Dian Suo*," were founded during the Sui, Tang-Song, and Ming-Qing dynasties, respectively. Ancient Chinese agricultural and craft texts also contain records of the cultivation of dye plants and methods of plant dyeing (Table 2). Although there were signs of using plant dyes during the Neolithic period, it was not until the Xia and Shang dynasties that some dye plants began to be cultivated on a large scale.

Table 2 The Evolution and Discussion of Plant Dyeing in China

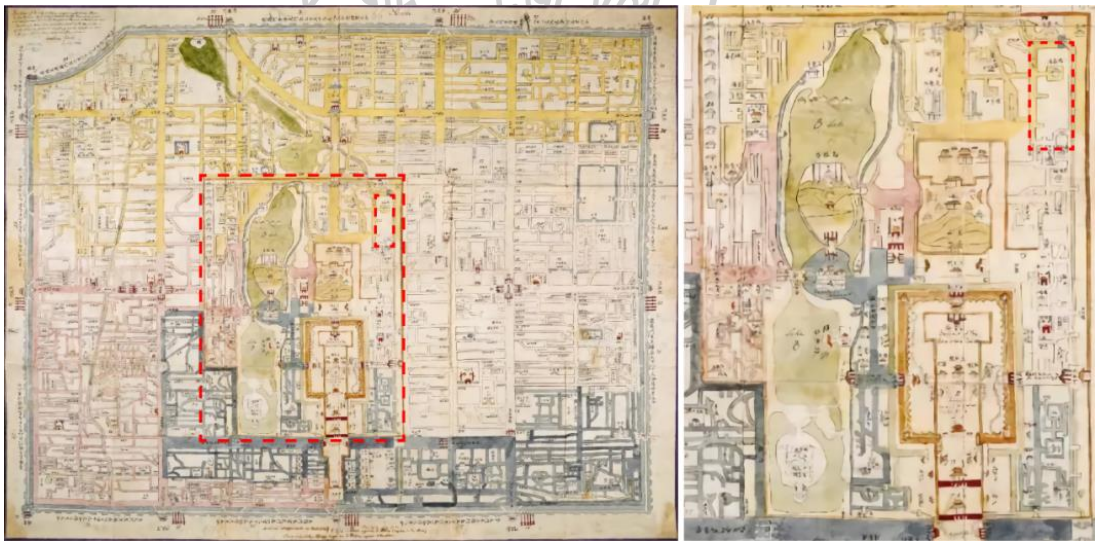
Dynasty	**Development**	**Ancient Texts**	**New Discoveries**
Zhou Dynasty	During the Zhou Dynasty, a specialized agency for the management of dye plants was established.	*ShiJing, ZhouLi Diguang*	Numerous records pertain to the hues of plants, as well as the duties of officials known as "masters of

			dye plants."
Spring and Autumn and Warring States Period	With the rise of sericulture and hemp cultivation, the technique of dyeing textiles with plants experienced rapid development. Grass dyeing essentially supplanted stone dyeing as the dominant method, with techniques such as direct dyeing, over-dyeing, and mordant dyeing emerging and being skillfully employed.	*Yu Gong*	indigo, madder, gromwell, Japanese indigo, and soapberry.
Qin and Han Periods	Dyeing technology inherited the traditions of the pre-Qin period and underwent further development.	*KaoGongJi* , *Jijiupian* , *ShuoWenJieZi* , *DaDaiLiji, Chapter 47: Xiaxiaozheng etc.*	turmeric, gardenia, and safflower.
Tang and Song Periods	Dyeing technology advanced rapidly, with the variety of plant dyes increasingly enriching. Significant progress was achieved in cultivation, manufacturing processing, dye pigment purification, and the use of mordants.	TangLiuDian, Newly Revised Materia Medica, ZhongShuShu, BeiHuLu, BenCaoJingZhuJi, BenCaoShiYi	buckthorn, amur cork tree, rehmannia, sumac, sage, lycopus, Chinese tallow tree, and tobacco willow.
Yuan, Ming, and Qing Dynasties	Innovations and advancements built upon existing technologies and experiences, coupled with extensive documentation from the same period, vividly illustrate the flourishing	*Compendium of Materia Medica* , *TiGongKaiWu* , *TianShuiBingKaiWu* , *CanSangCaoBian* , *Records of the Suzhou Weaving Office, YangZhouHuaFangLu*	holly, Japanese knotweed, indigofera, madder, lithospermum, saffron, sweet gum, sappan wood, gardenia, persicaria tinctoria, logwood, Asiatic dayflower,

	development of plant dyeing technology.	dyer's woad, duckweed, buckthorn, Chinese mulberry, mulberry, sumac, sophora, turmeric, Japanese indigo, gamboge, crocin, barberry, persimmon (lacquer persimmon), Japanese pagodatree, galls, pomegranate, Beleric, walnut, Sappanwood, and bayberry.

Note. Compiled and analyzed by the researcher.

Figure 8 Map of the Original Site of the Weaving and Dyeing Bureau



Note. Source: The British Library.

Figure 9 Ming Dynasty Dye Workshop

Note. Source: Part of "Along the River During the Qingming Festival" by Qiu Ying, in the collection of the Liaoning Museum.

Until the Ming and Qing dynasties, ancient Chinese plant dyeing techniques had reached a considerable level, with the colors of plant dyes becoming increasingly rich and the technology gradually maturing. Plant dyeing products were widely used, and among the contributors to showcasing the most beautiful posture of silk fabrics, the role of the "Dyeing Bureau" was indispensable. (Figure 8 , 9)

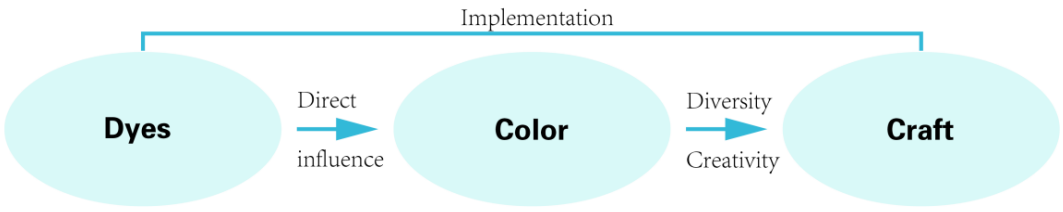
During the Qianlong period, Shanghai's dye workshops were described as follows: "The dye workshops were divided into the blue, red, bleaching, and mixed-color workshops. The blue workshop specialized in dyeing blue, indigo, azure, light

blue, and moonlight white; the red workshop was responsible for dyeing bright red, crimson, and peach red; the bleaching workshop could bleach rough yellow to white; the mixed-color workshop had richest colors, including yellow, green, black, purple, cyan, and blue."

In September 2021, the China Silk Museum hosted the "Qianlong Color Spectrum 2.0 - The Color Reconstruction of Qing Dynasty Court Silk Fabrics" exhibition, showcasing Qing Dynasty silk garments from the Qianlong period and color palettes reconstructed scientifically using multiple lines of evidence, systematically explaining the relationship between high-level dyed and woven products in China from the late 17th to the early 19th century. (Figure 10)

One of the key exhibits of the exhibition, a piece of autumn fragrance-colored kesi silk with a design of colorful clouds, bats, and golden dragons, was collected by the Beijing Art Museum (Figure 11). Researchers analyzed the dyes and colors of this Qianlong period garment, combined with historical archives and traditional craft research, and scientifically reconstructed 25 colors using natural dyes such as safflower, sappanwood, indigo, sophora japonica, and turmeric (Figure 12). Comparing with the dyeing and selling records of the Beijing Dyeing Bureau, it was found that the types of dyes used on the artifacts differed from those recorded in the documents, partially revealing the true sources of dyes for the court silk colors in the mid-Qing period.

Figure 10 The Relationship Among Dyes, Colors, and Techniques in Early Chinese Dyed and Woven Products



Note. Illustrated by the researcher.

Figure 11 Autumn Fragrance Colored Kesi Silk with Multicolored Cloud and Dragon Pattern Auspicious Robe Fabric

Note. Source: Beijing Art Museum.

Figure 12 25 Traditional Chinese Plant Dye Color Cards

Note. Source: "Qianlong Color Spectrum 2.0" Exhibition.

Among them, the reconstruction of 25 colors on the Autumn Fragrance Silk Brocade with Multicolored Cloud Bats and Golden Dragon Official Robe Material holds a significant position in the Qing Dynasty's clothing and matching system. For instance, the color of the robe uniformly used indigo, and the dragon robe also stipulated that "the collar and cuffs are all in indigo," with the emperor's dragon robe often utilizing blue. Whether it's records in historical archives or the colors on actual artifacts, there are more than ten different shades of blue. In ancient times, the only plant dye used for blue was indigo (Figure 13).

The "Qianlong Color Spectrum 2.0" exhibition and research provide technical references for modern artifact preservation and eco-friendly dyeing and finishing, offering theoretical support for the arguments presented in this paper. It also demonstrates that this study, based on plant dyeing technology, is conducive to the promotion and development of traditional Chinese culture.

Figure 13 Indigo Blue Horizontal Luo Qilin Patch Uniform for First-Rank Military Officials

Note. Source: Fengming Zhejiang.

Figure 14 Bluegrass

Note. Source: Zhuo Ye Indigo Dyeing.

Figure 15 Saffron

Note. Source: The Museum of Chinese Medicine.

Chinese ancestors developed various plant dyes through the changes in official color usage over dynasties and the increasingly diverse color needs of the people. This led to the emergence of many farmers who specialized in dyeing plants, such as bluegrass (Figure 14) and safflower (Figure 15), cultivating these crops for a living. This profession still exists in modern society, mainly concentrated in areas like Guangdong and Henan. The inclusion of plant dyes in some ancient texts is shown in Table 2 below.

2.1.3 DISCONTIMUITIES IN THE DEVELOPMENT OF PLANT DYEING (THE RISE OF CHEMICAL DYES)

In 1856, William Henry Perkin attempted to synthesize quinine but ended up with a sticky black substance. When he cleaned the test tube with alcohol, this black residue dissolved, turning the alcohol a beautiful purple color. Curious, Perkin used this purple solution to dye fabric and discovered that the color did not fade, regardless of exposure to sun or wind. This accidental discovery led to the creation of the first synthetic dye, mauveine. This breakthrough sparked the industrialization of the dye industry, leading to the establishment of many dye manufacturing companies. Mauveine was commercially produced in 1857, marking the beginning of the synthetic dye industry(Figure 16).

Figure 16 Chemical Dyes and Pharmaceuticals, William Henry Perkin

Note. Source: Pharma TEC Talk.

In 1858, German chemist August Wilhelm von Hofmann first prepared basic fuchsin and other red dyes. Over the next two years, he successfully synthesized various chemical dyes, including basic blue and aniline blue, using similar methods. That same year, Johann Peter Griess discovered the diazo reaction, leading to the synthesis of diazonium salts six years later, laying the foundation for the development of azo dyes. In 1861, Johann Friedrich Wilhelm Adolf von Baeyer used aromatic amine diazonium salts to couple with aromatic amines, creating the azo dye aniline yellow. In 1868, Carl Graebe, Carl Liebermann, and Perkin almost simultaneously discovered the first elemental dye, alizarin. In 1870, Baeyer produced indigo red by

oxidizing natural indigo and achieved full synthetic indigo production by 1878, patenting the process in 1880. In 1884, Emil Böttiger synthesized the dye Congo red. In 1901, BASF chemist René Bohn synthesized the anthraquinone dye indanthrone (vat blue).

From the latter half of the 19th century, the synthetic dye industry led a revolution in chemical technology, peaking in the 20th century. Synthetic dyes not only became widespread in the textile printing and dyeing industries but also found extensive applications in leather, coatings, paper, and inks, gradually replacing natural dyes.

2.1.4 THE REVIVAL OF MODERN PLANT DYEING

At the beginning of the last century, with the development of industrial technology and the impact of industrial dyes on China's dyeing and weaving industry, plant dyeing technology suffered a severe blow. However, by 2013, "Traditional Plant Dyeing Technology" was officially included in the fourth batch of national intangible cultural heritage list in Hubei Province. Alongside the promotion of traditional culture and the advocacy of cultural and national confidence, the Chinese people have become increasingly aware of the importance of protecting these intangible cultural heritages.

The 2018 CHIC China International Fashion Fair attracted many brands and alliances in the textile and garment industry. The first participation of the Chinese Plant Dye Industry Alliance drew widespread media attention, signifying the convergence of multiple brands and alliances within the textile and garment fields. Feng Dehu, President of the China Textile Planning Institute and Chairman of the Plant Dye Industry Alliance, emphasized that the alliance aims to inherit the millennia-old plant dye civilization, showcase the classical charm of Chinese dyeing and printing technology, enhance national cultural confidence, promote the sustainable development of the plant dye industry, and enhance China's leadership in the global plant dye field. He believed that as an ancient Chinese art of dyeing and printing, plant dye technology is destined to shine again. In 2019, the "Blue Pulse - 2019 Cross-Strait Natural Dyeing Art Joint Exhibition," organized by the Taiwan Craft Research and Development Center, opened in Taipei. The exhibition brought together 100 works from 62 natural dyeing artists from both sides of the Taiwan

Strait, focusing on indigo dyeing art derived from plant indigo, showcasing the elegant and free beauty of "plant aesthetics."

Figure 17 Home Textile Brand nacasa

Note. Source: nacasa.

The home textile brand nacasa, established in 2016, integrates Chinese traditional culture and folk handicrafts. It draws natural dyes from various parts of plants—flowers, fruits, leaves, stems, and roots—and applies them to towels and bath towels, launching 100% cotton plant-dyed towels that are very suitable for children, pregnant women, and people with sensitive skin (Figure 17).

In summary, plant dyes align with ecological cycles and sustainability principles, due to their natural sourcing and biodegradability. In our highly industrialized society, plant dyes are favored by consumers, textile artists, fashion designers, and environmentalists for their eco-friendliness, non-toxicity, and hypoallergenic properties. Thus, integrating plant dyes into daily life and the market not only meets contemporary consumer expectations but also achieves a harmonious blend of culture, health, and market demands.

2.1.5 SUMMARY

With the global enhancement of sustainable development and environmental awareness, traditional plant dyeing techniques have garnered renewed attention and

application in contemporary society. Designers and brands are increasingly adopting plant dyes for their unique natural beauty and eco-friendly characteristics, catering to modern consumers' demand for healthy, sustainable products.

2.1.5.1 The Advantage of Cultural Inheritance and Identity Symbol

With the improvement of global sustainable development and environmental protection awareness, traditional plant dyeing technology has been paid new attention and applied in contemporary society. Designers and brands are increasingly adopting vegetable dyes to respond to modern consumers' demands for healthy, sustainable products with their unique natural beauty and environmental properties.

A series of studies have explored the use of plantdyes in different cultural contexts, highlighting their importance as a cultural heritage and status symbol.For example, the Baiku Yao people of China use unique anti-dyeing materials in their cotton dyeing process, which are deeply rooted in their cultural identity (Hu et al., 2022). Similarly, the Tai-Lao ethnic group in Thailand use a diverse range of plants for textile dyeing, with the knowledge of these plants being crucial for their cultural preservation (Junsongduang et al., 2017). However, the use of plant dyes and associated traditional knowledge is under threat from modernization and the introduction of synthetic colors (Teron & Borthakur, 2012) Despite these challenges, the use of plant dyes continues to play a significant role in expressing cultural identity and preserving traditional practices. Jin Shaoping and Wu Hao (2012) have revealed the types and uses of plant dyes recorded in ancient Chinese documents, as well as the relationship between plant dyes and ancient cultural connotations. This helps us better understand the lifestyles, aesthetic concepts, and cultural traditions of ancient worlds, and it is of great significance for the protection and inheritance of traditional dyeing and weaving crafts.

Traditional plant dyeing techniques are not only production processes; they are deeply rooted in the social and spiritual lives of various cultures. These techniques and practices not only retain traditional craftsmanship but also convey the cultural values and aesthetic principles of plant dyeing. Compared to chemical dyes, plant dyeing has a lesser environmental impact, promoting the concept of green living, which aligns with the ecological civilization concept we currently pursue.

2.1.5.2 The Innovative Value of Modern Plant Dye Products

With the progress of science and technology and the growing awareness of environmental issues, the public has become increasingly aware of the drawbacks of certain chemically synthesized dyes, which can harm the ecological environment and affect human health.

- **Aesthetic Value**

In the fast-paced society filled with competition and pressure, people often experience various physical and mental exhaustion and constraints, leading to a suboptimal health state. This pushes individuals to unconsciously seek an escape from this urgency, yearning for a serene, peaceful, and simple lifestyle. Plant dyeing, with its natural dyeing techniques, offers gentle colors and a rustic texture, providing a sense of tranquility away from the hustle and bustle. This allows people, even in bustling cities, to find inner peace.

- **Commercial and Economic Value**

The uniformity and synthetic nature of mass-produced items under mechanized production have led people to appreciate and pursue handmade, natural, unique, and personalized clothing designs. Hand-dyed elements are increasingly seen in interior soft furnishings and clothing design. Plant dyeing, with its simple coloring process and fun characteristics, has also attracted many folk enthusiasts to participate in hand-dyeing with plant dyes. The hands-on experience of plant dyeing allows urban dwellers to feel the charm of nature, thus promoting economic development.

- **Environmental Value**

The fashion industry is one of the world's major polluters. A United Nations conference highlighted that the global fashion industry, with an annual output of about $3 trillion, also generates significant wastewater and emissions. Nearly three-quarters of the water used in dyehouses ends up as undrinkable wastewater, contaminated with dyes, salts, strong alkalis, heavy metals, and other chemicals used for setting colors in fabrics.

The study aims to promote the application of sustainable and environmentally friendly plant dyeing, reducing reliance on synthetic dyes to protect the environment and human health. The promotion of plant dyeing helps to raise environmental

awareness, thereby affecting the application prospects of plant dyeing in the modern market.

- **Cultural Dissemination Value**

As a traditional handicraft with a long history, plant dyeing records the historical and cultural spirit of nations and embodies the endless wisdom and creativity of ancient laborers. The state has introduced many policies to protect intangible cultural heritage, providing substantial financial support to remote ethnic minorities and bringing handicraft culture into classrooms, allowing more people to feel and experience the charm of handicraft. In recent years, cultural documentaries like "Great Craftsman," "Seeking Artisanship," and "The Incredible Artisan" have once again resonated with the public, primarily due to the cultural perseverance behind them.

Plant dye workshops and exhibitions have become important platforms for cultural exchange, not only promoting plant dyeing techniques but also enhancing understanding and respect between different cultures, while also raising public awareness of traditional handicrafts and sustainable lifestyles.

- **Health and Functionality**

As toxicological testing and analytical techniques have matured, it has been discovered that some synthetic dyes contain serious chronic toxins and carcinogens, such as azo dyes, Sudan Red, Lemon Yellow, and Sunset Yellow (Suping, 2015). Beyond the synthetic dyes used in the food and pharmaceutical industries, some synthetic dyes widely used in the textile industry also pose significant threats to human health and the ecological environment. Many synthetic dye molecules are toxic and even carcinogenic, and the improper disposal of dye wastewater can severely damage the surrounding ecosystem (Tian et al., 2012).

Looking at the development history of plant dyes, we find that many dyes originate from medicinal herbs discovered in nature. Li Shizhen recorded the dyeing effects of many herbal medicines in "*Compendium of Materia Medica.*" Medicinal herbs themselves have certain therapeutic functions, and when applied as plant dyes to clothing, they can also endow the dyed fabrics with antibacterial and anti-inflammatory health benefits. For example, mugwort can resist bacteria and prevent allergies, offering medical value for rhinitis patients. Clothes dyed with Isatis root exhibit strong antibacterial properties, repel mosquitoes, and detoxify.

2.1.5.3 Challenges in Cultural Heritage and Development

Although the plant dyeing craft receives government support, its development relies on market recognition and cultural awareness. There are still limitations in product innovation and application research, posing significant challenges for plant dyeing.

- **Lack of Innovation in Plant Dye Product Design**

Currently, most plant-dyed products in the market are simple patches or replicas of traditional elements, lacking creativity and innovation. The majority of plant-dyed products only utilize traditional dyeing techniques without integrating these methods into the product's external form, making it difficult to meet modern consumers' aesthetic and purchasing desires.

- **Low Color Fastness of Plant Dyes**

The low color fastness of plant dyes, leading to easy fading of plant dye products, is also a significant reason why plant dyes have not been widely industrialized and why plant dye culture has not spread more extensively. M Inan, DA Kaya, S Kirici - Industria Textila (2014) primarily studied the impact of different plants and quantities of plants on the color and color fastness of wool yarn, providing practical guidance for dyeing with natural dyes. Abera Kechi, R.B. Chavan, Reinhart Moeckel (2013) extracted natural dyes from Ethiopian dye plants, determining the rough dye yield, color strength, and equivalence to commercial dyes. However, the research was limited to Ethiopian dye plants, with relatively limited studies on the dyeing performance and durability of the dyes.

Therefore, this research aims to address these market development issues, bridging the gap between cultural inheritance and market development, and offering valuable references for the plant dye industry.

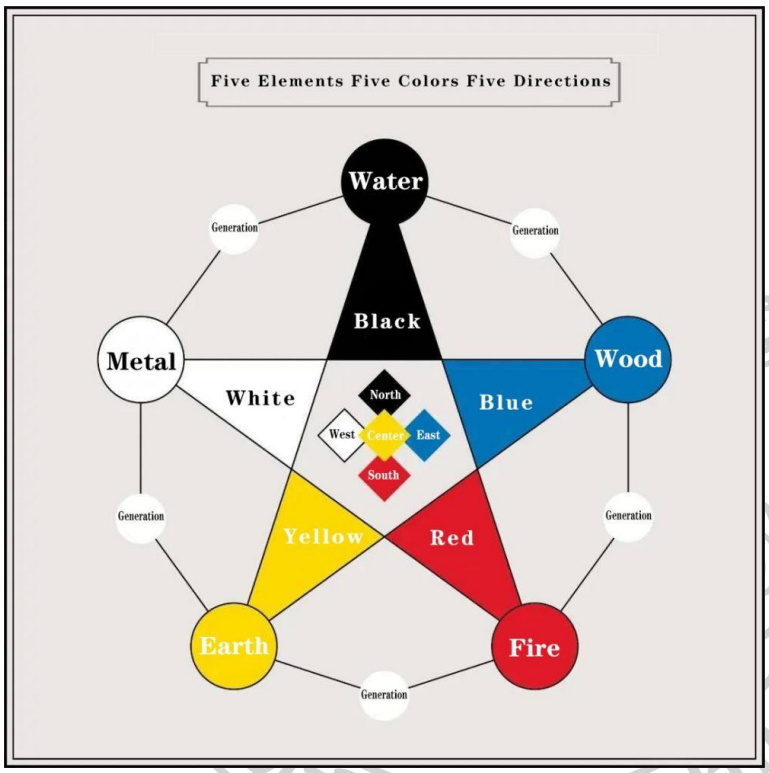
2.2 COMMON DYES AND TECHNIQUES OF PLANT DYEING

2.2.1 TRADITIONAL CHINESE THEORY OF FIVE COLORS

The Five Elements theory is a philosophical system used by ancient Chinese to explain the creation, evolution, and composition of the world through the interrelationship of elements. It forms an essential part of traditional Chinese culture. The Five Colors theory, derived from observations and imitation of nature, further

extends this philosophy into a combination of natural, philosophical, and cultural color perspectives. This distinctive aspect of Chinese color culture, with detailed concepts and meanings recorded in the *YiZhou Shu* identifies the five colors as blue, red, yellow, white, and black".

Figure 18 China's Five Elements, Five Colors, Five Directions



Note. https://www.163.com/dy/article/HQN9OF800553A614.html

Table 3 Correspondence Chart of the Chinese Five Colors Theory

Five Elements	**Five Directions**	**Five Organs**	**Five Seasons**	**Five Flavors**	**Five Colors**
Wood	East	Liver	Spring	Sour	Blue
Fire	South	Heart	Summer	Bitter	Red
Earth	Center	Spleen	Late Summer	Sweet	Yellow
Metal	West	Lung	Autumn	Pungent	White
Water	North	Kidney	Winter	Salty	Black

Note. Compiled and analyzed by the researcher.

Yanqing Chen, in "The Color of Concepts: A Study of Traditional Chinese Color Theory," notes, "Tianxuan (the dark sky) as a higher existence symbolizes authority, mystery, position, past, and future, whereas the five colors represent the present." Besides corresponding to the Five Elements colors, the ancient commonly mentioned five directions, five organs, five seasons, and five flavors also correspond to the Five Elements one-to-one (Table 3). Everything in the world can be associated with the Five Elements. In the field of clothing design, metal corresponds to sewing tools, wood to dyeing materials and plants, water to the water needed for dyeing, fire to the boiling process during dyeing, and earth to the cultivation of cotton and linen.

Chinese people pay attention to the doctrine of Feng Shui based on the Five Elements, believing that clothing matching the colors of the Five Elements will bring good luck and smooth sailing. Therefore, this paper analyzes the colors of plant dyes from the perspective of the Five Elements, conducting a color analysis from the viewpoint of bringing auspicious meanings to the audience.

2.2.1.1 Blue (Qing)

Indigo plant is the earliest and most widely used blue plant dye in ancient times, and any plant that can extract indigo is referred to as "blue," with common species including Persicaria tinctoria (Japanese indigo), Isatis tinctoria (woad), Baphicacanthus cusia (Nees) Bremek, and Strobilanthes cusia.

In the Ming Dynasty, Qiu Ying's scroll painting " Riverside Scene at Qingming Festival " depicts the life of commoners, such as men carrying water jars, leading horses, and pushing carts, all wearing blue-dyed printed fabric made of hemp (Figure 19).

Throughout Chinese history, blue dragon robes, with blue as the primary color, were prominently worn by emperors, especially during rituals of worshipping the heavens. This choice of color harmonizes with the blue sky, demonstrating a clear element of nature worship inherent in the traditional Chinese color spirit (Figure 20).

Figure 19 Riverside Scene at Qingming Festival

Note. Source: Liaoning Provincial Museum.

Figure 20 Qing Dynasty Blue Brocade Dragon Robe

Note. Source: Xuzhou Imperial Edict Museum

The leaves of indigo plants contain indican, which, after being soaked in water for about a day, ferments and decomposes into water-soluble indigo precursors. At this stage, the extract is yellow-green. Under the action of enzymes in water, the indigo precursors further break down into indoxyl, which exists in plant cells in the form of glycosides. Indigo is a typical vat dye, known for its excellent wash and lightfastness.

Indigo plant was the most used plant dye material in ancient times, with many varieties, and different varieties of indigo plants and the color differences they produce often have different names in different periods and regions. Therefore, some necessary sorting and discussion of related records in ancient documents and contemporary research are expected to provide valuable information and insights for a better understanding of the history and tradition of Chinese blue dyeing. (Table 4)

Table 4 Records Related to Indigo Plant Dyeing

Number	**Name**	**Scientific Name**	**Family**	**Pigment Location**	**Source**	**Characteristics**
1	Persicaria tinctoria	Isatis indigotica	Polygonaceae	Leaf	*The Book of Rites: Monthly Ordinances*	Persicaria tinctoria is primarily used for producing indigo dye, yielding shades of blue with excellent color fastness. The dyeing characteristic is gentle yet profound, revealing a unique patina and natural beauty through wear and washing.
2	Isatis tinctoria	Isatis tinctoria	Brassicaceae	Leaf	*Newly Revised Materia Medica*	The blue dye from Isatis tinctoria is pure, bright, and also a primary source for indigo. Compared to Persicaria tinctoria, the blue dyed with Isatis tinctoria is brighter and more distinct.
3	Baphicacanthus cusia	Indigofera tinctoria	Fabaceae	Leaf	*Compendium of Materia Medica*	The most traditional indigo-producing plant, capable of dyeing a deep blue that is rich in color and extremely durable, maintaining its vibrancy over time.
4	Strobilanthes	Strobilanthes cusia	Acanthaceae	Leaf	*Erya*	The blue dyed with Strobilanthes cusia resembles that of

cusia	Baphicacanthus cusia but carries a slightly warm purple hue. The dyeing characteristic of Strobilanthes cusia is its deep color, offering good coverage and depth.

Note. Compiled and analyzed by the researcher.

2.2.1.2 Red

The dye plants capable of producing red hues include madder, safflower, sappanwood, knotweed, hawthorn, hibiscus, gardenia, holly, jujube, litsea, saffron, and more than a dozen others, with madder, safflower, and sappanwood being particularly significant.

The ancient reverence and taboo associated with red blood made red one of the earliest colors to emerge in human consciousness as a symbol of good fortune and protection from evil. Early humans also worshipped the sun and fire, viewing the sun as the god of life and fire as a crucial tool for warding off wild animals, keeping warm, and preparing food.

From antiquity to the present, red has been an indispensable color in the three major human ceremonies: birth, marriage, and funerals. Red conveys a sense of warmth and vividness, symbolizing auspiciousness and happiness. China has long utilized plant-based dyeing techniques to color fabrics red. This affinity for red has not only reflected cultural preferences but also spurred the development of ancient Chinese red dyeing techniques. (Table 5)

Table 5 Records Related to Red Plant Dyeing

Number	Name	Scientific Name	Family	Pigment Location	Source	Characteristics
1	Madder	Rubia cordifolia L	Rubiaceae	Rhizome	*The Book of Songs*	Madder is one of the earliest dyes used for red plant dyeing, with records as early as the Zhou and Han dynasties in China indicating its widespread cultivation.
2	Safflower	Carthamus tinctorius	Boraginaceae	Flowers	*Records of the Broad Knowledge of Things*	Among the red plant dyes, it produces the most vivid red, quickly becoming the primary dye material for red over other red dyes.
3	Sappan Wood	Caeslpinia sappan	Fabaceae	Trunk center position	*Description of Southern Plants*	Sappan wood was an important red plant dye in ancient China. Paired with different mordants, it could dye a rich array of colors. Sappan wood offers more vibrant colors than madder and is easier to extract than safflower.

Note. Compiled and analyzed by the researcher.

2.2.1.3 Yellow

Chinese people, born on the yellow earth and known as the "descendants of Yan and Huang," have always had an enduring affection for the color yellow. Imperial garments and the resplendent Buddhist temples and statues symbolize nobility and devotion, fostering early development of yellow dyeing techniques. Among the numerous dye plants, many are used to produce yellow dye. (Table 6)

Table 6 Records Related to Yellow Plant Dyeing

Number	Name	Scientific Name	Family	Pigment Location	Source	Characteristics
1	Japanese indigo	Arthraxon hispidus	Poaceae	Stems and leaves	*The Book of Songs*	Dyeing silk and wool fibers directly with Japanese indigo liquid yields a vivid yellow; overdyeing with indigo results in green.
2	Gardenia	Gardenia jasminoides Ellis	Rubiaceae	Dry fruits	*Biographies of the Money-Makers in Records of the Grand Historian*	Dyeing directly with gardenia achieves a bright yellow, easy to apply and uniformly colored, but with poor resistance to sunlight.
3	Amur cork tree	Phellodendron amurense	Magnoliaceae	Bark	*Important Arts for the People's Welfare*	The pigment contained in the bark is berberine, the only alkaline pigment dye used in ancient China from dye plants.
4	Sophora	Sophora japonica	Fabaceae	Flowers	*Classified Materia Medica*	Resistant to fading and bright in color, it was widely used during the Song Dynasty and commonly used in the Qing Dynasty to dye the bright yellow robes.
5	Sumac	Cotinus coggygria	Euphorbiaceae	Leaf, Fruit	*Supplement to the Materia Medica*	Besides being ornamental, sumac was used early on as a dye material, being a very important yellow dye in ancient times.
6	Turmer	Curcuma	Zingibe	Rhizome	*Compe*	Curcumin changes

	ic	longa	raceae	s	*ndium of Materia Medica*	color significantly under different mordants; it turns reddish-brown with alkalis and bright yellow with acids. Its color fastness is poor, especially under sunlight.
7	Gambo ge	Garcinia cambogia	Clusiac eae	Fruit peel	*Brief Knowle dge of Physics*	A commonly used traditional Chinese medicine, also a renowned painting pigment and high-quality yellow dye.

Note. Compiled and analyzed by the researcher.

2.2.1.4 Black

Black, one of the five primary colors, can be dyed with many dye plants, including oak gall, lacquer, sage, Chinese tallow, dyer's woad, barberry, black walnut, pomegranate, hazelnut, mulberry, tea, black soybean, lotus, persimmon, rhubarb, Belamcanda chinensis, elm, lotus, bayberry, hibiscus, and more than twenty others.

In ancient China, black was considered the most sacred color, corresponding to water in the Five Elements theory. The veneration of black is evident in artifacts from the Longshan culture of the late Neolithic period, where cups, jars, and pots were made from black pottery. During the Xia Dynasty, black was regarded as noble, used in serious and formal occasions such as warfare and rituals. Imperial attire and flags were primarily black. As the most important ceremonial color in pre-Qin times, black was worn by emperors during significant ceremonies, indicating that the art of plant-based black dyeing began very early.

Table 7 Records Related to Black Plant Dyeing

Number	Name	Scientific Name	Family	Pigment Location	Source	Characteristics
1	Soap Bean Pod	Quercus acutissima Carruth	Fagaceae	Bark	*Erya: The Section on Explaining Wood*	The soap bean pod is a primary black dye, turned black through the use of iron and salt as mordants. It is the earliest, most enduring, and most widely used plant-based black dye in China.
2	Chinese Tallow Tree	Sapium sebiferum	Euphorbiaceae	Leaf	*Compendium of Materia Medica*	The leaves of the Chinese tallow tree contain a rich amount of tannic acid, which, when combined with an iron mordant, produces a black hue.
3	Galla Chinensis	Galla Chinensis	Anacardiaceae	Lea, Fruit	*Compendium of Materia Medica*	The cultivation of Galla Chinensis is extremely widespread, making it a very commonly used plant dye in China.
4	Oak	Carpinus betulus	Betulaceae	Bark	*Newly Revised Materia Medica*	Oak material, when ground, dried, and mixed with mordants, can produce a black-gray color.
5	Lotus Seed Pod	Nelumbo nucifera	Nelumbonaceae	Fruit Shell	*The Exploitation of the Works of Nature*	The lotus seed pod, the fruit of plants in the Nelumbonaceae family, can produce a black-gray color when combined with mordants.

Note. Compiled and analyzed by the researcher.

2.2.1.5 White

In traditional color concepts, white is a paradoxical color. This paradox arises from the different moods people experience when perceiving the colors of all things in various environments or contexts. In plant dyeing, white represents the natural color of cotton and linen, embodying the negative space in tie-dye techniques, conveying simplicity, elegance, and purity.

2.2.1.6 Intermediate Colors

- **Purple**

Plants used for dyeing purple include gromwell, purple sandalwood (Pterocarpus santalinus), and hibiscus, among which gromwell yields the best purple and is the most commonly used across different regions.

Gromwell (Lithospermum erythrorhizon) is a perennial herb. Its cultivation techniques first appeared in Jia Sixie's "Qi Min Yao Shu" during the Northern Wei period. Subsequent works like the Yuan Dynasty's "Nong Sang Ji Yao," Ming Dynasty's Xu Guangqi's "Complete Book of Agricultural Policy," and the Qing Dynasty's Ertai's "Comprehensive Studies in Seasons" all include records, indicating its widespread use.

- **Green**

In ancient China, green was often achieved by over-dyeing with blue and yellow dyes, using plants like luffa, crabgrass, mugwort, mint, willow leaves, and buckthorn. Few plants can directly dye fabrics green on their own, and buckthorn is one of them, hence it is also known as "Chinese Green."

In summary, the Chinese plant dyeing system is vast, deriving from various botanical sources, and can display different colors depending on the medium. This research will conduct experiments on different dyeing methods for various dye materials, aiming to create a visual catalog specifically tailored, providing practical value for modern plant dye design.

2.2.2 DEVELOPMENT AND APPLICATION OF DYEING TECHNIQUES

2.2.2.1 Pigment Extraction from Dye Plants

Different dye crops have their cultivation, harvesting, storage, and pigment extraction methods. "Qi Min Yao Shu," the oldest comprehensive book on agriculture

in China, discusses dye plants like safflower, indigo plant, gardenia, gromwell, rehmannia, hawthorn, pomegranate, mulberry, and sophora, each discussed separately.

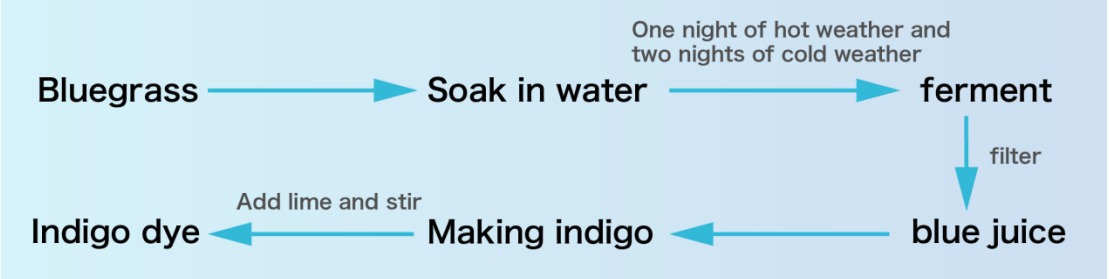
The indigo plant, with the longest history of cultivation among dye crops, varies in sowing methods and times among different varieties. The advent of indigo processing technology allowed the pigment from the indigo plant to be presented in the form of indigo blue, which can be stored for a long time and used as needed.

The exact start of indigo blue manufacturing technology in China is unrecorded, but considering the large-scale cultivation of indigo plants during the Qin and Han dynasties, it likely began no later than this period.

Early indigo production used solid fermentation, as recorded in the Sui Dynasty's "Yu Zhu Bao Dian," the Tang Dynasty's "Chu Xue Ji," and the Song Dynasty's "Tai Ping Yu Lan." The process involves spreading indigo plant leaves on the ground, watering them to ferment and heat up, drying the leaves, and then turning them over and watering repeatedly until fermentation is complete. The result is a dark greenish-black substance known as indigo, historically referred to as "lan wan."

Liquid fermentation for indigo production appeared during the Northern and Southern Dynasties. Jia Sixie's "Qi Min Yao Shu" provides a detailed account of this indigo production method. The principle involves indigo plant stems and leaves placed in water, fermenting over time to release indoxyl, which, after adding lime, frees indoxyl. Air oxidation then condenses it into indigo blue. (Figures 21 , 22)

Figure 21 Indigo Blue Manufacturing Process



Note. Illustrated by the researcher.

Figure 22 Indigo Dyeing Fermentation Process

Note. Source: Zhangrancao.

2.2.2.2 Ancient Plant Dyeing Techniques

Since the Western Zhou period, people have had a deep understanding of various dye plants and could use different dyeing methods based on the properties of the dye plants, which they applied very proficiently. The dyeing techniques used in ancient times can be summarized into five main types: direct dyeing, layering, mordant dyeing, combined dyeing, and resist dyeing.

- **Direct Dyeing**

This method is recorded in "Mozi·So Dyeing" and "Ti Gong Kai Wu": placing the fabric to be dyed directly into a fermented dye solution containing branches, leaves, or other parts rich in pigment, soaking or boiling the fabric once or multiple times in the same dye bath to obtain varying shades.

- **Layer Dyeing Technique**

The principle and craft of layer dyeing are similar to that of direct dyeing, involving multiple immersions of the fabric into two or more different dye baths alternately or in combination to achieve intermediate colors. Employing the layer dyeing technique allows for a broader spectrum of colors to be achieved with a limited selection of dyes, greatly enriching the color palette available to dyers. (Table 8)

During the pre-Qin period, green was one of the most common popular colors in clothing, with many people adorning themselves in "green garments with yellow

lining" or "green robes with yellow skirts." Ancient methods of dyeing green primarily achieved through layer dyeing yellow dyes with indigo, an example being the green dyeing method recorded in Song Yingxing's "Tiangong Kaiwu."

Table 8 Layer Dyeing Technique

Dyes	initial dyeing	redyeing	resulting colors
Phellodendron amurense, Indigofera tinctoria	Boiling and dyeing with Phellodendron amurense	Indigo water cover	Canary yellow
Indigofera tinctoria ,Caesalpinia sappan	Lightly dyed in an indigo vat	Caesalpinia sappan water cover	Sky blue
Indigofera tinctoria ,Phragmites australis,Myrica rubra	Indigo dyed dark cyan	Phragmites australis,Myrica rubra water cover	Dark blue-black

Note. Compiled and analyzed by the researcher.

- **Mordant Dyeing Technique**

Mordant dyeing, also known as mordant coloring, is necessary when most fibers lack strong dye affinity and cannot be dyed directly. Metal salt mordants facilitate a chemical reaction between the coordinating groups in dye molecules and the metal salt, allowing the pigment to adhere to the fiber in the form of a complex. Common ancient mordants included green vitriol (ferrous sulfate), alum, copperas, black oak, copper sulfate, and wood ash.

Mordant dyeing is applicable to various fibers, and different mordants can produce different colors from the same dye. As shown in Table 9, the effects vary between different mordants.

Table 9 Mordant Dyeing Technique

Dye	No medium	Aluminum mordant	Iron mordant
Rubia tinctorum	light yellow red	Light orange-red to deep red	Yellowish brown
Polygonum aviculare	Yellow	Bright yellow	Dark yellow
Lithospermum erythrorhizon	Cannot be dyed	Reddish purple	Purple brown
Sapindus mukorossi	Grey	No effect	Black

Note. Compiled and analyzed by the researcher.

Mordant dyeing techniques can be categorized into simultaneous mordanting, pre-mordanting, post-mordanting, and multiple mordanting:

·Simultaneous mordanting involves dyeing the fabric directly in a dye bath that includes the mordant.

• Pre-mordanting involves soaking the fabric in a water solution of the mordant before dyeing it in the dye bath.

• Post-mordanting, opposite to pre-mordanting, involves dyeing the fabric in the dye bath first before soaking it in a water solution containing the mordant. Its advantage over simultaneous or pre-mordanting is more uniform dyeing and precise end points.

• Multiple mordanting refers to a technique where fabric is pre-mordanted with alum, then dyed, and finally post-mordanted with copper sulfate, resulting in deeper, more uniform, and fast colors.

Among these mordant dyeing techniques, the dyeing outcomes with different plant dyes vary. Pre-mordanting yields less fast colors with imprecise end points; simultaneous mordanting makes uniform and accurate dyeing challenging; post-mordanting is slower; and multiple mordanting is more rational as a dyeing process. In summary, compared to other dyes, mordant dyes have better color uptake, lightfastness, acid and alkali resistance, and color fastness. The dyeing process is more complex than other methods and must be used correctly to achieve the desired outcome.

- **Combined Dyeing Technique**

The combined dyeing technique utilizes a combination of direct dyeing, layer dyeing, and mordant dyeing methods.

- **Resist Dyeing Technique**

The essence of resist dyeing is a dye-resist process that employs methods to prevent dye from reaching certain areas of the fabric. There are three main methods: clamp resist, wax resist, and tie-dyeing.

- **Clamp Resist**

Clamp resist involves using two identically shaped wooden blocks to tightly clamp the fabric, which is then dyed to create symmetrical patterns or designs. Sometimes, multiple hollowed blocks are used for dyeing in two or three different colors.

- **Wax Resist**

Wax resist, also known as batik, has two traditional methods: one is a clamp resist method, where fabric is sandwiched between two hollowed-out blocks and molten beeswax is poured into the hollows. The other method involves using a bamboo pen or a metal wax knife to draw on smooth fabric with melted wax. Both methods of wax resist dyeing primarily use indigo dye for monochrome and polychrome effects.

- **Tie-Dyeing**

Tie-dyeing, also known as bound resist or knot-dyeing, is a common ancient Chinese folk dyeing technique. There are two main approaches to tie-dyeing:

・Sewing or Binding Method.

・Knotting or Folding Method.

2.2.2.3 Modern Plant Dyeing Techniques

The craft of plant dyeing has evolved from traditional handicrafts to modern techniques. These techniques include, but are not limited to:

- **Plant Heat Transfer Printing**

Plant heat transfer printing transfers pigments from plants to fabric through heating or steaming:

- **Plant Tapping Print**

Select leaves with distinct patterns and soak them in saltwater. Then, place the leaves with their backsides facing down on the cotton fabric according to the design layout. Cover and secure the leaves with transparent tape. Firmly strike the leaves until their shapes are imprinted on the cotton fabric.

2.2.2.4 Current Status of Plant Dyeing in China

Currently, the research on plant dyes exhibits a significant geographical imbalance, primarily focused on economically underdeveloped minority regions. This is partly due to these areas' remote locations and limited external interactions, which have preserved better ecological environments, ensuring abundant plant dye resources. Additionally, these minority communities have consciously retained traditional plant dyeing techniques through their daily lives and production activities, preserving the related knowledge relatively intact.

Despite China's rich accumulation of traditional knowledge in plant dyeing, these valuable cultural heritages are under threat of disappearing due to the impact of the market economy, and there is still a lack of comprehensive and in-depth research, urgently requiring further study and protection. Among China's numerous ethnic minorities, the Bai people's plant dyeing techniques have a long history and have accumulated a vast amount of knowledge through continuous dyeing processes. However, there remains a lack of thorough and in-depth research on the Bai people's plant dyeing resources and their profound knowledge system.

2.2.3 SUMMARY

Research has found that due to the spatial limitations of the complex plant dye production process, it is difficult for audiences to experience it firsthand. Therefore, designing and disseminating visual step-by-step diagrams of plant dyes can allow the public to understand the entire process more intuitively, from plant selection and dye extraction to each step of the dyeing process. Visual step-by-step diagrams can serve as effective tools for recording and disseminating information, helping to protect and preserve the craft of plant dyeing.

For brands committed to sustainability and eco-friendly practices, using visual step-by-step diagrams to showcase their product creation process can significantly

enhance brand image and attract target consumers. This approach is a crucial factor in boosting brand competitiveness and gaining market recognition.

2.3 SUSTAINABLE FASHION DESIGN

2.3.1 DEFINITION AND SCOPE

Sustainable fashion, also known as "green fashion" or "eco-fashion," refers to fashion industry practices that aim to minimize negative environmental impacts throughout the entire production and consumption process, while also promoting social justice and economic sustainability. This encompasses not only the use of eco-friendly materials and production methods but also involves raising consumer awareness about sustainable consumption.

Sustainable fashion is a growing trend, driven by both consumer demand and environmental concerns (Saksena, 2020). The industry faces significant environmental challenges, but there is a willingness among consumers to pay more for sustainable fashion (Statovci, 2018). The concept of sustainable fashion is part of a broader shift towards system maintainability, and there are practical guides available for designers to reduce the negative impacts of fashion garments. The circular economy concept is also being applied to sustainable fashion, with a focus on keeping textiles and clothing in high quality throughout their life cycle (Matušovičová, 2020). Global fashion brands are adopting sustainable materials and technologies, such as eco-friendly and biodegradable materials, and environmentally friendly manufacturing processes (Nayak et al., 2020).

2.3.2 THE 4R DESIGN CONCEPT

Since the emergence of the eco-design concept, it has garnered widespread attention from various industries both domestically and internationally. Eco-design emphasizes designing product structures, functions, and processes from ecological principles to achieve coordinated economic and environmental development. Increasingly, industries focused on sustainable development are beginning to incorporate eco-design principles.

As a consumable product, clothing should adhere to the eco-design principle, namely the 4R design concept: a design philosophy centered around environmental protection to promote sustainable development, encompassing four aspects: Reduce,

Reuse, Recycle, and Recover. This concept stresses reducing the consumption of natural resources and environmental impact throughout the product's design, production, usage, and disposal phases, to achieve a harmonious coexistence between economic activities and environmental protection.

- **Reduce**

• Minimize resource consumption: In the product design phase, reduce the amount of raw materials used through optimized design, improve material utilization rates, and decrease energy consumption and waste generation.

• Decrease pollution emissions: Choose eco-friendly materials and clean production technologies to reduce pollutant emissions during production and mitigate environmental impact.

- **Reuse**

• Extend product lifespan: Design durable, repairable products that can be used for a long time by consumers, reducing resource waste due to frequent replacements.

• Encourage product reuse: Design products that are easy to disassemble and reassemble so that parts or the whole can be reused in other products, extending the material usage cycle.

- **Recycle**

• Design products for easy recycling: Consider the recyclability of products during design, select materials that are easy to separate and recycle, simplify the recycling process, and increase recycling rates.

• Support material recycling: Encourage material recycling through design, reducing the demand for new resources and lowering environmental impact.

- **Recover**

• Energy recovery: For materials that cannot be directly reused or recycled, recycle fabrics through secondary dyeing transformation to reduce the environmental burden of waste.

• Biomass energy utilization: Utilize the characteristics of biodegradable materials and recover them as biomass energy or soil amendments through composting and other biological treatments.

The 4R design concept provides guiding principles for achieving sustainability in plant-dyed products, helping not only to reduce resource consumption and waste generation but also to promote efficient resource use and the development of a

circular economy. Facing increasingly severe global environmental issues, adopting and implementing sustainable plant dyeing design concepts is a collective effort for designers, manufacturers, and consumers, significantly contributing to society's transition towards a greener, sustainable future.

2.3.3 THE SUSTAINABLE RELATIONSHIP BETWEEN PLANT DYEING AND THE ENVIRONMENT

Figure 23 Sustainable Pathways for Fashion Practices Using Plant Dyes

Note. Illustrated by the researcher.

The relationship between plant dyeing technology and environmental sustainability is gaining increasing attention. Compared to traditional chemical dyes, plant dyes are derived from nature and are biodegradable, helping to reduce industrial dyeing pollution of water resources and promoting biodiversity conservation and sustainable resource management. Additionally, promoting plant dyeing encourages traditional agriculture to grow dye plants, helping to maintain ecological balance and promote rural economic development. Thus, plant dyeing technology serves as a crucial bridge connecting tradition and innovation, fostering environmental sustainability.（Figure 23）

A range of studies have explored the potential of plant-based dyes in sustainable design. Arora (2017)highlight the environmental benefits of plant-based dyes and discussed their biodegradability. However, Halford (2019) and Santos (2022) point out the challenges of using plant-based dyes, including their resource intensity and potential limitations in functionality. Lai (2021) and Thakker (2021) provide insights into the visual and functional aspects of plant-based dyes, with Lai focusing on the sustainability of light-colored indigo dyes and Thakker discussing the potential for these dyes to create functional textiles.

2.3.3.1 Recyclable Plant Dye Design

With the growing awareness of environmental protection and increasing concern for health, the negative impacts of some synthetic dyes on human health and the ecological environment have garnered significant attention. Recent studies have shown that over 100 commonly used dyes worldwide contain carcinogenic substances. Additionally, the ongoing depletion of Earth's petroleum resources has highlighted the issue of raw material shortages for synthetic dyes. As a result, researchers in many countries are now focusing on developing "natural eco-friendly dyes" and "environmentally clean dyeing and finishing technologies." Therefore, the sustainable concept of eco-friendly plant dyeing has gained wider recognition and importance.

In the context of the growing environmental concerns and resource scarcity, sustainable fashion design has emerged as a major trend in the fashion industry. The design of recyclable plant dyes, as a crucial component of sustainable fashion, not only minimizes environmental impact but also promotes innovation and application of traditional dyeing techniques, showcasing unique cultural values and aesthetic beauty.

It is believed that plant dye materials can change their color through recycling, embodying the concept of sustainable creation:

In China's Song Dynasty, there were already records of recyclable economics in plant dyeing. "Tianguan Kaowu" mentions that clothes dyed with safflower are particularly susceptible to the fragrance of agarwood. If clothes dyed with safflower are stored with agarwood, their color tends to deteriorate after about ten to fifteen days. To restore the original color of the clothes, one only needs to wet the dyed fabric and drop some alkali water or rice husk ash water onto it; the red color can be revived, making the clothes appear as new. This recyclable method of plant dyeing not only

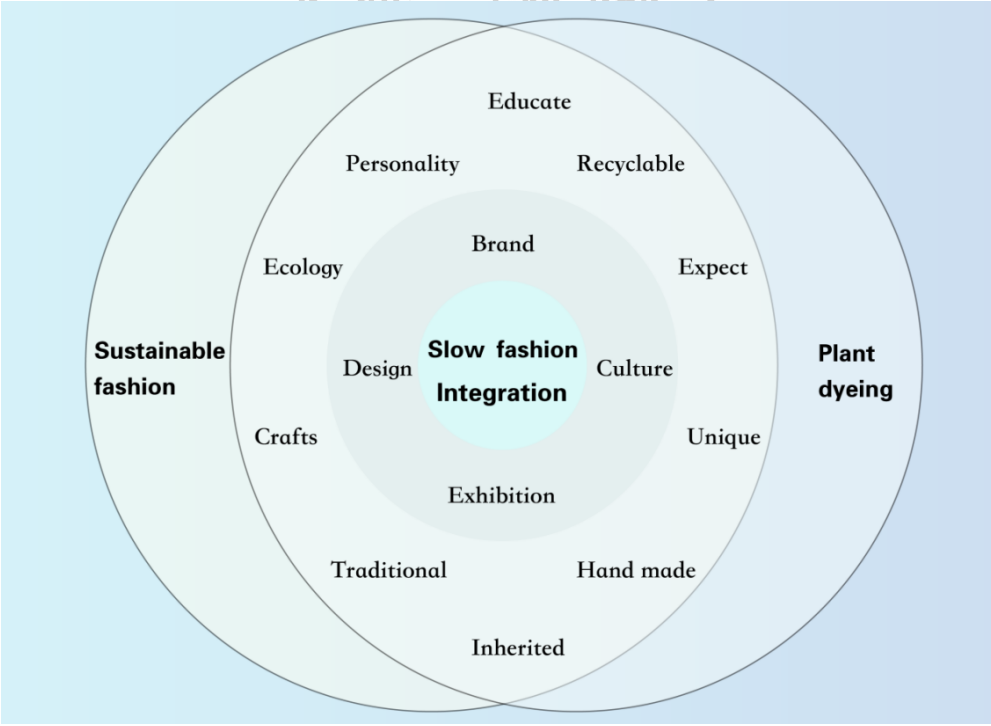
allows for the reused dye to continue being applied to fabrics but also saves the safflower dye.

Therefore, plant dyeing can also present new colors through redyeing and other methods, achieving the purpose of transforming old clothes and enabling sustainable wearing of garments.

2.3.3.2 The Aesthetics of Slow Fashion

In the fashion world, as consumers increasingly demand deeper meaning and quality from their clothing, some designers have begun to focus on ecology, humanity, and a better appreciation and respect for the design and artistic path of slow fashion. Slow fashion seeks a balance point between philosophy and design concepts, a pursuit of a harmonious life, and a contemplative approach to art and creation.

Figure 24 Overview of the Relationship between Plant Dyes and Sustainable Fashion



Note. Illustrated by the researcher.

The philosophy of slow fashion embodies both fashionability and popularity. Under the influence of the "slow fashion" philosophy, clothing brands can more accurately analyze and grasp fashion trends, showing greater foresight and sensitivity

to fashion. Slow fashion emphasizes a blend of modern and handmade elements. With growing environmental awareness, there is a pursuit of returning to nature and simplicity. Plant-dyed clothing allows customers to feel and experience the beauty of clothing details, paying more attention to the quality, culture, and essence of the garments. (Figure 24)

The concept of slow fashion, characterized by locally made, sustainable, and durable clothing, challenges traditional retail models (Štefko & Steffek, 2018). It aligns with the principles of Sustainable Development Goal 12, especially regarding production practices (Koltai, 2023). Slow fashion also offers a potential solution to the environmental and social issues in the fashion industry (Jung & Jin, 2014).

Slow fashion design focuses on using eco-friendly materials and production methods to reduce negative environmental impacts. Plant dyeing considers how to reduce waste and pollution in the production process, aiming for sustainable development economically, socially, and environmentally. This also aligns with consumer demands for environmental protection and sustainability, driving the fashion industry towards sustainability.

2.3.3.3 Emotional Design

Over time, plant dyes undergo changes that bring new sensations. The sustainable concept of plant dyeing emphasizes emotional design, focusing on the communicative and commemorative value of products and highlighting respect for and preservation of the history and culture of plant dyes.

Figure 25 Emotional Design

Note. Illustrated by the researcher.

Designers can express respect and nostalgia for traditional cultures and histories through traditional plant dye techniques, cultures, and materials, evoking emotional resonance and a sense of belonging in people. Through brand design elements and storytelling, products are endowed with unique emotional and personal

characteristics, attracting people's attention and emotional engagement. Emotional design in plant dyeing encourages people to participate in the dyeing process, experiencing the extraction of colors from nature, thereby enhancing their appreciation and respect for natural beauty and traditional craftsmanship. Designing with natural plant dyes not only reduces environmental pollution from chemical dyes but also reflects respect for natural resources and the concept of sustainable use, imbuing the design with profound ecological emotions. (Figure 25)

2.3.4 PRACTICAL STRATEGIES FOR SUSTAINABLE FASHION DESIGN

Using natural plants as dye sources reduces environmental pollution from the production and use of chemical dyes, becoming an important component of sustainable fashion while also promoting the heritage and innovation of traditional culture. Fashion brands demonstrate their commitment to environmental protection and social responsibility through plant dyeing, also endowing products with unique aesthetic qualities and cultural narratives.

2.3.4.1 Sustainable Fashion Brands

A range of studies have explored the concept of sustainable fashion brands, with a focus on both consumer and industry perspectives. Khandual (2019) and Kim (2020) highlight the growing interest in sustainable fashion among consumers, with a particular emphasis on eco-friendly materials and processes. This is further supported by Nayak (2020), who discusses the use of sustainable technologies and materials by global fashion brands. The importance of storytelling and brand image in promoting sustainable fashion is underscored by Woodside (2019) and Kim (2022), with the latter providing a case study on the core values of sustainable fashion. The role of sustainable marketing activities in building brand loyalty is also emphasized by Jung (2020). However, the challenge of achieving sustainability in the fast fashion industry is addressed by Jang (2012), who suggests the need for a shift in social content towards environmentally friendly products and practices. Overall, these studies underscore the multifaceted nature of sustainable fashion brands, encompassing consumer preferences, industry practices, and marketing strategies.

Sustainable fashion brands are committed to reducing environmental impact by utilizing eco-friendly materials, supporting fair trade and workers' rights, and

advocating for a circular and sustainable development concept. Here are some well-known sustainable fashion brands:

- **Patagonia**

Patagonia has long been a pioneer in sustainable fashion, demonstrating its commitment to the environment through the use of recycled materials, support for environmental initiatives, and transparent supply chain practices.

- **Stella McCartney**

A high-end fashion brand, also occupies a leadership position in the field of sustainable fashion by promoting cruelty-free and eco-friendly fashion using materials like organic cotton, recycled polyester, and plant-based leathers.

- **Eileen Fisher**

showcases its commitment to sustainability through its clothing recycling program and the use of sustainable materials. The brand actively engages in community building and environmental protection activities to increase public awareness of sustainable fashion.

- **Veja**

A French sneaker brand, uses sustainably sourced rubber, organic cotton, and recycled materials, emphasizing fair trade and production transparency.

- **Reformation**

Reformation is known for producing fashionable yet eco-friendly women's clothing, utilizing sustainable materials with a focus on water conservation and waste reduction.

- **Loomstate**

Loomstate is dedicated to using 100% organic cotton and sustainable materials, promoting agricultural sustainability through education and collaboration projects.

- **Levi' s**

Levi' s has reduced water usage in its jeans production process through its Water < Less initiative and has launched a program to recycle old jeans.

- **Alternative Apparel**

Alternative Apparel uses organic cotton, recycled polyester, and natural dyes to produce low-impact casual wear.

- **Ma Ke "Useless"**

In order to better protect and pass on traditional folk handicrafts, Ma Ke established the "Useless Design Studio" in 2006. The studio guides people to reduce or even abandon the use of fast-moving consumer goods, valuing and utilizing handcrafted products with zero environmental cost and high quality, practicing an eco-friendly and sustainable lifestyle.

Ma Ke is one of the designers engrossed in plant dyeing. From a young craftsman fascinated by traditional colors and techniques to an independent designer hoping to rejuvenate plant dyeing, more and more people are stepping away from the dazzlingly complex hues to trace back to the essence, from the words "design," "fashion," and "clothing" to the more fundamental "color" and "fabric" itself.

"Land" (Figure 26) was showcased in a century-old middle school basketball court in Paris. This show took place in a century-old high school basketball court in Paris, where the audience walked around observing static displays of the actors. This presentation method reflects Marco's belief in the inherent equality of humans. Since the birth of fashion, it has often been seen as a symbol of rank and privilege. However, when faced with works of art, the real earth, and the diligent laborers, everyone should be treated equally. Without the hard work of these laborers, city dwellers would struggle to survive on this planet. Therefore, we have no superiority in front of them. This show is Marco's deep respect for Mother Earth, who has nurtured humanity for millions of years, and for the farmers who continuously toil on the land.

Figure 26 "Land" at Paris Fashion Week 2007

Note. Source: Brand Wu Yong.

Figure 27 Pengtai 2022 Shanghai Fashion Week "The Five Elements" Collection

Note. Source: Pengtai.

- **Pengtai**

Pengtai, a designer from Taiwan, China, is dedicated to handmade craftsmanship, infusing time and patience into every process from dyeing to sewing. Plant dyeing is a distinctive feature of his brand. To create timeless marks, PengTai uses unassuming leaves and flowers as tools to record the passage of time. He soaks fabrics with various medicinal herbs such as peppergrass, summer grass, mugwort, and gardenia flowers, boiling them together. Each garment in PengTai's collection harmonizes with nature, using fallen leaves, soil, branches, and flowers as tools, capturing their essence on the fabric. Amid the fast fashion trend, the wrinkles and marks left on clothing over time represent its most authentic form. (Figure 27)

- **SHIJIE**

SHIJIE adheres to the use of natural fabrics such as mulberry silk, tussah silk, linen, hemp, and cotton, which are environmentally friendly and offer healthier and more comfortable wear. The brand's main theme is to inherit and innovate Oriental culture and artisanship.

This season, SHIJIE employs intangible cultural heritage crafts such as xiangyun silk, plant dyeing, tie-dyeing, and Chinese knot buttons, combined with contemporary design and lifestyle to present its collection. The designer manually draws images of Dunhuang ink paintings and calligraphy, incorporating auspicious Chinese patterns such as the treasure vase flower, gesang flower, and the pine and crane motif, revitalized with a fashionable design. (Figure 28)

These brands showcase the diversity and innovation of sustainable fashion, proving that the fashion industry can pursue aesthetics while also committing to environmental protection and social responsibility. Through innovative design concepts, the use of eco-friendly materials, and sustainable management of the entire production process, sustainable fashion brands can reduce their environmental impact, gain market recognition, and provide guidance for the sustainable development of the fashion industry.

Figure 28 SHIJIE at China 2024 International Fashion Week

Note. Source: SHIJIE.

Figure 29 UMAWANG SS 2023

Note. Source: UMAWANG.

2.3.4.2 Textile Printing and Dyeing Works

A range of studies have explored the use of plant-derived dyes in the textile industry, highlighting their potential for sustainable and environmentally friendly production. Sharma (2013) and Sankat (2008) both emphasize the need for high-quality, pure dyes, with the latter specifically focusing on the use of eco-friendly metallic mordants. Flint (2008) and Junsongduang (2017)provide practical insights into the use of plant dyes, with the former offering a handbook of sustainable dyeing methods and the latter documenting traditional knowledge of dyeing plants. The potential applications of plant dyes in other industries, such as histological staining, are also explored by Akinloye (2010)and Kumar (2018). These studies collectively underscore the value of plant-derived dyes in promoting sustainable and environmentally friendly practices in various sectors.

Here are some well-known brands' works featuring plant dyeing and tie-dyeing techniques:

- **UMA WANG**

Influenced deeply by traditional philosophy, designer Wang Zhi enjoys using fabrics as a medium to tell stories, innovatively combining textural fabrics, and accustomed to integrating a variety of materials, printing and dyeing techniques, oversized silhouettes, and Chinese prints in her designs, ultimately evolving into an elegant state of opposition and fusion.

The UMA WANG Spring/Summer 2023 Collection, "Gaze of the Wilderness," could be considered the most serene show at Paris Fashion Week. The use of coffee plant material for dyeing conveyed a rustic and tranquil natural state, the blending of different cultures, and a gentle yet firm feminine power. (Figure 29)

This season's collection showcases the different elements of nature through various fabric textures. For example, fabrics dyed with coffee to create an earthy, pleated texture are fashioned into scarves reminiscent of tree roots. Inspired by the forces of nature, the collection transforms soil, rocks, trees, and clouds into natural colors and fabric textures, combining them with traditional textile craftsmanship to evoke wilderness and freedom, simplicity, and rusticity.

The textures and feels of different fabrics blend cultural and natural elements within a desert-like atmosphere, showcasing a tension between softness and strength.

Through the unique characteristics of each fabric, the collection expresses the idea of harmonious coexistence between humans and nature.

Figure 30 MITHRIDATE New York Spring/Summer 2024

Note. Source: Mithridate.

Figure 31 Juana Martín 2023 S/S Haute Couture

Note. Source: Juana Martín.

- **Mithridate**

By blending Oriental aesthetics with avant-garde design, the collection constructs an imaginary Oriental island, harboring a "panacea" and exploring the healing and reconstruction of internal order in contemporary society.

The series "Healing·THE CURE" draws on the dynamic imagery of "water" in nature to express the first stage of self-healing—awareness. (Figure 30) By becoming aware of one's inspiration, talents, flaws, and pain, people question their confusion and indecisiveness, explore the diverse energies of life, and gradually find the foundation for self-growth. The collection uses Western cyanotype and Chinese traditional bean dyeing techniques, giving the garments a calm and deep blue hue. The silhouettes are inspired by the three-dimensional tailoring found in traditional Chinese clothing, following the Oriental aesthetic philosophy of "the heaven is round, and the earth is square." Exquisite ethnic prints exude a clear and joyful atmosphere, conveying the awareness of life's diverse energies.

- **Juana Martín**

Juana Martín's Spring/Summer 2023 Haute Couture collection, titled "Origins," was showcased in a grand cathedral in the United States, drawing inspiration from the designer's childhood summers spent near the port city of Málaga on Spain's southern Costa del Sol. The collection features tie-dyed denim, sculpturally curved sleeves, ruffled tiers, and polka dots, designed for the elegant yet rebellious woman, serving as an ode to her Spanish and Flamenco heritage. (Figure 31)

- **DIOR**

The DIOR 2020 Pre-Fall collection (Figure 32), led by creative director Maria Grazia Chiuri, initiates a dialogue with classic Dior elements. It revisits the traditional crafts of Italian and French fashion. The new collection focuses on the silhouette design of the garments, skillfully incorporating tie-dye patterns.

Figure 32 DIOR Pre-Fall 2020 Collection

Note. Source: DIOR.

Figure 33 DIOR Spring/Summer 2020 Collection

Note. Source: DIOR.

The DIOR Spring/Summer 2020 collection (Figure 33) employs plant dyeing, specifically the plant-based heat transfer printing technique. This natural color palette, though somewhat faded, exudes a tranquil and elegantly understated warmth, presenting a unique botanical texture.

Figure 34 Feng Chen Wang Spring/Summer 2024 Collection

Note. Source: Feng Chen Wang.

Figure 35 Yuima Nakazato Fall/Winter 2022 Haute Couture

Note. Source: Yuima Nakazato.

- **Feng Chen Wang**

Feng Chen Wang aims to recreate these memories through an ancient and unique botanical relief dyeing technique. She selected plants cherished by her grandmother, such as onion skins, eucalyptus leaves, and apple leaves. Collaborating with local Chinese artisans, she transferred these botanical imprints onto traditional Chinese silk fabrics. (Figure 34)

- **Yuima Nakazato 2022**

Integrating advanced digital technology with traditional crafts, digital UV printing enables precise control over the shape of fabrics while accommodating natural dyes. Traditional tie-dye techniques and indigo dyeing leave profound and beautiful marks on soft garments. (Figure 35)

2.3.4.3 Strategies of Sustainable Brands

• Borrowing Colors from Nature: The core of plant-dye brands lies in respect for and utilization of nature. Employing renewable natural dye resources enhances the connection between design and nature through the use of plant-derived colors.

• Balancing Heritage and Innovation: While preserving traditional plant dyeing techniques, the fusion of these methods with modern design concepts results in fashionable products that embody traditional aesthetics and meet contemporary tastes.

• Education and Dissemination: Through workshops, exhibitions, cultural forums, and social media, public awareness of plant dye culture and environmental values is enhanced. This not only improves the brand image but also promotes a consciousness for sustainable consumption.

• Integrating Environmental and Social Responsibility: The use of eco-friendly dyes and fabrics reduces negative environmental impact, demonstrating a commitment to environmental responsibility and fostering sustainable economic and social development.

• Transition to a Circular Economy: In the practice of sustainable fashion design, plant dye brands explore recycling and circular dyeing experiments, reducing resource consumption and offering new ideas and directions for sustainable fashion design.

With the increasing global emphasis on sustainable development, the comprehensive consideration and practical application of plant dyeing in sustainable

fashion design will contribute significantly to achieving sustainability in fashion, society, and the economy.

2.3.5 SUMMARY

Dye pH values exceeding standard regulations can disrupt skin balance and resistance, leading to skin allergies or infections, making the skin more susceptible to bacterial invasion. However, many plant dyes also possess medicinal properties, such as dyeing blue with dyer's woad, which has antibacterial, detoxifying, hemostatic, and anti-inflammatory effects. Plant-dyed fabrics are beneficial to both physical and mental health. Additionally, their antibacterial and antimicrobial properties make plant-dyed clothing and products particularly suitable for sensitive skin individuals.

Figure 36 Opportunities and Challenges for Plant Dye Brands

Note. Illustrated by the researcher.

As consumers become more aware of environmental protection, the demand for sustainable fashion products is steadily increasing. Plant dyeing, due to its natural and eco-friendly characteristics, is becoming a hotspot in the market, attracting an increasing number of consumers seeking a green lifestyle. Plant dye brands face many opportunities and challenges in the current market environment (Figure 36). Brands need to overcome challenges and seize opportunities for sustainable development through strategies such as innovative design, precise market positioning, and effective consumer education. Additionally, by strengthening the protection and inheritance of

traditional culture and enhancing the market competitiveness of plant dye products, they can contribute to the development of the sustainable fashion industry.

The theory and practice of sustainable fashion reveal the immense potential of the plant dye fashion industry in environmental protection, social responsibility, and economic sustainability. This research aims to further expand the theoretical foundation and practical application in this field, providing valuable references for advancing the fashion industry.

2.4 THE ROLE AND INFLUENCE OF FASHION EXHIBITIONS

2.4.1 OVERVIEW OF FASHION EXHIBITIONS

Fashion art, as the name suggests, is the product of combining fashion with art. It is a form of artistic expression that uses clothing as a medium to reflect the creator's thoughts and emotions.

Fashion exhibitions are a significant form of fashion communication, serving as a platform for the convergence of research, design, storytelling, and aesthetics (Green et al., 2021). They can be categorized into two main types: fashion brand exhibitions and museum fashion exhibitions, each with distinct objectives and presentation techniques (Jung & Ha, 2018). The history of fashion exhibitions has been documented, with over 900 entries from 1971 to the present day (Horsley, 2014). These exhibitions have evolved to become visual spectacles, often overshadowing their role as public fora for inclusive, critical, and social debates (Catalani, 2014). Despite their popularity, the influence of fashion exhibitions on museum fashion collecting and presentation policies remains a topic of debate (Delhaye & Bergvelt, 2012).

As time progressed, especially after the Industrial Revolution, fashion exhibitions began to become public and gradually commercialized, attracting a wider audience. In the 20th century, with the development of media and globalization, fashion weeks and major fashion exhibitions became indispensable parts of the global fashion industry. They not only showcase the latest works of designers but also serve as important platforms for setting fashion trends and promoting cultural exchange.

2.4.2 TYPES OF FASHION EXHIBITIONS

2.4.2.1 Art Appreciation Fashion Exhibitions

From the moment of its inception, fashion art has been admired not only for its exquisite craftsmanship but also for its sophisticated decorative techniques and material recreations, making it akin to painting art in carrying and conveying humanity's continuous pursuit of beauty.

The history of fashion itself also forms a perfect tapestry of art history. Shortly after the suicide of fashion designer Alexander McQueen, the Metropolitan Museum of Art in New York presented a commemorative retrospective exhibition that sparked an unprecedented viewing frenzy at the time (Figure 37). In the designer's hometown, the exhibition paid homage to London's prodigy, McQueen, in a more humanized manner. McQueen's creative fashion shows have been lauded as "the most compelling fashion performances in the world today"; his iconic "skull" motif remains an unshakable symbol in the fashion world. The exhibition, titled "Savage Beauty," revealed to the public the dramatically shocking designs born from a heart filled with anger, contradictions, unrest, and darkness.

Figure 37 Alexander McQueen: Savage Beauty / Victoria& Albert

Note. Source: VOGUE CHINA.

Art appreciation exhibitions primarily involve a linear review of designers or brands, emphasizing the interpretation of individual pieces within the context of fashion art. These exhibitions aim to comprehensively showcase each exhibit while maintaining the overall tone of the display space.

By interpreting individual exhibits within the same context, visitors can better understand and integrate the information presented, enhancing their knowledge and appreciation of aesthetics. This approach optimizes their knowledge system and elevates their aesthetic appreciation.

2.4.2.2 Historical Document Fashion Exhibitions

One characteristic of the development of fashion art is that, with the flow of historical trends, fashion exists in a cyclical form, where current fashion trends often draw from the past. In documentary research exhibitions, curators typically focus on a period, zooming in on a decade or era, and explain its specific zeitgeist by combining social-political climates, artistic scenes, innovations in fabric technology, or other historical documents.

In 2015, "China: Through the Looking Glass" was exhibited at the Metropolitan Museum of Art in New York, USA. This exhibition primarily focused on the influence of China on Western fashion. By showcasing a vast array of historical documents, it explored the impact of Sino-Western cultural exchanges on fashion design (Figure 38). The exhibition emphasized fashion narratives, the unpredictable nature of fashion, and the trend of drawing inspiration from its own history. In the context of fashion, symbolic information conveys two levels of meaning: the first is technique and form, and the second is cultural connotation.

Figure 38 China: Through the Looking Glass / MET Gala

Note. Source: Crossing Cultures - Platon for China: Through the Looking Glass.

2.4.2.3 Cultural Education Fashion Exhibitions

Fashion art exhibitions, by combing through the history, development, and dissemination of fashion art culture, create a sensual atmosphere for viewing from specific contexts, eliciting common emotional responses among viewers and

establishing a shared intellectual context. This, in turn, achieves the exhibition's purpose of promotion and cultural enlightenment.

Fashion exhibitions serve as a powerful tool for cultural communication, allowing designers to convey their philosophies and messages (Jang & Yang, 2011). The rise of these exhibitions is influenced by the digital communication ecosystem, which has normalized their cultural offerings (Torregrosa & Sánchez-Blanco, 2021). They also play a role in the heritagization process of fashion, highlighting the "Made in" discourse (García, 2018). Fashion, as a form of communication, reflects the identities of human societies and serves as a representation of civilizations in contemporary media. The popularity of fashion exhibitions has influenced the fashion collecting and presentation policies of museums, aligning with the visual culture and participatory nature of audiences (Delhaye & Bergvelt, 2012). However, there is a need for a method to peer review fashion exhibitions to elevate their scholarly status (Green et al., 2021). Fashion communicates information related to potency, evaluation, physiological and biological traits, demographic characteristics, dynamism, and quality of thought (Lennon et al., 2014). In the field of education, fashion communication is a valuable tool for connecting students to the world, particularly through the lens of intercultural communication (Lenoir, 2019).

Figure 39 The China National Silk Museum

Note. Source: The China National Silk Museum.

Fashion exhibitions, as a unique cultural phenomenon, play a crucial role in cultural dissemination. They not only present the history and development of fashion but also showcase the interaction between fashion and society, politics, economics, and art. By displaying works from designers of diverse cultural backgrounds, fashion

exhibitions promote global cultural exchange and understanding, enhancing public awareness and respect for multiculturalism.

Additionally, fashion exhibitions provide a platform for traditional crafts and techniques, fostering the preservation and inheritance of cultural heritage. The China National Silk Museum, the world's largest museum dedicated to silk, has played a significant role since its opening in 1987. It preserves history, educates the public, promotes cultural exchange, advances craftsmanship, and boosts cultural confidence. The museum is vital for fostering understanding and appreciation of Chinese silk culture and for the transmission and development of silk techniques. It serves as an essential bridge between China's tradition and modernity, as well as between China and the world. (Figure 39).

China's craftsmanship culture, with its long history and splendid achievements, is an essential part of Chinese civilization, embodying the wisdom and aesthetics of creation. In August 2018, the China Artists Association held the first National Crafts and Arts Exhibition in Shanghai, themed "The Vitality of Traditional Crafts." This event included an academic seminar on "The Revival and Creative Vitality of Traditional Crafts," discussing the inheritance and innovation of traditional crafts in the contemporary era, and exploring the integration of traditional craftsmanship with emerging industrial forms, current cultural ecosystems, and social life. In summary, through immersive exhibition experiences and extensive public outreach, fashion exhibitions have become an important part of cultural dissemination and promotion, allowing brands' cultural appeals and stances to be fully expressed. Therefore, sustainable plant dye fashion exhibitions not only convey fashion and cultural reflections but also possess significant social value. Designers can more completely present their artistic concepts, while academic researchers and fashion commentators can access a wealth of informational resources. The public gains greater discourse power through their exhibition experiences.

2.4.3 VIRTUAL FASHION EXHIBITIONS

A range of studies have explored the potential of 3D technology in the fashion industry. Wu (2013) and Xu (2020) both highlight the ability of 3D digital fashion shows to enhance creativity and provide a more immersive experience for consumers.CLO 3D virtual simulation technology has been used to innovate the

design of Wenzhou blue clamp-resist dyeing, reducing product development costs and improving design efficiency (You, 2022). The application of CLO3D technology in the structure design of national costumes has been found to be cost-effective and efficient (Cao & Wang, 2023). CLO 3D has also been used in the production of digital fashion contents based on augmented reality, providing a practical method for fashion designers (Kang et al., 2020).

Figure 40 "Natural Dye" Digital Art Exhibition

Note. Source: AIVR QIUZIJUN.

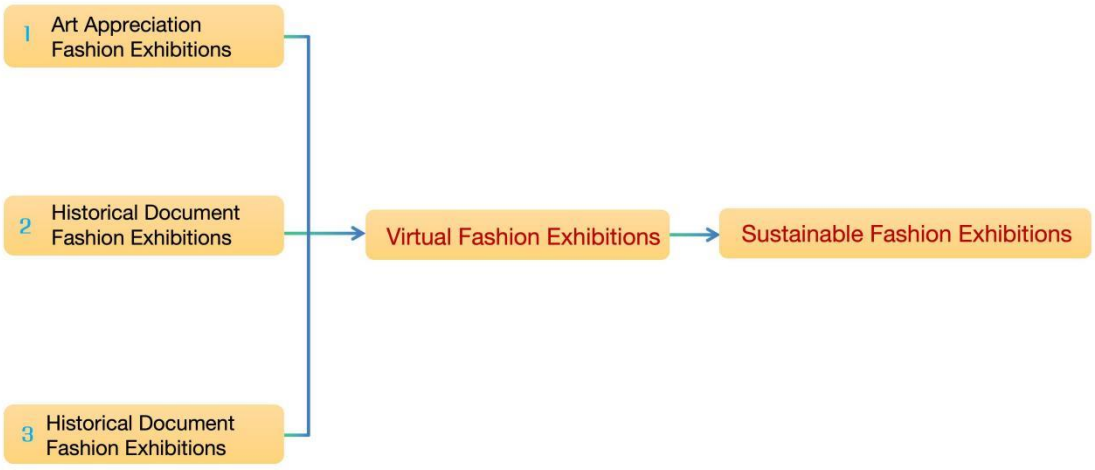
Figure 41 Digital Blockchain Apparel – Iridescence

Note. Source: Weibo SuperDimension.

The development of Chinese folk craft plant dyeing has evolved into a form of culture and art. When appreciating tie-dye works, we not only experience the beauty and harmony of the colors but also understand the profound cultural heritage and historical background behind them. As 3D technology matures, the line between real and virtual becomes increasingly blurred, suggesting that new definitions may emerge for reality and virtuality in the near future. "Fashion freedom" might become a new direction for sustainable fashion. The "Natural Dye" digital art exhibition (Figure 40) takes the public into the world of intangible cultural heritage hand tie-dyeing through an AI art exhibition.

Influenced by the COVID-19 pandemic in 2029, the year 2020 became a pivotal period for the burgeoning development of virtual fashion. Accelerated by the virtual fashion shows, numerous luxury brands hosted grand virtual events, marking a quiet revolution with a significant impact on the fashion industry. As depicted in Figure 41, the world witnessed its first piece of "digital blockchain apparel" - Iridescence, which was auctioned at the Ethereal Summit in New York. As an art piece, it was sold for an impressive $9,500, leading digital apparel to pioneer a new realm in the fashion industry.

Figure 42 Contact for the Virtual Fashion Exhibition



Note. Illustrated by the researcher.

Attempts at virtual fashion exhibitions serve two main purposes (Figure 42) : they provide a unique direction for fashion research, prompting considerations of the

sustainable values of plant dyeing within the intersection of culture and art. Additionally, they are grounded in the cultural representation of the era, with designers infusing their perceptions of the history and culture of plant dyeing into their works, thus reflecting on the social sustainability embedded in fashion pieces.

- **Connecting with Younger Consumers**

Young consumers are increasingly engaging in shopping, socializing, and entertainment within virtual realms, shifting away from exclusively real-world interactions. For brands, embracing digital apparel and virtual experiences enables connections with younger demographics, such as millennials and Generation Z, deepening communication channels and enhancing audience engagement.

- **Expanding New Consumer Bases**

The nature of digital apparel offers a distinct advantage by allowing consumers to experience brands without leaving home, thereby supporting brand growth and fostering loyal consumer bases.

- **Enhancing Brand Influence**

Whether through virtual personas, social marketing, eSports marketing, or e-commerce, luxury brands are witnessing a shift towards digital investments. From another perspective, this could be seen as brands emphasizing the actualization of digital significance by establishing a new presence in a parallel virtual world, crafting brand narratives, and sustaining their brand equity.

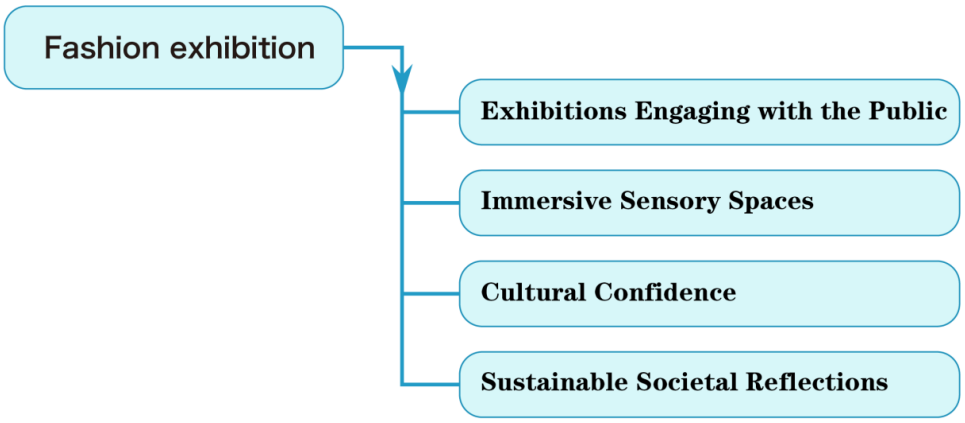
Fashion exhibitions, bridging past and present, tradition and innovation, not only showcase the artistry and creativity of fashion but also play a crucial role in cultural dissemination and sustainable development. These exhibitions are increasingly focusing on the human element over material objects, with the functionality of dissemination and experience becoming significantly more pronounced. This format of fashion communication, incorporating art discussions and cultural studies, is gradually taking shape.

2.4.4 SUSTAINABLE FASHION EXHIBITIONS

In the past, window displays and runways were the primary venues for brands and designers to convey their design concepts. However, these methods still fail to provide the public with a "close-up experience." In an era that prioritizes experiential retail, fashion brands can no longer rely solely on extravagant visuals to attract

consumers. Instead, the underlying brand philosophy and design attitude are becoming the dominant factors in consumer decisions. Among various fashion communication methods, sustainable fashion exhibitions showcasing plant dyeing allow the public to immerse themselves in the intrinsic allure of the apparel (Yuanyi, 2018).

Figure 43 Objectives of Sustainable Fashion Exhibitions



Note. Illustrated by the researcher.

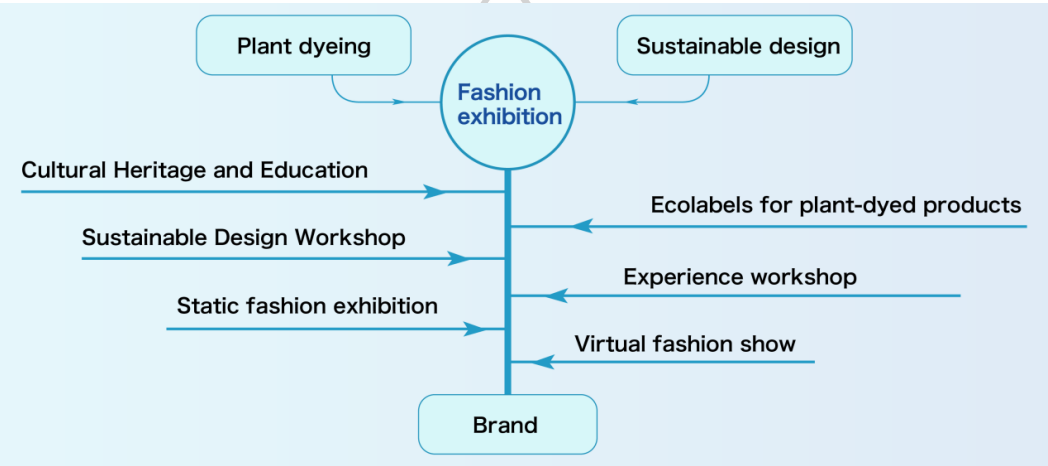
Sustainable fashion exhibitions focused on plant dyeing represent a cultural presentation of the era, promoting the development direction of contemporary sustainable plant dyeing while integrating the history and culture of plant dyeing into design works. This not only sorts through academic references but also reveals the societal contemplations behind the creations. (Figure 43)

In recent years, with the growing emphasis on environmental protection and sustainable development, fashion exhibitions have actively engaged in promoting sustainable fashion. By showcasing clothing designs made with eco-friendly materials and technologies, these exhibitions convey the importance of sustainable fashion to the public and spark interest in environmentally friendly lifestyles. Additionally, fashion exhibitions provide designers and brands with a platform to present their sustainable innovation ideas, fostering the dissemination and practice of sustainable fashion concepts.

2.4.5 SUMMARY

In summary, contemporary fashion exhibitions have transcended the mere collection, display, and retrospection of history. With thought-provoking content, flexible narrative forms, industry-leading concepts, and rich cultural and craft dissemination, contemporary exhibitions play a crucial role in guiding industry trends, nurturing design talent, and promoting culture, brands, and fashion.

Figure 44 Conceptual Framework of Plant Dye Fashion Exhibition



Note. Illustrated by the researcher.

The dissemination of plant dye culture and the trend of sustainable fashion mutually permeate, with exhibitions serving as the bridge for communication and integration between the two. The exhibition elucidates the history and culture of plant dyeing, contemporary design, aesthetic trends, and fashion brands. (Figure 44) By establishing bridges such as sustainable design seminars, experiential workshops, offline fashion exhibitions, and virtual fashion shows, participants gain a more direct and systematic impression of plant dye culture and fashion, cultivating a cultural ambiance where tradition and modernity coexist.

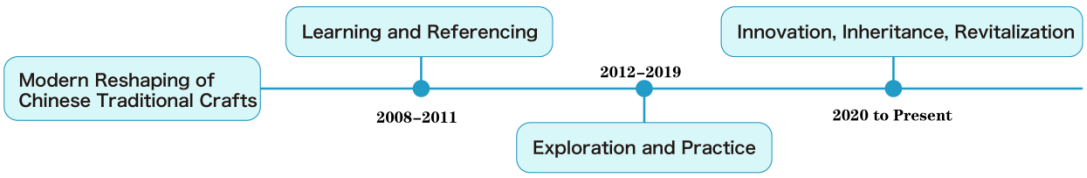
Fashion exhibitions are windows showcasing sustainable design with plant dyes, reflecting cultural identity and social value orientations, benefiting the plant dye fashion brand industry, and positively contributing to the fusion of tradition and innovation in plant dyeing.

2.5 TRADITION AND INNOVATION

2.5.1 IMPORTANCE AND SIGNIFICANCE

Over the past decade, Chinese society has shifted from a superficial understanding of traditional crafts to a deeper appreciation of their aesthetic value in life. This shift in perception has also seen traditional craftsmen and emerging designers exploring the modern innovation of Chinese traditional crafts, demonstrating their value in improving livelihoods, societal development, and lifestyles. (Figure 45)

Figure 45 The Development Journey of Modern Reshaping of Chinese Traditional Crafts



Note. Illustrated by the researcher.

By discussing the application of plant dyes in fashion exhibitions, the importance of protecting and inheriting this traditional skill is emphasized, promoting the maintenance and development of cultural diversity. Integrating traditional crafts and environmental concepts into modern design brings new creativity and inspiration to the fashion design field, enhancing public awareness of sustainable fashion and eco-friendly lifestyles, and offering consumers more diverse and personalized fashion choices.

2.5.2 MARKET AND AUDIENCE

For plant dye brands to preserve and promote traditional culture and enhance the commercial value of plant dyeing, it is essential to focus on accurately targeting their consumer base and deepening the understanding of their target consumers. Innovating plant dye designs to serve modern economic and cultural life and meet contemporary aesthetic demands is crucial. As society rapidly develops, people increasingly seek products and experiences that are unique and reflective of their quality of life and personal pursuits.

In building a plant dye brand, it is important to clarify the cultural foundation and address social needs. Chinese plant dyeing, produced within specific social and cultural contexts, inherently possesses regionality and uniqueness. This distinctiveness is an advantage in designing cultural and creative products and in brand development.

The younger generation quickly embraces cultural concepts and shows strong tolerance for diverse cultures. They tend to prefer avant-garde, unique aesthetics and lifestyles, making them the primary consumers of creative fashion products. Therefore, focusing on the 20-36 age group for innovative plant-dye themed fashion design aligns with user needs and is crucial for gaining market recognition.

Focusing on young customers is not merely about catering to them with simplistic designs but involves combining market demands and trends from both brand development and product market perspectives. By deeply exploring the cultural connotations of plant dyeing and integrating traditional elements with contemporary fashion trends, we can enhance the alignment between products and the user market. This approach not only promotes the heritage and development of plant dye culture but also ensures its relevance and appeal in today's fashion industry.

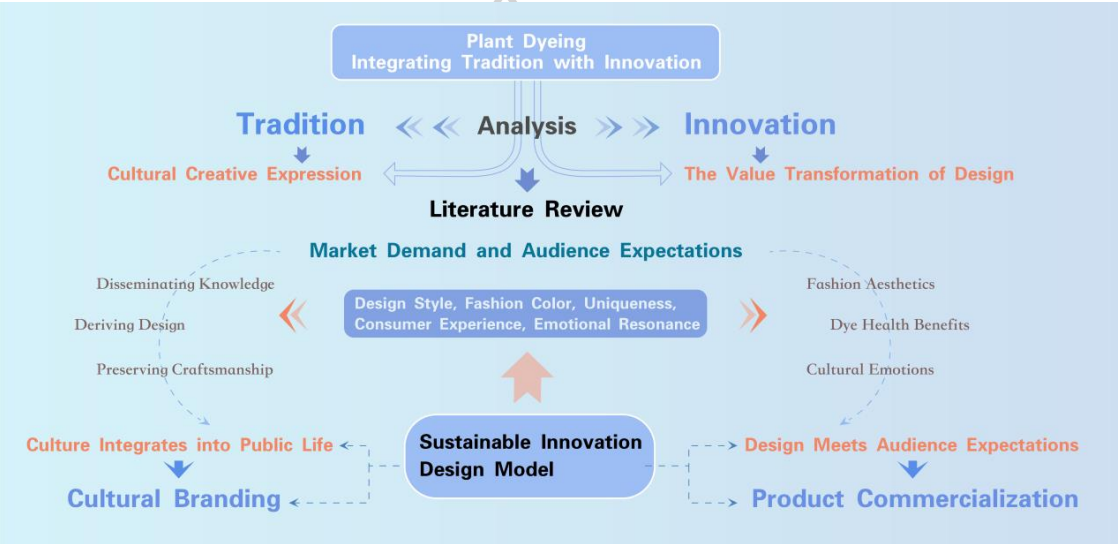
2.5.3 CHALLENGES AND OPPORTUNITIES

Conveying the cultural essence and aesthetic concepts of plant dyes through fashion products and stimulating the brand effect of plant dye-themed cultural products require innovative design in fashion modeling and exhibition formats, resulting in contemporary consumer-demand-driven fashion products based on plant dye themes.

Currently, the tradition and innovative design of plant dyes lack a complete system of creativity and development. Integrating intangible cultural heritage plant dyes into fashion design involves not just offering creativity and products but also establishing a practical design outcome system for value transformation, maximizing the role of modern design in the inheritance and development of intangible cultural heritage. Most cultural and creative practices focus only on product packaging and decoration, lacking deep cultural creativity and expression and innovative design depth.

Branding and commercialization are fundamental paths for cultural preservation and development. This article will explore methods from the perspective of sustainable design to enhance market competitiveness and integrate plant-dye fashion creative design into everyday life, thereby promoting the heritage of plant dye culture. (Figure 46)

Figure 46 Research on Methods Based on the Sustainable Design Model of Plant Dyes



Note. Illustrated by the researcher.

Integrating tradition and innovation in the fashion industry is a crucial development trend. It not only aids in the preservation and transmission of traditional culture but also promotes sustainable development and innovation in the fashion industry. By exploring relevant theoretical foundations and frameworks, this literature review provides theoretical support for understanding this complex process and guides future research and practice.

2.5.4 SUMMARY

In recent years, with economic development and increased environmental awareness, the safety of synthetic dyes in the textile and food industries has been questioned. Traditional plant dyes, with their green, non-toxic, and harmless characteristics, have re-entered public awareness.

Current research on plant dyes, both domestically and internationally, focuses on several aspects:

- Ethnobotanical surveys of plant dye resources
- Chemical properties of plant dyes
- Color fastness of plant dyes
- Resource verification of plant dyes
- The plant dyeing culture of ethnic minorities

Reviewing literature related to this study reveals that current research not only provides theoretical foundations and practical references for the academic community but also highlights research gaps and future directions. Particularly in the integration and innovation of sustainable fashion and traditional crafts, there remains extensive research space and practical potential, offering further depth for continued exploration and empirical validation.

Sustainable design concepts for plant dyes include:

- Promoting environmental concepts
- Advocating humanistic spirit
- Facilitating the dissemination of plant dye culture
- Exploring the medicinal value of plant dyes
- Integrating tradition and innovation in plant dyeing

Culture has never been monolithic; it has always been a symbiosis of one culture with another, complementing and coexisting. At the heart of design lies innovation and creation. Plant dye elements can be presented as independent cultural and creative products or combined with their cultural attributes and forms of expression with sustainable fashion, fashion exhibitions, and other cultural aspects for cross-boundary integration, thereby stimulating brand effects and promoting the dissemination of plant dyeing in modern life.

2.6 CHAPTER SUMMARY

This chapter encompasses a literature review and related research across five sections. The first part discusses the historical evolution and current state of plant dyeing crafts in China. The second part covers Chinese plant dyeing crafts, common dye plants and their techniques, and the development and application of modern plant

dyeing techniques. The third part focuses on the application of sustainable fashion design. The fourth part analyzes the role and impact of fashion exhibitions. The fifth part discusses the importance and practice of tradition and innovation in contemporary fashion. These sections collectively form the research body, aiming to provide a comprehensive and in-depth perspective on the significant role of sustainable fashion with plant dyes in environmental protection, social development, and cultural inheritance.

The first section reviews Chinese literature on plant dyes, systematically presenting the rich connotations and application values of plant dyeing technology and laying the foundation for plant dyes from cultural craft to sustainable modern design.

The second section explores the current status of plant dyeing in China, addressing how to protect and inherit plant dyeing techniques while enhancing their application value in modern society.

The third section on sustainable fashion design theory and case analysis reveals the impact of sustainable fashion on consumer behavior and changes. The 4R design concept and circular economy principles become important guidelines for sustainable fashion design. Case studies of plant dyeing techniques underscore the value and application potential of traditional crafts in sustainable fashion.

The fourth section explores the role of fashion exhibitions in promoting sustainable fashion concepts, educating the public, and enhancing cultural exchange. Fashion exhibitions, as an important form of cultural dissemination, evolve with technology, with virtual fashion exhibitions offering more environmentally friendly and innovative solutions.

The fifth section emphasizes the importance of preserving, inheriting, and innovating traditional crafts and culture in the era of globalization and digitalization. It discusses strategies for market and audience engagement, highlighting the opportunities and challenges faced by sustainable plant-dye fashion brands in meeting modern consumer demands and enhancing market competitiveness.

In summary, through the analysis of these key areas, the significant role of plant dyeing technology in inheriting Chinese traditional culture and promoting the development of sustainable fashion is showcased, serving as an essential bridge between tradition and modernity, nature, and humanity.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 SAMPLE

3.1.1 EXPERT INTRODUCTION

The present study involved interviews and evaluations with nine experts, including three specialists in plant-dying, three in sustainable fashion design, and three in fashion brand design (Table 10).

Table 10 List of Review Experts

Number	Name	Specific Information
Plant Dye Research: 3 people		
1	Ruan Jiangjun	Doctor of Design Science, Chiba University, Japan; School of Packaging Design, Hunan University of Technology Research direction: Intangible Cultural Heritage and the historical culture of plant dyeing
2	Yin Jing	Associate Professor, School of Fine Arts and Design, Changsha Normal University Research direction: Plant dye design and innovation
3	Zou Liulan	Milan plant dye culture heritage researcher Research direction: Folk plant dye culture and heritage
Sustainable Fashion Design: 3 people		
4	He Jingwei	Professor, Dean of the School of Fine Arts and Design, Guangzhou University Research direction: Ethnic and folk art and clothing design
5	Song Yanhui	Professor, Department of Clothing and Apparel Design, School of Fine Arts and Design, Changsha Normal University Research direction: Clothing and apparel design
6	Ouyang Xian	Associate Professor, Department of Clothing and Apparel Design, School of Fine Arts and Design, Changsha Normal University Research direction: Clothing craftsmanship and pattern making

Fashion Brand Design: 3 people		
7	Li Xiang	Associate Professor, Department of Clothing, School of Engineering and Design, Hunan Normal University Research direction: Clothing brand planning
8	Huang Xinjun	Associate Professor, Founder of Zuo Cai You Jian Clothing Design Studio Research direction: Clothing product development
9	Chen Peng	Associate Professor, School of Fine Arts and Design, Changsha Normal University Research direction: CLO virtual fashion design and display

Note. Compiled and analyzed by the researcher.

3.1.2 TARGET AUDIENCE

Preliminary research and observation have found that the development and dissemination of plant dye brands attract a younger audience: ages 25-45. Studies indicate that plant dye fashion exhibitions and brand shaping have relevance and cultural dissemination value for the target audience.

3.1.3 EXPERIMENTAL SAMPLE SUBJECTS

In this study, sufficient analysis of the experimental sample size was conducted to ensure the reliability and validity of the research results. It is also adequate to reflect the characteristics and behaviors of the target sample. The experimental samples primarily included tourists and residents from Yunnan, Hunan, and Zhejiang, as well as selected target audiences. To ensure the reliability of the experimental results, systematic sampling will be employed to select the samples (Table 11).

Table 11 Sample Experimental Data Sheet

Sample Subject	Sampling Method	Purpose	Sample Size	Valid Samples
Audience for Sustainable Fashion Design	"Target Audience Perception Survey" will be distributed via the Questionnaire Star platform.	To investigate awareness with the purpose of promoting sustainable plant dye brands, clarifying the current awareness of the audience towards plant dye to define educational	260	253

		and promotional plans for cultural heritage.		
Audience for Plant Dye Brand Consumption	"Audience Expectation Survey" will target specific audiences and conduct in-depth surveys both online and offline.	The positioning of five expected dimensions of the plant dye brand will allow us to recognize and evaluate an in-depth analysis of the brand image from different perspectives, accurately positioning user needs, and providing necessary guidance for subsequent research and design innovation work.	350	327
Exhibition Audience	During the 14-day exhibition, online surveys will be conducted on a voluntary basis, including "Perception and Willingness to Host Survey on Plant Dyeing Culture" and "Pre-test and Post-test Feedback on the Sustainable Innovation Exhibition of Plant Dyeing."	Based on the integration of tradition and innovation, a measurement of design perception and cultural cognition was conducted for the Xiaran Sustainable Plant Dyeing Fashion Exhibition to evaluate the design proposals.	322	320
		To assess the impact of the Sustainable Plant Dyeing Design Exhibition on audience cognition, a comparative analysis of pre-test and post-test was conducted.	155	150

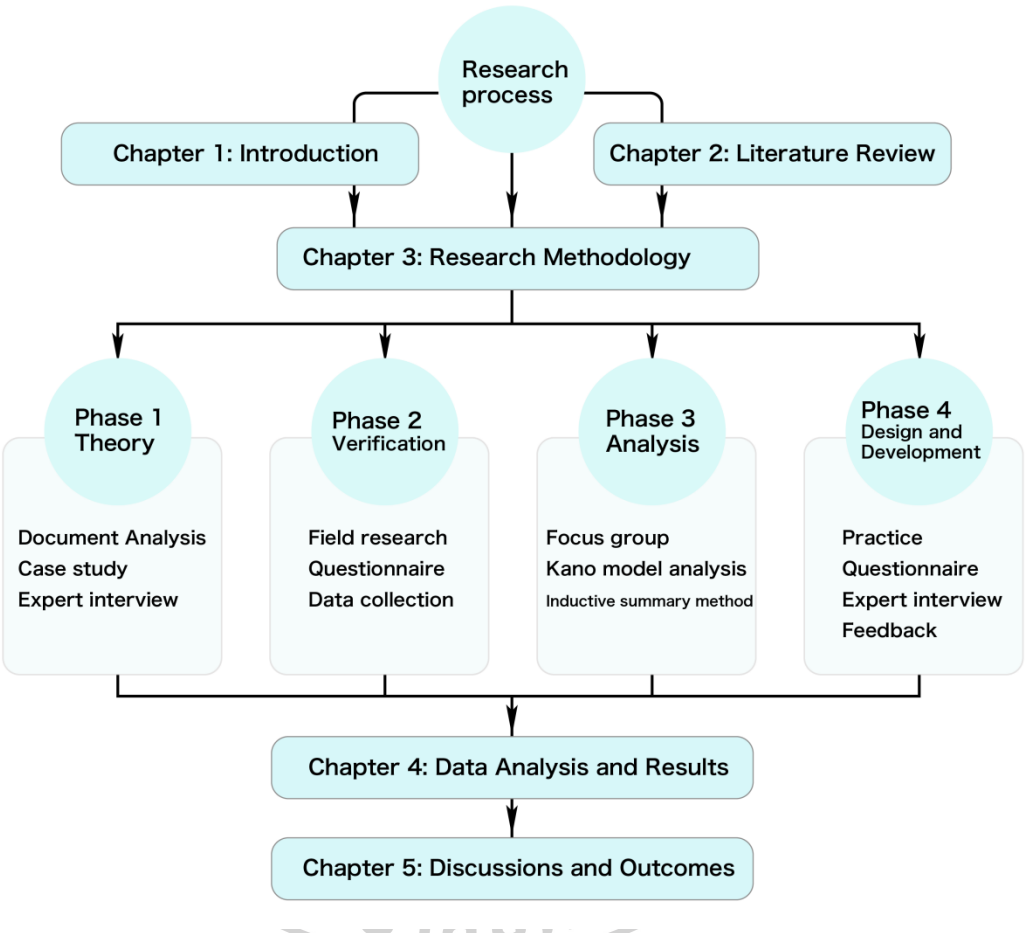
Note. Compiled and analyzed by the researcher.

3.1.4 RESEARCH METHODS

This study employs a mixed-methods approach. Qualitative and quantitative research on plant dye culture and design is conducted through literature analysis, case studies, field research, surveys, interviews, design development, exhibitions, and

evaluation (Spratt et al., 2004). Data, techniques, and methods from this study will be used to assess the quality of evidence for the research.（Figure 47）

Figure 47 Research process framework diagram



Note. Illustrated by the researcher.

3.2 RESEARCH VARIABLES

By defining research variables (Joshi et al., 2015), it is possible to systematically investigate the effects of sustainable plant dye fashion design on enhancing audience cultural cognition, achieving the integration of tradition and innovation, and addressing the challenges faced by plant dye brands in market development. This approach provides a clear direction for organizing the research paper and specifies the path for data collection and analysis.

3.2.1 INDEPENDENT VARIABLES

- Integration of Tradition and Innovation
- Design and Execution of Fashion Exhibitions

3.2.2 DEPENDENT VARIABLES

- Enhancement of Cultural Cognition
- Market Development of Plant Dye Brands

3.2.3 CONTROL VARIABLES

- Stability and Reliability of Plant Dyeing Techniques
- Insufficient Basic Cultural Cognition and Market Awareness among Audiences

3.3 RESEARCH TOOLS

3.3.1 LITERATURE REVIEW

The systematic literature review method involves identifying relevant literature through various steps (Ngwakwe, 2020). Conduct a systematic review of literature on the history and development of plant dyeing, sustainable design, and fashion exhibitions. The types of literature include journals, monographs, doctoral dissertations, websites, newspapers, images, etc. During this process, targeted analyses of cases integrating tradition and innovation are conducted, exploring the existing research scope, academic viewpoints, deficiencies, entry points, research emphases, and research questions in the literature review.

3.3.2 CAFÉ ANALYSIS

Case analysis is a method for in-depth exploration of specific instances to analyze and address related issues deeply (Stake, 2013). In this study, case analyses will focus on a series of representative sustainable fashion exhibitions that successfully integrate plant dyeing techniques with modern design concepts.

Data collection will be conducted through various means such as accessing exhibition records, catalogues, designer interviews, audience feedback, and related media reports (Tellis, 1997). These data will provide detailed information on each case, including the purpose of the exhibition, the displayed works, audience reception, and market response. The study will explore how these cases address the challenges

of applying traditional crafts in modern contexts and their impact on raising public awareness of sustainable fashion concepts.

3.3.3 FIELD RESRARCH

Field research is a crucial link between theory and practice and deepens the understanding of the research, significantly relevant to the thesis theme of "integrating tradition with innovation" (McKinnon, 1988).

• Purpose: The main objectives for field research are set in Hunan Shaoyang, Hunan Xiangxi, and the Bai ethnic group in Yunnan. The goals are to deeply understand the modern applications of plant dyeing crafts, explore plant dyeing practices in fashion design, and assess the impact of fashion exhibitions on public cognition.

• Collection: Conduct in-depth interviews with continuous users of plant dyeing techniques, fashion designers, and exhibition curators to collect their views on plant dyeing techniques, practical experiences, and attitudes towards sustainable fashion.

• Observation: Perform on-site observations at fashion exhibitions and studios, recording the application processes of plant dyeing techniques, visitor interactions, and the layout of exhibitions.

• Analysis: Analyze related documents such as exhibition catalogs, craft manuals, and project reports to understand the background, objectives, and outcomes of plant dyeing projects. Organize and analyze the collected data to identify the application models, challenges, and opportunities of plant dyeing techniques in modern design.

• Evaluate how fashion exhibitions serve as an effective platform to showcase the innovation and artistry of plant dyeing and their contribution to raising public awareness.

Finally, articulating the modern application status of plant dyeing techniques, the role of fashion exhibitions, and the practice of integrating tradition with innovation based on the findings from field research. Propose recommendation strategies based on the results of the field research to guide further development of plant dyeing techniques and optimization of fashion exhibitions.

3.3.4 QUESTIONNAIRE

The questionnaire used in this study is divided into the following three parts:

• **Part One: Questionnaire survey about the general situation of the respondents.**

These include the respondent's gender, age, educational experience, family income, whether they know or understand the culture of plant dyeing, and whether they have participated in such plant dyeing exhibitions.

• **Part Two: Focuses on consumer expectations for traditional Chinese plant dye products.**

This article determines the list of expected features for traditional plant dye products through in-depth interviews.

The target locations for the expectation list survey were primarily chosen to be consumer places such as museums and tourist areas. Using a random sampling method (Turisová, 2015), Conducting in-depth interviews with respondents and collecting 92 text samples of consumer expectations. However, considering the need for precise identification and reasonable differentiation of the expectation list, an expert interview panel was established. The panel filtered, merged, adjusted the expression, and categorized the expectation text list. Once the expert panel reached a consensus, the information was consolidated into five dimensions of expectations: brand style, brand design, product performance, purchasing preferences, and product culture, resulting in a list of 28 expectation indicators .

• **Part Three: Based on the integration of tradition and innovation, the measurement of design perception and cultural cognition of plant-dyed fashion exhibitions.**

Through literature and case analysis of traditional plant-dyed fashion designs and exhibitions, we can realize that plant-dyed technology not only carries profound cultural significance and the wisdom of traditional craftsmanship, but also embodies the integration of the pursuit of environmental sustainability and modern design (He et al., 2020). The study aims to explore the audience's design perception and cultural cognition of traditional plant-dyed fashion exhibitions and measure their willingness to participate in plant-dyed fashion exhibitions. Based on the artistic characteristics of plant dyeing, a survey scale was compiled, divided into five dimensions: artistry,

culture, tradition, authenticity, and emotion, to measure the audience's design perception and cultural cognition of traditional plant dyeing fashion exhibitions. (Table 12)

Table 12 Integration of Tradition and Innovation: Design Perception and Cultural Cognition of Plant Dye Fashion Exhibitions

Artistry	
F1	The ambiance of the exhibition conveyed a unique cultural essence and artistic beauty.
F2	The plant dye fashion design piqued my curiosity and desire to explore plant dye culture further.
F3	The plant dye fashion exhibition sparked my interest in engaging more deeply and learning about related activities.
Culture	
F4	The exhibition enhanced my knowledge of traditional dyeing culture and broadened my horizons.
F5	The exhibition provided insights into traditional dyeing techniques and their applications in contemporary design.
F6	The exhibition demonstrated the integration of cultural creativity and craftsmanship, showcasing the innovation in dyeing culture.
Tradition	
F7	The exhibition effectively showcased the charm of traditional dyeing techniques and culture.
F8	The exhibition displayed respect for and the continuation of traditional dyeing techniques.
F9	The plant dye fashion exhibition facilitated wider dissemination and understanding of traditional dyeing techniques and culture.
Authenticity	
F10	The exhibition displayed works that are close to nature, reflecting the authentic beauty of plant dyeing.
F11	The plant dye fashion presented a genuine use and respect for raw materials and traditional techniques.
F12	The exhibition conveyed the raw and pure essence of the dyeing culture.
Emotion	
F13	Viewing the exhibition provided me with an appreciation of the beauty of plant dyeing and spiritual pleasure.
F14	The exhibition evoked my respect for and emotional resonance with nature and traditional culture.
F15	The exhibition immersed me in an artistic atmosphere where tradition and modernity converge, allowing me to experience unique cultural narratives.

Note. Compiled and analyzed by the researcher.

In exploring participants' willingness to engage in plant dye fashion exhibitions, a specialized perceptual scale for willingness to participate in plant dye fashion exhibitions (Hua & Yongjin, 2010), was further developed. This scale measures the audience's attitudes and willingness to participate in and support plant dye fashion exhibition activities, reflecting the level of interest and support for the integration of traditional crafts and modern fashion. (Table 13)

Table 13 Willingness to Participate in Plant Dye Fashion Exhibitions

D1	If time and financial conditions allow, I am willing to participate in plant dye fashion exhibitions.
D2	I am willing to recommend visiting plant dye fashion exhibitions to friends and family, sharing this unique cultural experience.
D3	Compared to other traditional plant dye exhibition forms, I am more interested in participating in plant dye fashion exhibitions.
D4	Even if time and financial conditions are limited, I will look for opportunities to understand and support plant dye fashion culture, such as through online platforms to watch exhibitions, purchase plant dye products, etc.
D5	I believe that participating in plant dye fashion exhibitions is an important way to understand and support sustainable fashion and traditional crafts.
D6	I am willing to participate in plant dye workshops or activities, to personally experience and learn the plant dyeing technique.
D7	Understanding the culture and skills behind plant dye fashion design increases my interest in participating in the exhibition.
D8	I support the promotion and inheritance of traditional dyeing techniques through plant dye fashion exhibitions.

Note. Compiled and analyzed by the researcher.

The article employs a Likert 5-point scale (Joshi et al., 2015), facilitating feedback collection and assessment across five levels, with the specific rating standards as follows:

- "Strongly Disagree" indicates the lowest level.
- "Disagree" represents a low level.
- "Neutral" stands for medium.
- "Agree" denotes a high level.
- "Strongly Agree" represents the highest level.

Through the above rating standards, this study aims to gain a deep understanding of the audience's perception and cultural awareness of traditional plant-dye fashion design. It seeks to explore effective ways to promote the inheritance and innovation of traditional dyeing techniques in contemporary society. Additionally, it will help understand the audience's attitudes towards traditional culture and sustainable fashion, accurately identifying their preferences for participating in and experiencing such cultural activities and exhibitions.

3.3.5 FOCUS GROUP INTERVIEWS

3.3.5.1 Purpose of the Interview

To further understand the audience's awareness, attitudes, and the impact of plant dye culture, explore the necessity of development and innovation of plant dye culture in contemporary society, and the significance of integrating traditional skills with modern design concepts for the sustainable fashion industry (Dilshad & Latif, 2013).

3.3.5.2 Content of the Interview

- **Inheritance of Plant Dye Culture**

The interviewees' understanding of the history and cultural value of plant dyeing techniques. The challenges and obstacles faced, as well as the main issues encountered in the inheritance process and the strategies for solving them.

- **Innovation and Development of Plant Dye Culture**

Attitudes towards innovation in plant dyeing techniques, sharing examples or case studies, and describing the role and impact of innovation on the inheritance and promotion of plant dye culture.

- **Market Development Challenges**

The market positioning and audience acceptance of plant dye products, including consumers' views on sustainable fashion. The challenges encountered in market promotion and brand building, as well as suggestions and insights for enhancing the market competitiveness of plant dye products.

- **Integration of Tradition and Modern Design**

How interviewees view the practice of integrating traditional plant dyeing techniques with modern fashion design. Examples or experiences of promoting plant dye culture and sustainable fashion concepts through design practices.

• **Future Prospects for Plant Dyeing Development**

The respondents' expectations and predictions for the future development of plant dyeing technology and culture, along with their suggestions for promoting the advancement and innovation of plant dyeing techniques.

This interview record form is designed to collect the insights and recommendations of experts who have a deep understanding and contribution to the research on "Fashion Exhibitions in the Transition of Plant Dyeing from Cultural Craft to Sustainable Modern Design."

3.3.6 EXPERT INTERVIEWS AND EVALUATIONS

3.3.6.1 Inviting plant dye experts (Ruan Jiangjun, Yin Jing, Zou Liulan) for discussions and comparative studies on early plant dye culture, history, and development, focusing on commonly used dye colors and techniques in plant dyeing for compilation and comparative research.

3.3.6.2 Inviting sustainable fashion design experts (He Jingwei, Song Yanhui, Ouyang Xian) for discussions on innovative design based on traditional plant dye culture.

3.3.6.3 Collaborating with fashion brand design experts (Li Xiang, Huang Xinjun, Chen Peng) for discussions on brand development and exhibition communication.

Based on the insights, experiences, and recommendations of the aforementioned experts, a qualitative analysis was conducted to extract commonalities, points of contention, and solutions. This process culminated in the development of research interviews and questionnaires. (Von Soest, 2023).

3.4 RESEARCH PROCESS

This study primarily revolves around research and development work, with researchers dividing the research process into three stages. Specifically, as follows:

- **Stage One Research**

Analysis of the Theory and Practice of Plant Dye Culture and Modern Design Process Overview:

• Cultural and Technological Development Research: Through literature review and field research, systematically analyze the history and cultural background of plant

dyeing technology and its current market development trends. Investigate applications of plant dyeing in modern fashion design to understand how plant dyeing integrates with modern design concepts.

• Expert Interviews: Interview 10 experts or professors from the fields of traditional craft protection, fashion design, and plant dye culture research to collect insights and recommendations on the inheritance and innovation of plant dye culture, providing suggestions for subsequent research.

• Theoretical Model Construction: Based on collected data and expert opinions, construct a theoretical model for the integration of plant dye culture and modern fashion design. Use fashion design theory to analyze and interpret the cultural significance and application value of plant dyeing in modern design.

- **Stage Two Research**

Plant Dye Sustainable Fashion Survey Questionnaire

Process Overview:

• Scope and Structure of Research Tools for Sustainable Fashion Design: Define the scope and structure of the research tools to align with and support the objectives of this study.

• Drafting Research Instruments: Based on the advice of the doctoral advisor, refine the research instruments. Use the Item Objective Consistency Index (IOC) for reviewing, commenting, and scoring. Prepare a complete set of research instruments for data collection.

• Target Audience Characteristics Analysis: Identify the characteristics of the target audience's expectations towards plant dye designs, as well as their attitudes towards sustainable fashion.

• Questionnaire Design and Implementation (Table 11): Based on the theoretical model from the initial phase and expert recommendations, compile questionnaires for the target audience expectations survey, target audience cognition survey, plant dye cultural perception and willingness to host, and cognitive feedback survey for plant dye sustainable innovation exhibitions (pre-test and post-test).

• Data Analysis and Improvement Recommendations: Integrate preliminary research data to refine and analyze plant dye brand design and fashion exhibition strategies.

- **Stage Three Research**

Design and Implementation of Plant Dye Fashion Exhibitions

Process Overview:

• Cultural Heritage and Innovation Strategies: Based on the research findings from the first two stages, propose strategies to promote the inheritance and innovation of plant dye culture, designing plant dye fashion exhibition plans that conform to contemporary market aesthetics and sustainable fashion concepts.

• Exhibition Implementation: Carry out the XiaRan plant dye fashion brand design exhibition, enhancing audience participation and cultural dissemination through online and offline display and interactive experience design, achieving fashion exhibitions in the digital age (Loscialpo, 2016).

• Feedback Collection: Gather feedback from visitors to assess the exhibition's effect and further improve the communication strategies of plant dye fashion design.

• Cultural Dissemination and Educational Significance: Analyze the exhibition's role in enhancing public awareness of plant dye culture and sustainable fashion. Suggest how to further promote plant dye culture and design concepts through educational programs, workshops, and other means.

3.5 DATA COLLECTION

To collect information, researchers executed the following steps:

3.5.1 DATA COLLECTION FROM EXPERT INTERVIEWS

• Researchers applied to the Department of Fashion Design at Changsha Normal University to find cooperating experts.

• Researchers collected data from interviews and took further research steps.

3.5.2 DATA COLLECTION FROM SURVEYS: CONSUMER EXPECTATIONS FOR TRADITIONAL CHINESE PLANT DYE PRODUCTS

• Establish a list of expected features for traditional plant dye products through expert interviews.

• Distribute questionnaires to plant dye consumers and visitors of plant dye-related attractions.

• Collect the questionnaires and proceed to the next steps of analysis and research.

3.5.3 DATA COLLECTION FROM SURVEYS: DESIGN PERCEPTION AND CULTURAL COGNITION OF PLANT DYE FASHION EXHIBITIONS

• Researchers explained the questionnaire to the audience before they visited online or offline fashion design exhibitions.

• After viewing the exhibition, the questionnaire was distributed to the visitors of the exhibition through the "Questionnaire Star" platform (www.wjx.cn) via QR code or link.

• Collect the questionnaires and conduct further research according to the procedure.

3.5.4 EXPERT REVIEW DATA COLLECTION

• Researchers applied to the Department of Fashion Design at Changsha Normal University to find cooperating experts to review the exhibition.

• Researchers continued the research process by collecting all expert review data.

3.6 DATA ANALYSIS

In data analysis, researchers conducted the following analyses:

3.6.1 INTERVIEW ANALYSIS

The paper mainly covers interviews with experts and scholars on: the current development status of plant dye culture, related research on plant dye design, plant dye fashion exhibitions, fashion brand R&D, and the integration of traditional and innovative design concepts.

3.6.2 ANALYSIS OF SAMPLE DATA

Through the following series of steps:

• Establish reasonable sample screening criteria to filter the initial scales, such as questionnaires with errors or omissions.

• Conduct reliability and validity tests on the data used in the text.

• Perform descriptive statistical analysis on the basic information of the respondents.

• Analyze consumer expectation indicators for traditional Chinese plant dye products using the Kano model.

• Conduct a correlation analysis between the design perception and cultural cognition of plant dye fashion exhibitions and the variables of willingness to participate in plant dye fashion exhibitions (Gogtay & Thatte, 2017).

• erform a regression analysis on the design perception and cultural cognition of plant dye fashion exhibitions and the variables of willingness to participate in plant dye fashion exhibitions (Sykes, 1993).

• Data from visitors were collected before the exhibition (pre-test) and after its conclusion (post-test). A structured questionnaire was used to evaluate the effect size using Cohen's d, in order to ascertain the actual impact of the exhibition on the audience.

3.7 CHAPTER SUMMARY

This chapter provides a detailed overview of the methodological framework employed in this study, including population and sampling strategies, definitions of research variables and terms, selection of research tools, and specific steps for data collection and analysis. The study aims to deeply explore the evolution of plant dyeing technology from traditional cultural craftsmanship to sustainable modern design, with a particular focus on its application and impact in fashion exhibitions.

By organizing expert discussions, field research, surveys, and interviews, the study constructed a multidimensional research perspective, ensuring the comprehensiveness and depth of the research findings. The clear definition of research variables and terms provided a lucid theoretical framework, guiding the direction of the entire study and the data analysis process.

The diversity of research tools and the phased design of the research process ensured the systematic and scientific nature of the study, thereby enhancing the reliability and effectiveness of the research findings. The combination of quantitative and qualitative data analysis methods offered a scientific evaluation and deep insights into the application of plant dye in modern fashion design.

In summary, this chapter laid a solid research foundation for understanding the role of plant dye in the integration of tradition and modernity, especially in terms of its impact on fashion exhibitions. It not only provided significant support for the subsequent analysis and discussion of this study but also offered valuable references for the inheritance and development of plant dye culture and the advancement of sustainable fashion.

CHAPTER 4

DATA ANALYSIS AND RESULTS

This chapter conducts a thorough analysis of the cultural constitution of plant dyeing through empirical data obtained from field investigation, focus groups, case studies, expert interviews, literature reviews, questionnaire surveys, workshop experiments, and fashion design and exhibitions.

4.1 COMPOSITION OF PLANT DYEING CULTURE

4.1.1 FIELD INVESTIGATION

Field research provided this study with a wealth of firsthand information. Extensive site visits were conducted in multiple locations across China's Yunnan, Hunan, and Zhejiang provinces, along with comparative research on the plant dye market in Thailand (Wolcott, 2005).

4.1.1.1 Yunnan Province, CHINA

- **Xizhou Ancient Town, Dali**

Xizhou, as one of the tourist attractions in Yunnan Province, draws many visitors with its rich natural scenery and profound cultural heritage (Fan et al., 2018). It preserves well-maintained Bai ethnic traditional architecture and lifestyles, among which the most representative is the Bai ethnic blue dyeing handicraft culture. In the Xizhou ancient town market, a significant portion of the sales consists of plant-dyed goods, including apparel such as T-shirts, handmade dolls, decorative hangings, and home textiles (Figure 48). However, there is a notable homogenization among store products, lacking distinctive brand characteristics.

Figure 48 Xizhou Ancient Town, Dali

Note. Photographed by the researcher.

- **Zhoucheng Village, Dali**

In 2006, Bai ethnic tie-dyeing was listed in the first batch of national intangible cultural heritage (Liu et al., 2014). Zhoucheng Village is renowned for its Bai cultural background. The craft culture of tie-dyeing here has developed steadily, and the field study included a visit to the "Dali Puzhen Tie-Dye Experience Hall." The research observed that many shops and workshops in Zhoucheng not only provide tourists with explanations of plant dyeing history, techniques, and culture but also offer hands-on dyeing experiences and interactions. Under the guidance of artisans, tourists can actively participate in the dyeing process, enhancing their understanding of plant dye culture and local customs through interactions with villagers (Figures 49 , 50).

Feedback from on-site visitors indicates that creating indigo-dyed works based on personal preferences significantly enhances their understanding and appreciation of plant dye culture. This approach effectively contributes to the protection and transmission of the intangible cultural heritage of plant dyeing.

Figure 49 Zhoucheng Village Indigo Dyeing Experience Workshop

Note. Photographed by the researcher.

Figure 50 Indigo Dye Mold Templates

Note. Photographed by the researcher.

4.1.1.2 Hunan Province, China

- **Milan Plant Dyeing Workshop, Shaoyang**

Located in Baishuidong Village, Longhui County, Shaoyang City, Hunan Province, the "Milan Plant Dyeing Workshop" lies within a village populated by the Hua Yao ethnic group. Despite its remoteness from urban centers, the village maintains a fervent dedication to traditional plant dyeing. A one-on-one interview with the workshop's inheritor, Zou Liulan, highlighted the emphasis on environmental sustainability in modern developments of plant dyeing. Furthermore, the workshop hosts learning groups from various regions for systematic training in plant dyeing lasting one to two weeks, effectively fostering local cultural and economic development (Figure 51).

Figure 51 Milan Plant Dyeing Workshop in Shaoyang

Note. Photographed by the researcher.

- **Xiabu Culture Base, Liuyang**

In 2008, the craft of Xiabu fabric weaving was listed as a national intangible cultural heritage (Huo et al., 2013). The field study focused on the Xiabu Cultural Base located in Wanzai County, Yichun City, Jiangxi Province. A visit to the Wanzai County Shuangzhi Xiabu Factory was conducted, where the factory head, Song Zhixue, and his father, Song Shuya—one of the two national intangible cultural heritage heirs of Xiabu weaving—were interviewed. A comprehensive study of Xiabu dyeing history and product characteristics was carried out, alongside discussions on the weaving techniques and industrial cultural development pathways, offering theoretical insights for the development of plant dyeing (Figures 52 and 53). Typically, the Xiabu woven from ramie is seen only in its natural color. However, using plant dyeing as a medium follows a beneficial cycle between humans and nature, providing humans with pure plant materials that allow the skin to breathe freely, bringing the body back to nature. The intersection of plant dyeing and Xiabu represents a cultural exchange and heritage between two traditions.

Figure 52 Liuyang Xiabu Cultural Base

Note. Photographed by the researcher.

Figure 53 History of Xiabu Plant Dyeing

Note. Photographed by the researcher.

4.1.1.3 Zhejiang Province, China

- **China Silk Museum**

Located in Hangzhou, Zhejiang Province, the China Silk Museum is the largest silk museum in the world. It showcases a variety of textile and apparel cultural heritages, focusing on collection, preservation, research, display, transmission, and innovation. The museum narrates various textile processes in both two-dimensional and three-dimensional forms, providing visual cultural communication that effectively enhances the audience's cultural understanding of textiles and apparel (Figures 54，55) (Sless, 2019). Additionally, by displaying the application of plant dyes in textiles, the museum reveals the historical depth and broad applicability of Chinese plant dyeing techniques (Figure 56).

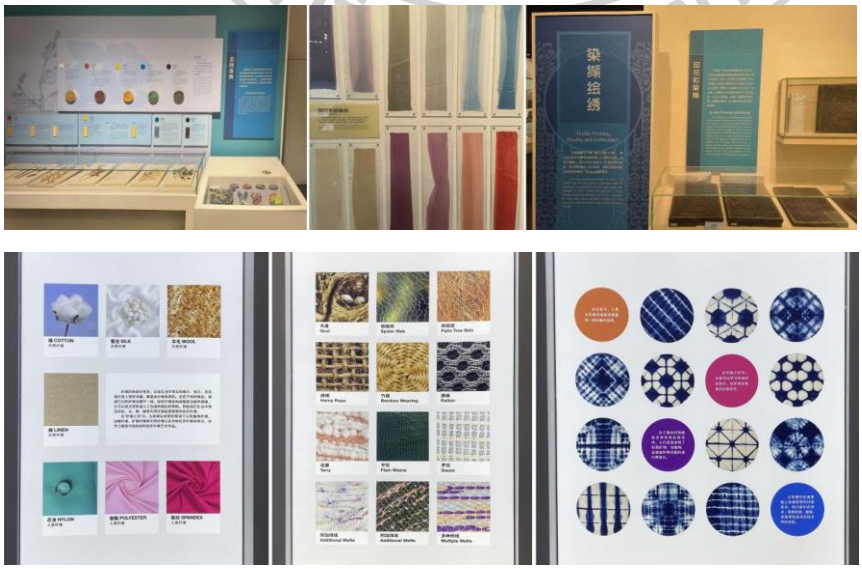
Figure 54 Three-Dimensional Visualization of Textile Processes

Note. Photographed by the researcher.

Figure 55 Graphic and Textual Visualization of Textile Processes

Note. Photographed by the researcher.

Figure 56 Plant Dyeing Cultural Exhibition



Note. Photographed by the researcher.

- **Wuzhen Plant Dyeing Workshop**

Chinese blue calico, originating during the Qin and Han dynasties and flourishing in the Song dynasty, saw significant development after the Southern Song dynasty relocated the capital to Lin'an (modern-day Hangzhou) (Jia & Liu, 2021). The aggregation of skilled artisans along the middle and lower reaches of the Yangtze River, fostered by the cultural integration between the north and south, propelled the evolution of blue calico. Wuzhen, historically situated at the intersection of two provinces (Zhejiang and Jiangsu) and three prefectures (Jiaxing, Huzhou, Suzhou), was a hub of waterway trade, which not only stimulated the local economy but also facilitated the exchange of various cultural and technical practices. Thus, Wuzhen is one of the original sites of blue calico production. The "Caomu Bense" Dyeing Workshop in Wuzhen's Xizha Scenic Area, established during the Song dynasty and continuing to this day, specializes in traditional plant dyeing. The workshop uses natural plant dyes primarily for producing blue calico and multicolored tie-dyed fabrics (Figure 57).

Figure 57 Wuzhen "Caomu Bense" Dyeing Workshop

Note. Photographed by the researcher.

In the plant dyeing workshop, visitors can actively participate in the fabric dyeing process, gaining insight into the origins of dyes and the techniques of fabric dyeing, thereby experiencing the allure of traditional Chinese craftsmanship. Overall,

Wuzhen is renowned for its unique culture and traditional crafts, with fabric dyeing and blue calico production serving as signature tourist experiences. Both viewing and participating in these activities significantly contribute to the local tourism economy and the preservation of handicraft culture (Figure 58).

Figure 58 Wuzhen Blue Calico

Note. Photographed by the researcher.

4.1.1.4 Bangkok, Thailand

- **Thailand Creative & Design Centre**

Figure 59 Thailand Creative & Design Centre

Note. Photographed by the researcher.

The Thailand Creative & Design Centre, established in 2004, serves as a public resource hub focused on design and creative industries. As one of Asia's largest creative resource centers, it houses over 70,000 books covering various design disciplines and related fields. During my visit to TCDC's Material and Design Innovation Center, I observed its role in promoting and supporting material innovation. The center aims to explore material choices and trends, offering consultation services for material and design innovation, and submission services for innovative and eco-friendly material suggestions. The plant-dyed fabrics displayed at

TCDC feature QR codes that provide access to information about the fabric's history, culture, origin, design, and application, enriching visitors' learning experience (Figure 59) (Suntrayuth, 2016).

- **Thai Apparel Market**

Figure 60 Thai Apparel Market

Note. Photographed by the researcher.

Through in-depth research on Thailand's plant-dye products, it is found that Thailand also has rich experience and extensive application in the field of plant dyeing. By examining different consumer districts such as Chatuchak Weekend Market and CentralWorld in Thailand, one can see various indigo dye brand stores, reflecting the diversity and innovation of plant dyeing techniques under different national cultural backgrounds (Figure 60).

Thailand and China each have unique advantages in the indigo dye market, mainly influenced by their cultural, geographical, and historical backgrounds:

Thailand's advantage lies in its deep cultural traditions and craftsmanship. The Sakon Nakhon area of Thailand is renowned for its high-quality indigo products, which showcase exquisite craftsmanship and reflect the rich cultural heritage of the region. Additionally, Thai indigo workshops and brands like Studio Chiangdao Blue not only offer visitors hands-on indigo dyeing experiences but also promote sustainable development and natural dyeing concepts.

In summary, both Thailand and China are distinctive in their approaches to advancing the global trend of natural plant dyeing and sustainable fashion. The plant dyeing industries in both countries strive to adapt to global market changes while preserving their unique cultural identities and craft traditions. However, the indigo markets in Thailand and China face common challenges such as increasing market demand, growing environmental awareness, and difficulties in technological

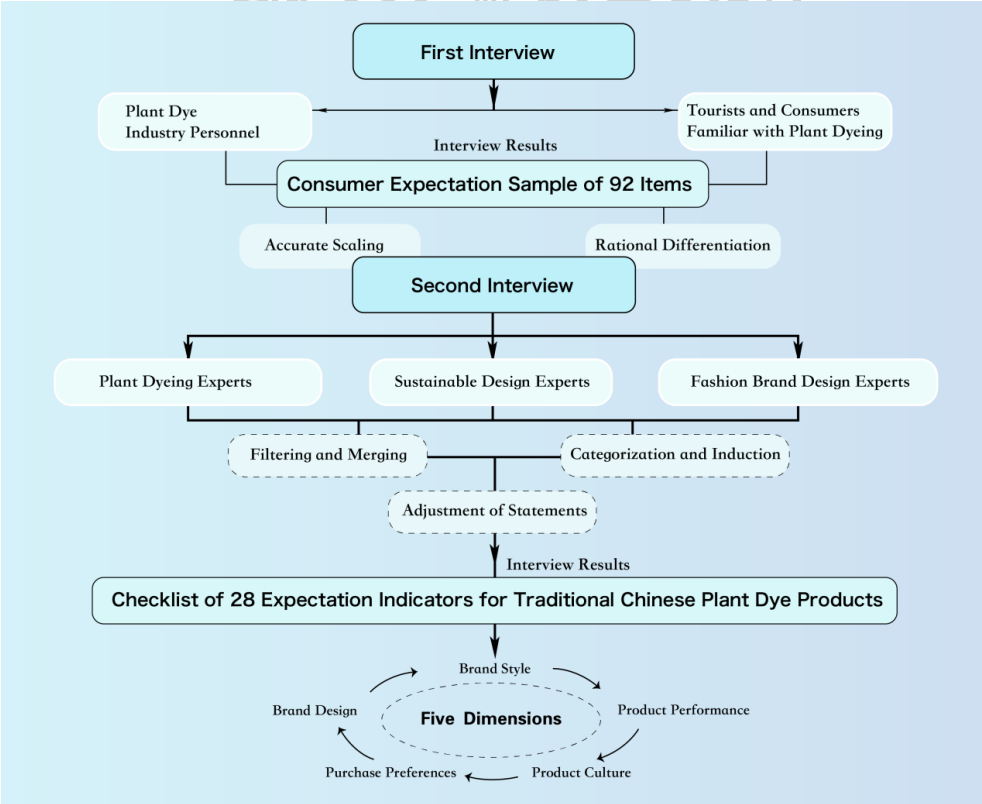
transmission, intense market competition, and low consumer awareness of natural dye products. These challenges necessitate that both countries not only promote traditional plant dyeing but also explore innovative technologies, enhance product creativity and market competitiveness, and strengthen consumer education to foster the healthy and sustainable development of the plant dyeing industry (Karaboyaci, 2014).

4.1.2 FOCUS GROUP DISCUSSIONS

Focus group discussions are a core component of this study, aimed at delving into the status, challenges, and consumer expectations of plant dyeing, thereby guiding innovative design and brand development for plant-dyed products. By organizing focus group interviews, this study collected and analyzed opinions from participants across various fields, utilizing the Kano model to categorize audience expectations for plant-dyed products (Rabiee, 2004).

4.1.2.1 Identification of Audience Expectations

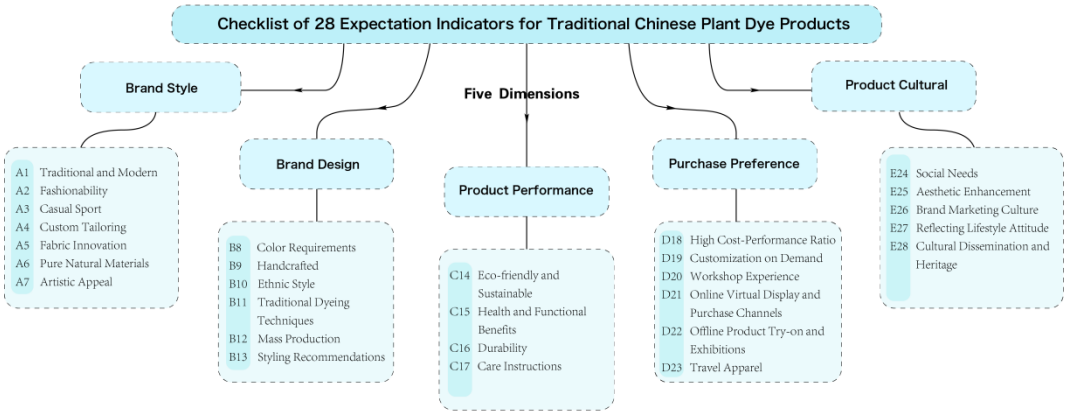
Figure 61 "List of 28 Expected Indicators for Traditional Chinese Plant-Dyed Products" Confirmation Process



Note. Illustrated by the researcher.

To determine consumer expectation dimensions and characteristics, based on the main production areas of traditional Chinese plant-dyed products, target survey locations were primarily selected in Yunnan tourist areas and silk museum souvenir shops. As shown in Figure 61, using a random sampling method, 20 key respondents were identified from "relevant professionals" and "local tourists or consumers knowledgeable about plant dyeing" at the target survey points. In-depth group interviews with these 20 respondents yielded 92 samples of "consumer expectation information," from which traditional plant dyeing expectation entries were analyzed. To ensure precise and differentiated wording of the expectation list, a focus group was formed consisting of "1 plant dye expert, 1 sustainable design expert, 1 fashion brand design expert." This group refined, adjusted, and categorized the expectation text list. Upon reaching consensus, the experts integrated the list into five dimensions of expectations: brand style, brand design, product performance, purchasing preferences, and product culture, ultimately deriving the "List of 28 Expected Indicators for Traditional Chinese Plant-Dyed Products" (Figure 58).

Figure 62 Dimensions of Expectations for Plant-Dyed Products



Note. Data collected and analyzed by the researcher.

Through the distribution and collection of questionnaires under the KANO model, potential brand positioning and design directions were extracted from 327 valid responses regarding expectations for plant-dyed products.

4.1.2.2 Sample Analysis

Of all valid samples, 175 were female, accounting for 59.1%, and 152 were male, representing 40.9%, with a slightly higher proportion of females. The age group of 25-30 years had the highest representation, accounting for 38.6%, and the majority of respondents held master's degrees, exceeding 50%. Professional employment was the most common occupation among respondents, making up 63.0% of the sample, with household monthly incomes most frequently ranging from 10,001 to 20,000 yuan, accounting for 48.0%. Detailed statistics data of each background variable are presented in Table 14.

Table 14 Sample Data Statistics

Background Variables	**Categories**	**Number of People**	**Proportion**
Gender	Female,	175	59.1
	Male	152	40.9
Age	Under 18	41	12.6
	18-24 years old	67	20.5
	25-30 years old	126	38.6
	31-35 years old	59	18.1
	Over 36 years old	34	10.2
Educational Background	High School/Vocational School and Below	49	15.0
	Bachelor's Degree	103	31.5
	Master's Degree	167	51.2
	Doctorate	8	2.4
Occupation	Student	49	15.0
	Employed Professional	206	63.0
	Freelancer	67	20.5
	Other	5	1.6
Monthly Family Income	5,000 Yuan and Below(RMB)	18	5.5
	5,001-10,000 Yuan(RMB)	77	23.6
	10,001-20,000 Yuan(RMB)	157	48.0
	Over 20,001 Yuan(RMB)	75	22.8

Note. Data collected and analyzed by the researcher.

4.1.2.3 Audience Expectations Analysis Under the Kano Model

According to the evaluation process of the Kano model, the questionnaire is designed with both positive and negative questions for each indicator (Xu et al., 2009). The Better-Worse parameter is used as the basis for distinguishing the categories of needs, and a quadrant scatter plot is drawn using the mean values of these parameters as critical lines to accurately classify the attributes of the requirements. The Better coefficient is calculated as(A+O)/(A+O+M+I), and the Worse coefficient is–(O+M)/(A+O+M+I) (Kermanshachi et al., 2022). The statistics for each indicator and the results of the Better-Worse parameter calculations are shown in Table 15.

Table 15 Statistics and Classification of Different Types of Needs

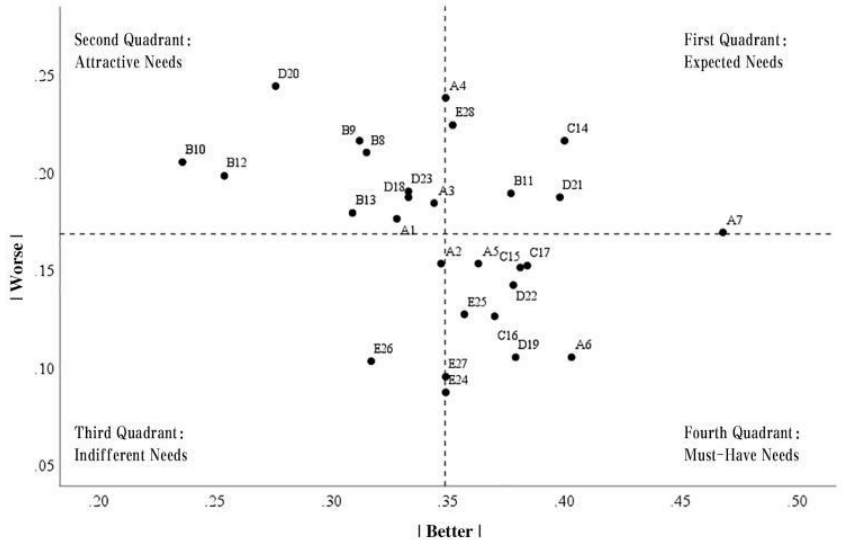
	Attractive Needs *A*	Basic Needs *M*	Performance Needs *O*	Indifferent Needs *I*	Reverse Needs *R*	Questionable Results *Q*	*Better* Value	|*Worse*|Value	*Better-Worse* Classification
A1	32	13	9	71	2	0	0.328	0.176	Basic Needs
A2	35	11	8	70	2	1	0.347	0.153	Indifferent Needs
A3	32	12	11	70	1	1	0.344	0.184	Basic Needs
A4	34	20	10	62	1	0	0.349	0.238	Performance Needs
A5	36	10	9	69	3	0	0.363	0.153	Attractive Needs
A6	45	8	5	66	2	1	0.403	0.105	Attractive Needs
A7	46	9	12	57	3	0	0.468	0.169	Performance Needs
B8	29	16	10	69	3	0	0.315	0.210	Basic Needs
B9	26	14	13	72	1	1	0.312	0.216	Basic Needs
B10	24	20	6	77	0	0	0.236	0.205	Basic Needs
B11	34	11	12	65	4	1	0.377	0.189	Performance Needs
B12	27	20	5	74	1	0	0.254	0.198	Basic Needs
B13	34	18	4	67	4	0	0.309	0.179	Basic Needs
C14	36	13	14	62	2	0	0.400	0.216	Performance Needs
C15	37	8	11	70	1	0	0.381	0.151	Attractive Needs

C16	41	10	6	70	0	0	0.370	0.126	Attractive Needs
C17	41	12	7	65	2	0	0.384	0.152	Attractive Needs
D18	35	17	6	65	4	0	0.333	0.187	Basic Needs
D19	41	7	6	70	3	0	0.379	0.105	Attractive Needs
D20	22	18	13	74	0	0	0.276	0.244	Basic Needs
D21	41	15	8	59	4	0	0.398	0.187	Performance Needs
D22	40	10	8	69	0	0	0.378	0.142	Attractive Needs
D23	33	15	9	69	1	0	0.333	0.190	Basic Needs
E24	39	6	5	76	1	0	0.349	0.087	Attractive Needs
E25	39	10	6	71	1	0	0.357	0.127	Attractive Needs
E26	34	7	6	79	1	0	0.317	0.103	Indifferent Needs
E27	38	6	6	76	1	0	0.349	0.095	Attractive Needs
E28	35	19	9	62	2	0	0.352	0.224	Performance Needs

Note. Data collected and analyzed by the researcher.

According to the results in Tables 15 and 16, the first quadrant represents attractive requirements, which can both eliminate customer dissatisfaction and enhance satisfaction, with 6 indicators categorized here; the second quadrant contains one-dimensional requirements that do not eliminate dissatisfaction but can increase satisfaction, with 10 indicators; the third quadrant includes indifferent requirements, neither eliminating dissatisfaction nor enhancing satisfaction, with 2 indicators, which are attributes customers do not care about; the fourth quadrant contains must-be requirements, which can eliminate dissatisfaction but do not enhance satisfaction, with 10 indicators (Wu et al., 2015).

Table 16 "Better-Worse"Four-Quadrant Scatter Plot



Note. Data collected and analyzed by the researcher.

Based on the quadrant classification, sensitivity is used as a priority ranking index to calculate the priority order of each requirement. The formula for calculating sensitivity is as follows (Ying et al., 2022)：

$$R = \sqrt{(Batter\ Value)^2 + (|Worse|\ Value)^2}$$

The calculation results show that among all the indicators, A7 (Artistic Influence) ranks highest in priority, followed by C14 (Environmental Sustainability), D21 (Online Virtual Display and Purchasing Channels), while E26 (Brand Marketing Culture), B12 (Mass Production), and B10 (Ethnic Style) rank lowest (Table 17). Therefore, the study model will focus on the expectation demands of A7, C14, and D21.

Table 17 Demand Index Sensitivity Analysis

	Better-Worse Classification	**Sensitivity (R)**	**Priority Ranking**
A1	Attractive Needs	0.372	21
A2	Indifferent Needs	0.379	18
A3	Attractive Needs	0.390	14
A4	Expected Needs	0.423	4
A5	Attractive Needs	0.394	11
A6	Attractive Needs	0.417	7

A7	Expected Needs	0.497	1
B8	Attractive Needs	0.378	20
B9	Attractive Needs	0.379	17
B10	Attractive Needs	0.313	28
B11	Expected Needs	0.422	5
B12	Attractive Needs	0.322	27
B13	Attractive Needs	0.357	25
C14	Expected Needs	0.455	2
C15	Must-Have Needs	0.410	9
C16	Must-Have Needs	0.391	13
C17	Must-Have Needs	0.413	8
D18	Attractive Needs	0.382	16
D19	Must-Have Needs	0.393	12
D20	Attractive Needs	0.368	22
D21	Expected Needs	0.440	3
D22	Must-Have Needs	0.404	10
D23	Attractive Needs	0.384	15
E24	Must-Have Needs	0.360	24
E25	Must-Have Needs	0.379	19
E26	Indifferent Needs	0.334	26
E27	Must-Have Needs	0.362	23
E28	Expected Needs	0.417	6

Note. Data collected and analyzed by the researcher.

4.1.2.4 Branding and Design Positioning

Based on the Kano model, indifferent attributes (Table 16) have minimal impact on user satisfaction and are generally not considered in design. The top 10 sensitive customer expectation indicators are prioritized, with the highest three (A7, C14, D21) serving as the main points of appeal in product marketing, highlighting these indicators as product highlights to enhance market competitiveness. Upon satisfying high sensitivity expectations, the mid to low sensitivity expectations C15, D22, and E25 are chosen as supplements in design. Consequently, the research results indicate that Chinese plant dye branding and design can be segmented into five modules:

• **Brand Style Expectations:** Main points include A4, A7, A6—proposing a lifestyle concept where the brand sells not only clothing but also advocates a lifestyle. Through cultural activities, workshops, and media sharing of plant dye stories, customers' interest and participation in art, nature, and sustainable living are ignited.

• **Brand Design Expectations:** Main points include B8, B9, B11—establishing a Chinese plant dye brand that integrates environmental concerns with aesthetics, emphasizing the beauty, practicality, and eco-friendly philosophy of design.

• **Product Performance Expectations:** Main points include C14, C15—committing to environmental, health, comfort, and innovative standards. Reducing environmental impact during production, protecting the health of producers, and offering safe apparel choices for consumers. Avoiding synthetic dye irritants to minimize skin issues.

• **Purchasing Preferences Expectations:** Main points include D21, D22—meeting the diverse needs of modern consumers. Enhancing brand recognition and image through fashion shows and cultural activities.

• **Product Culture Expectations:** Main points include E25, E28—enhancing consumer aesthetics, preserving Chinese plant dye culture, actively fulfilling social responsibilities, and sustainable development, thus enhancing the brand's cultural depth and market competitiveness. By sharing brand stories, design inspirations, and production processes, an interactive cultural atmosphere is built with consumers.

The research findings reveal multi-layered expectations among consumers for plant dye brands, involving respect for traditional culture, support for environmental principles, and a pursuit of fashion design. Based on these findings, researchers propose a plant dye brand design and development process (see Section 4.4.1) to accurately capture and address the varied consumer expectations.

4.1.3 CASE STUDY

4.1.3.1 Sustainable Fashion Case Analysis

Through case study methodology, sustainable fashion brands are extensively examined to extract key elements of successful sustainable innovative design models and to assess the impact and innovativeness of brands within the sustainable fashion industry (Table 18) (Manski, 1990).

Table 18 Sustainable Fashion Design Case Analysis

Brand	Analysis	Results
Patagonia	The business model is built around environmental responsibility and fair trade practices.	The key to success for sustainable fashion brands lies in innovation, transparency, social responsibility, and respect for tradition. These brands demonstrate the diverse paths of sustainable fashion through their respective approaches, contributing not only to environmental sustainability but also achieving commercial success in the market, proving that sustainability and business interests can coexist.
Stella McCartney	No animal cruelty and the use of eco-friendly materials.	
Eileen Fisher	A transparent supply chain and circular design principles.	
Veja	Fair trade practices and the use of sustainable materials.	
Reformation	Sustainable production methods and the utilization of eco-friendly materials.	
Loomstate	Sustainable agricultural and production practices.	
Levi's	Water-saving technologies and innovative recycling of old jeans.	
Alternative Apparel	The use of environmentally friendly materials such as organic cotton, recycled polyester, and natural dyes.	
Marco 'Useless'	A unique sustainable design philosophy that respects and conserves resources.	
Pengtai	The integration of traditional craftsmanship with modern design.	
SHIJIE	The use of environmentally friendly materials and the promotion of social responsibility programs.	

Note. Compiled and analyzed by the researcher.

4.1.3.2 Case Analysis of Botanical Dye Works

This section conducts an in-depth analysis of signature botanical dye fashion pieces, exploring the application of botanical dyeing techniques in contemporary fashion design and how traditional crafts introduce new perspectives and innovations to sustainable fashion. (Table 19)

Table 19 Case Analysis of Botanical Dye Works

Fashion Printing and Dyeing Works Series	Analysis	Results
UMA WANG Spring/Summer 2023 Collection "Gaze of the Wilderness"	The unique plant dyeing technique and natural textures are highlighted, showcasing the profound significance and aesthetic value of plant dyeing in fashion design.	These cases reveal the diverse applications and profound impact of plant dyeing techniques in contemporary fashion design, demonstrating that plant dyeing not only brings unique visual effects and profound cultural symbolism to fashion design but also provides important strategies and inspiration for promoting sustainable fashion development.
MITHRIDATE New York Spring/Summer 2024 Collection "YU· THE CURE"	Plant dyeing is portrayed as a means of healing and reconnecting with nature, conveying the concept of sustainable fashion and emphasizing the importance of returning to nature and environmental protection.	
Juana Martín 2023 S/S Haute Couture Collection "Origins"	Exploration of the connection between culture and nature is undertaken. A modern interpretation of traditional plant dyeing techniques is presented, demonstrating the perfect integration between craftsmanship and fashion.	
DIOR 2020 Early Autumn Collection	Traditional indigo dyeing techniques are incorporated into high-end fashion, proposing a new expression of fashion by merging tradition with modernity.	
Feng Chen Wang Spring/Summer 2024 Collection	Distinctive visual effects are created, reflecting a design concept that engages directly with natural elements.	
Yuima Nakazato 2022 Autumn/Winter Haute Couture	There is a deep exploration and innovation in traditional dyeing techniques, integrating advanced digital technology with traditional craftsmanship.	

Note. Compiled and analyzed by the researcher.

4.1.3.3 Fashion Exhibition Type Analysis

Case studies of various types of fashion exhibitions reveal their significant role in promoting the concepts and practices of sustainable fashion. Not only do these exhibitions enhance public awareness of botanical dyes and sustainable fashion, but they also facilitate the integration of tradition and innovation. (Table 20)

Table 20 Fashion Exhibition Type Analysis

Types of Exhibitions	Analysis	Results
Art Appreciation Exhibition	Through the lens of art, the exhibition presents fashion, emphasizing the aesthetics and creativity of design and offering audiences a new perspective for appreciating fashion.	By presenting practical examples, the exhibition demonstrates the feasibility and innovation of sustainable fashion, encouraging audiences and designers to adopt more environmentally friendly production and consumption practices.
Historical Documents Exhibition	The exhibition displays the history and development of plant-based dyes and sustainable fashion, providing visitors with an opportunity to deeply understand the materials, techniques, and cultural contexts involved.	By presenting practical examples, the exhibition demonstrates the feasibility and innovation of sustainable fashion, encouraging audiences and designers to adopt more environmentally friendly production and consumption practices.
Cultural Education Exhibition	Focused on education and dissemination, the exhibition aims to enhance public awareness of plant dyes and sustainable fashion.	By presenting practical examples, the exhibition demonstrates the feasibility and innovation of sustainable fashion, encouraging audiences and designers to adopt more environmentally friendly production and consumption practices.
Virtual Fashion Exhibition	Utilizing digital technology, virtual exhibitions open new channels for the dissemination of sustainable fashion.	
Sustainable Fashion Exhibition	By showcasing fashion pieces made from eco-friendly	By presenting practical examples, the exhibition

	materials, employing circular design, and adhering to ethical production practices, the exhibition actively promotes the principles of sustainable fashion.	demonstrates the feasibility and innovation of sustainable fashion, encouraging audiences and designers to adopt more environmentally friendly production and consumption practices.

Note. Compiled and analyzed by the researcher.

This section deeply explores the cases of sustainable brands, botanical dye works, and fashion exhibitions mentioned in the literature review of Chapter 2, to further analyze the practical applications and impacts of sustainable fashion. Through detailed case studies, the multifaceted and layered realities of sustainable fashion in practice are uncovered, demonstrating how sustainable brands establish their market positioning and how botanical dye fashion exhibitions serve as effective platforms for propagating sustainable fashion concepts. This provides robust theoretical support for the "XIARAN" botanical dye sustainable fashion exhibition (see Section 4.6.5).

4.1.4 EXPERT INTERVIEWS

4.1.4.1 Preliminary Stage

Through expert interviews, feedback and recommendations were collected on the Index of Item Objective Congruence (IOC) for questionnaire design. The panel of experts included scholars with extensive experience in botanical dyes, sustainable fashion design, statistics, and fashion brand design (Ljungqvist et al., 2009). Below is a summary of the feedback from the experts:

· Song Yanhui

Professor, Head of the Fashion Department at Changsha Normal University College of Fine Arts and Design. Research focus on creative design of folk costumes.

When designing questionnaire items, it is crucial to clarify the specific objective each item aims to measure and how each item relates to the research questions and objectives. This approach effectively enhances the Index of Item-Objective Congruence (IOC). The wording of the questionnaire should be as simple and precise as possible, aiding respondents in better understanding each question, thereby

improving the accuracy of responses and consistency with the item objectives. The study should focus on analyzing the popularity and attention given to plant dyeing in China, as well as the audience's expectations for plant dye exhibition fashion design.

· Yin Jing

Associate Professor, Changsha Normal University College of Fine Arts and Design, specializing in Craft Art. Research focus on botanical dye design and innovation.

It is recommended to conduct a pilot test before the formal study. This helps identify potential issues such as item comprehension difficulty and answer consistency problems, and make necessary adjustments based on feedback. The study should investigate visitors' experiences at different types of fashion exhibitions, analyzing how these experiences influence their perceptions and attitudes towards fashion, culture, and sustainability. It should also include a comparison and evaluation of pre- and post-exhibition assessments.

· Huang Xinjun

Associate Professor, founder of the "Left Cut Right Sew" Fashion Design Studio. Research direction in fashion product development.

Discussed how botanical dyeing can enhance brand recognition and consumer engagement through fashion exhibitions, and the popularity and user experience of different exhibition forms. Throughout the mid and final stages of the study, insights from botanical dye, sustainable fashion, and fashion brand experts were integrated to advise on the design of sustainable botanical dye fashion.

By integrating feedback from experts across different fields, the questionnaire design was optimized, ensuring a high degree of consistency between survey items and research objectives. After extensive discussions and revisions, a complete survey system was established. (See Appendix)

4.1.4.2 Mid-Stage: Opinions and Feedback

In the mid-stage, based on the sustainable innovation design model strategy set by the researcher, the expert panel provided opinions and feedback:

· He Jingwei

Professor and Dean, Guangzhou University School of Fine Arts and Design, specializing in folk art and fashion design.

Highlighted the importance of interdisciplinary collaboration. He suggested that the sustainable innovation design model should not only focus on botanical dye techniques but also encompass botanical dye art dissemination, cultural education, environmental science, and marketing to achieve true sustainability. Explored the role of botanical dyeing in education and cultural heritage, including how workshops, exhibitions, and educational courses can enhance public appreciation for botanical dye crafts and help preserve and transmit this traditional skill.

· Ruan Jiangjun

Ph.D. in Design Science from Chiba University, Japan

Research direction in Intangible Cultural Heritage and the historical culture of botanical dyes

Advised conducting empirical research and market testing before implementing the sustainable innovation design model to validate the model's effectiveness and market fit. Advocated focusing on China's representative indigo dyeing as a main study area while exploring new design languages and presentation forms to enhance the artistic value and market appeal of botanical dye products. Presented case studies of successful botanical dye brands or projects, analyzing how they overcome industry challenges, innovate products and marketing strategies, and contribute to the revival of botanical dye crafts and the sustainable fashion industry.

· Li Xiang

Associate Professor, Hunan Normal University School of Engineering and Design, specializing in fashion brand planning.

Identified consumer education as key to enhancing market acceptance of botanical dye products. Suggested using workshops and interactive activities to increase consumer knowledge of botanical dye culture and techniques, thereby stimulating their purchasing interest. Researched how exhibition design, exhibit selection, and narrative strategies can effectively convey the concept and value of

sustainable fashion, while attracting and educating the public. Developed and applied exhibition evaluation tools to measure the impact of fashion exhibitions in enhancing public awareness of sustainable fashion, changing consumer behavior, and facilitating cultural exchange.

In summary, the feedback and opinions provided by the expert panel have identified key elements of the sustainable innovation design model strategy and highlighted issues to be mindful of during its implementation process. Through optimization and adjustment, these insights aim to better align with market demands and sustainable development goals.

4.1.4.3 Post-Stage: Result Analysis

This study constructed a research framework for sustainable fashion innovation through data collection, expert interviews, case studies, and literature analysis, evaluating the feasibility and innovative potential of botanical dye technology and culture in the contemporary fashion industry from multiple perspectives. Here are the assessments and feedback from experts in various fields:

· Zou Liulan

Cultural inheritor of botanical dyes, focusing on the folk culture and transmission of botanical dyes.

Emphasized the significance of the study in highlighting the potential and importance of traditional botanical dye techniques in the sustainable fashion sector. By conducting field research on botanical dyes in China and Thailand, the study not only unveiled the diversity and cultural value of botanical dye techniques but also showcased their potential for new life in contemporary design. The fashion exhibition not only preserved the traditional artistic values of botanical dyes but also integrated modern design concepts, offering an environmentally friendly and culturally significant fashion design exhibition, which is crucial for promoting sustainable fashion development.

· Ouyang Xian

Associate Professor and Head of the Fashion Department at Changsha Normal University, specializing in fashion craft design.

The study deepened the understanding of sustainable botanical dye fashion design through focus group interviews and audience expectation surveys. Particularly appreciated the use of the Kano model to analyze consumer expectations for botanical dye products, considering it an effective tool for understanding audience needs and guiding product development and market strategies. The online and offline exhibitions provided not only a visual feast but also a profound educational experience, presenting botanical dyes as a traditional craft in modern society, allowing audiences to deeply understand the cultural stories and environmental philosophies behind botanical dyes, promoting public awareness of sustainable lifestyles, and enhancing cultural heritage consciousness.

· Chen Peng

Associate Professor at Changsha Normal University College of Fine Arts and Design, specializing in CLO virtual fashion design and display.

The study's significant contribution was proposing a sustainable innovation design model that not only emphasized the dissemination of botanical dye cultural values but also illustrated how to transform botanical dyes into modern market strategies based on audience expectations, thereby enhancing the effectiveness of sustainable botanical dye design. This model provided a practical framework and strategy for the sustainable development and innovation of botanical dye techniques. The analysis of botanical dye brands and market strategies revealed the potential and challenges of botanical dyes in the modern consumer market, offering valuable insights into how brands can successfully position themselves in the market.

The exhibition enhanced its appeal and educational impact by introducing interactive experience zones, enabling visitors to deeply understand the allure and value of botanical dye techniques. Future explorations could further showcase more international cases of sustainable fashion, strengthen cross-cultural exchanges and collaborations, and promote the joint development of the global sustainable fashion industry.

In summary, the expert panel highly appreciated the effectiveness and impact of this research on botanical dye sustainable fashion exhibitions, recognizing not only the profound insights provided into the protection, transmission, and innovation of botanical dye techniques but also the valuable guidance for the development of the sustainable fashion industry. The experts unanimously acknowledged the academic value and practical significance of the study. Through systematic analysis and evaluation, they offered forward-looking suggestions for the inheritance, development, and application of botanical dye techniques in the sustainable fashion sector.

4.1.5 LITERATURE ANALYSIS

Based on the literature review and analysis, the study delved into the opportunities and challenges of botanical dyes in contemporary society, proposing suggestions for the inheritance and development of botanical dye techniques and exploring the potential for spreading botanical dye culture through a visual cultural system (Gonzalez et al., 2006).

4.1.5.1 Opportunities and Challenges of Botanical Dyes

Through in-depth literature analysis, it was found that the development of botanical dyes not only concerns the innovation of techniques and crafts but also relates closely to environmental protection, cultural heritage, market demand, and consumer awareness.

1. Opportunities

• **The rise of sustainable fashion.** As sustainable fashion becomes a global trend, consumers increasingly focus on the environmental attributes of clothing and the sustainability of production processes. The natural, eco-friendly characteristics of botanical dyes perfectly align with this demand, offering broad opportunities for application in the modern apparel industry.

• **Changes in consumer awareness.** With the rise in consumer environmental consciousness and the pursuit of healthy lifestyles, botanical dye products are becoming increasingly popular due to their non-toxic, hypoallergenic features. This trend encourages market demand for botanical dye products, providing momentum for the development of botanical dyes.

• **Valuing cultural and artistic worth.** As a craft carrying deep cultural and artistic value, botanical dyes are favored by designers and artists, meeting audience needs for cultural identity and a return to natural lifestyles, and are widely used in fashion design, home decor, and artistic creation.

• **Integration of innovation and technology.** Technological advancements provide new possibilities for the innovation and application of botanical dyes. By improving dyeing processes and enhancing color stability and range through modern technological methods, botanical dye techniques can better meet market demands while maintaining their eco-friendly and natural characteristics.

• **Multidimensional value of botanical dyeing.** Emphasizes that botanical dyeing not only has significant implications for environmental and cultural heritage protection but also contributes substantially in economic and social dimensions. Botanical dye crafts can promote local economic development, providing income sources for farmers and artisans.

2. Challenges

• **Technical and Innovation Challenges.** Botanical dyes exhibit weaker color permanence and stability compared to chemical dyes, rendering them prone to fading or color alteration. This presents a significant hurdle for modern consumers who prioritize high quality and durability. Furthermore, the color range achievable with botanical dyes is relatively restricted, making it challenging to attain the saturation and diversity characteristic of chemical dyes. The absence of a definitive color reference system further constrains design liberty and innovation.

• **Market Acceptance Challenges.** The intricate nature of botanical dyeing processes coupled with elevated production costs often results in botanical dye products commanding higher prices in the market compared to conventional dyed products. Additionally, these products suffer from relatively low consumer awareness, potentially influencing consumer purchasing decisions.

• **Aesthetic Trend Challenges.** Contemporary consumers exhibit diverse aesthetic preferences towards fashion products. Harmonizing botanical dyeing techniques with modern fashion trends to meet the demands for both fashion and aesthetic appeal poses a challenge. The task is to craft fashion products that possess traditional allure while embracing contemporary aesthetic standards.

4.1.5.2 Cultural Visual System Dissemination

Using engaging visual narratives to showcase the history, process, and cultural significance of plant dyeing can effectively tell the story of this craft. By emphasizing the environmental and sustainable characteristics of plant dyeing through visual communication, the social responsibility and modern value of plant dye brands can be enhanced. This approach strengthens the audience's cultural identity and emotional connection with plant dyeing. (Meyer et al., 2007).

Figure 63 Indigo Production Visualization Process

Note. Illustrated by the researcher.

- **Indigo Dye Production - Visual Process (Figure 63):**

1. Planting: Twig cuttings are planted annually between March and May.

2. Harvesting: This is divided into summer and autumn harvests, with 2-3 harvests per year.

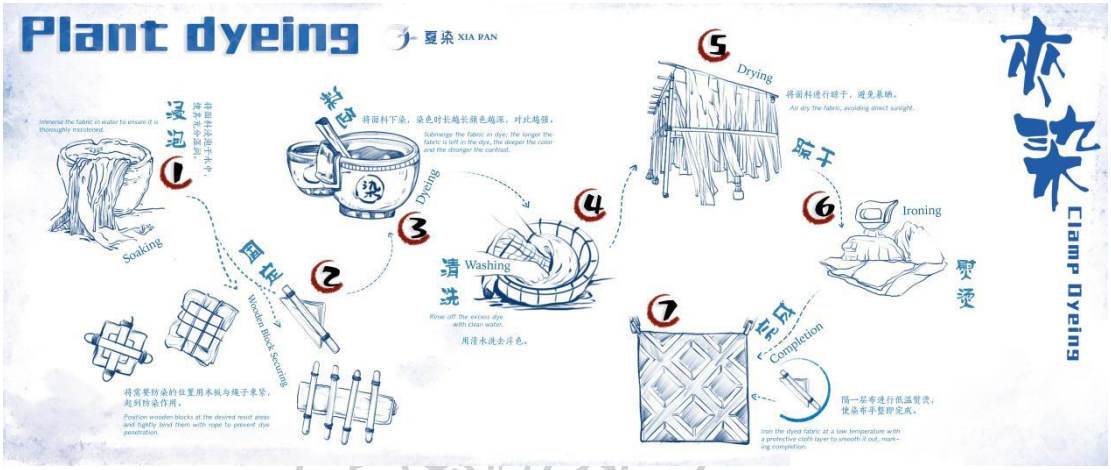
3. Soaking: The indigo plants are placed in a water tank to soak. They ferment until the water turns blue and the plants turn black. The plants are then removed and filtered.

4. Fermenting: Lime powder is added to the indigo water and left to settle for one to two days.

5. Oxidation: The vat is agitated repeatedly until a large amount of purple foam appears on the surface, after which the vat is covered.

6. Completion: The sedimented indigo liquid at the bottom of the vat is placed into a permeable container to form a honey-like indigo paste, marking the completion of the process.

Figure 64 Clamp Dyeing Visualization Process



Note. Illustrated by the researcher.

- **lamping Dye Process - Visual Workflow (Figure 64):**

1. Soaking: Submerge the fabric in water to ensure it is thoroughly moistened.

2. Clamping: Secure the areas on the fabric that require resist dyeing using wooden blocks and ropes to prevent dye penetration.

3. Dyeing: Immerse the fabric in dye. The longer the fabric remains in the dye, the deeper the color and the stronger the contrast.

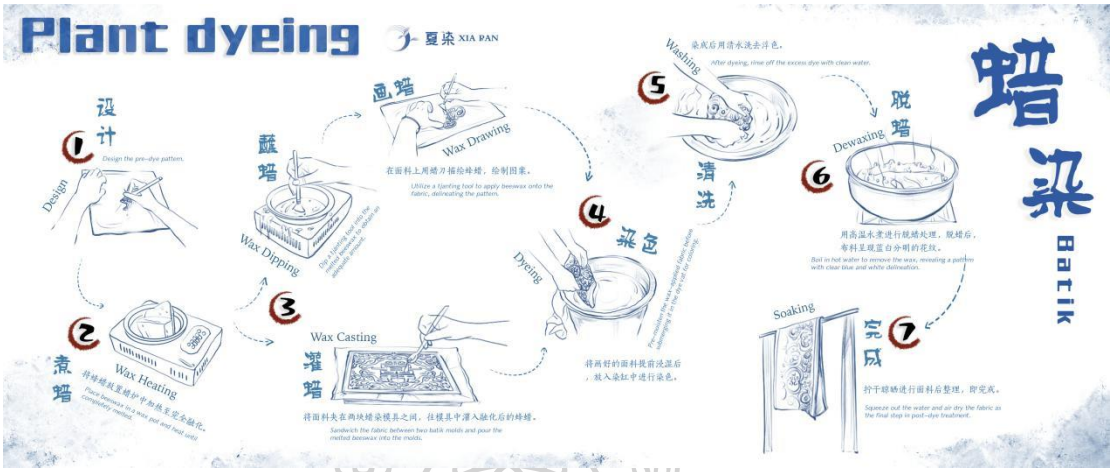
4. Washing: Rinse the fabric in clean water to remove excess dye.

5. Drying: Air dry the fabric, avoiding direct sunlight.

6. Ironing: Iron the fabric at a low temperature with a cloth barrier to smooth out the dyed fabric.

7. Completion: The process is completed once the fabric is ironed and smooth.

Figure 65 Batik Dyeing Visualization Process



Note. Illustrated by the researcher.

- **Batik Dyeing Process - Visual Workflow (Figure 65):**

1. Design: Design the pre-dyeing pattern design.

2. Wax Heating: Place beeswax in a wax pot and heat until fully melted.

3. Method One: Wax Dipping - Dip a tjanting tool into the beeswax to collect an adequate amount; Wax Drawing - Use the tjanting tool to apply the wax onto the fabric, drawing the intended pattern.

Method Two: Wax Pouring - Sandwich the fabric between two batik molds and pour the melted beeswax into the molds.

4. Dyeing: Pre-moisten the wax-applied fabric, then submerge it in a dye vat for dyeing.

5. Washing: After dyeing, rinse the fabric in clean water to remove any excess dye.

6. Dewaxing: Boil the fabric in hot water to remove the wax, revealing a distinct blue and white pattern.

7. Completion: Wring out and air dry the fabric, then perform final fabric finishing to complete the process.

Figure 66 Tie-Dyeing Visualization Process

Note. Illustrated by the researcher.

- **Tie-Dyeing Process - Visual Workflow (Figure 66):**

1. Fabric Soaking: Soak the fabric in water to wet it thoroughly.

2. Method One: Binding - Use cotton rope to bind the fabric tightly to resist dye penetration.

Method Two: Stitching - After designing the pre-dye pattern, use cotton thread to stitch the fabric tightly for dye resistance.

3. Dyeing: Place the bound or stitched fabric into the dye vat for dyeing, with the duration adjusted according to the desired depth of color.

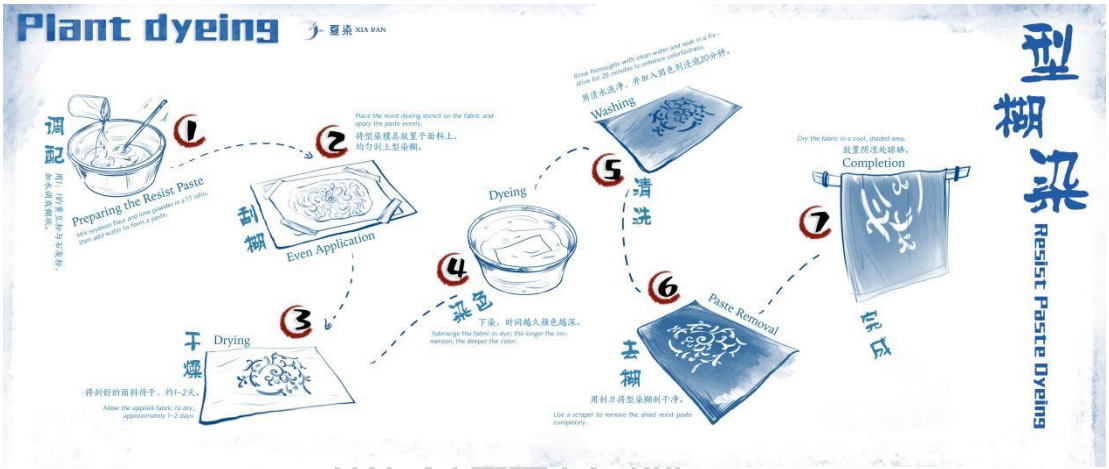
4. Thread Removal: After oxidation to check the depth and appropriateness of the color, remove the cotton threads.

5. Washing: Rinse the fabric to remove any excess dye on the surface.

6. Drying: Air dry the fabric, avoiding direct sunlight.

7. Completion: Iron the dyed fabric at a low temperature with a layer of cloth in between to ensure it is smooth and even, finalizing the process.

Figure 67 Resist Dyeing Visualization Process



Note. Illustrated by the researcher.

- **Resist Paste Dyeing Process - Visualization Workflow (Figure 67):**

1. Mixing: Prepare the resist paste by combining soybean powder and lime powder in a 1:1 ratio, adding water to form a paste.

2. Application: Place the resist paste stencil on the fabric and apply the paste evenly using a scraper.

3. Drying: Allow the applied fabric to dry for approximately 1-2 days.

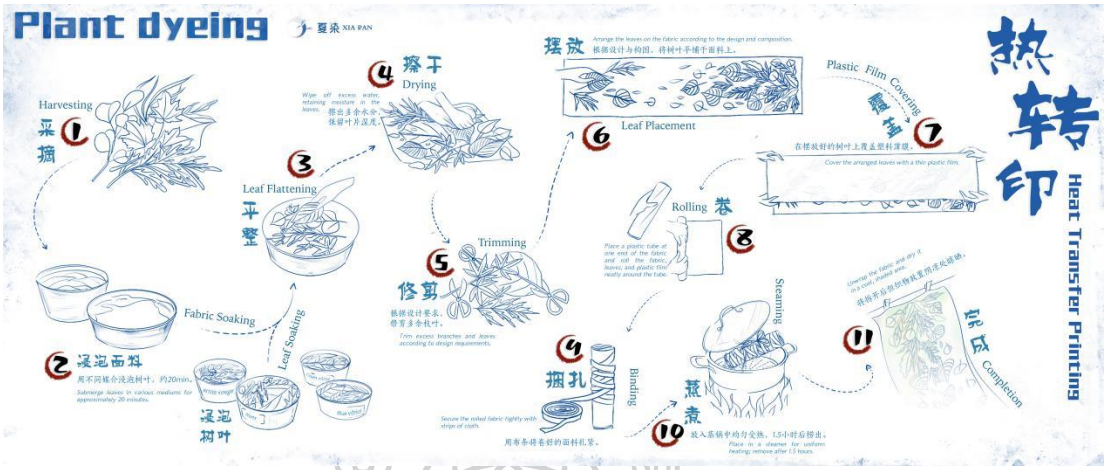
4. Dyeing: Submerge the fabric in dye; the longer the fabric remains in the dye, the deeper the color will be.

5. Washing: Rinse the fabric in clean water and soak in a fixative for 20 minutes to set the color.

6. Paste Removal: Use a scraper to remove the resist paste completely from the fabric.

7. Completion: Hang the fabric in a cool, shaded area to air dry.

Figure 68 Plant Heat Transfer Printing Visualization Process



Note. Illustrated by the researcher.

- **Botanical Heat Transfer Process - Visualization Workflow (Figure 68):**

1. Harvesting: Collect plants rich in pigments, such as gardenia seeds, aloe, flowers, and fruits.

2. Soaking: Soak the fabric and leaves. Submerge the leaves in various mordants for about 20 minutes. The mordants aid in dye adhesion and colorfastness, enhancing the vibrancy and durability of the dye.

3. Flattening: Flatten the leaves to prepare them for application.

4. Drying: Remove excess moisture while retaining some humidity in the leaves.

5. Trimming: Trim any excess foliage according to design requirements.

6. Arranging: Lay out the leaves on the fabric according to the design and composition.

7. Covering: Place a plastic film over the arranged leaves.

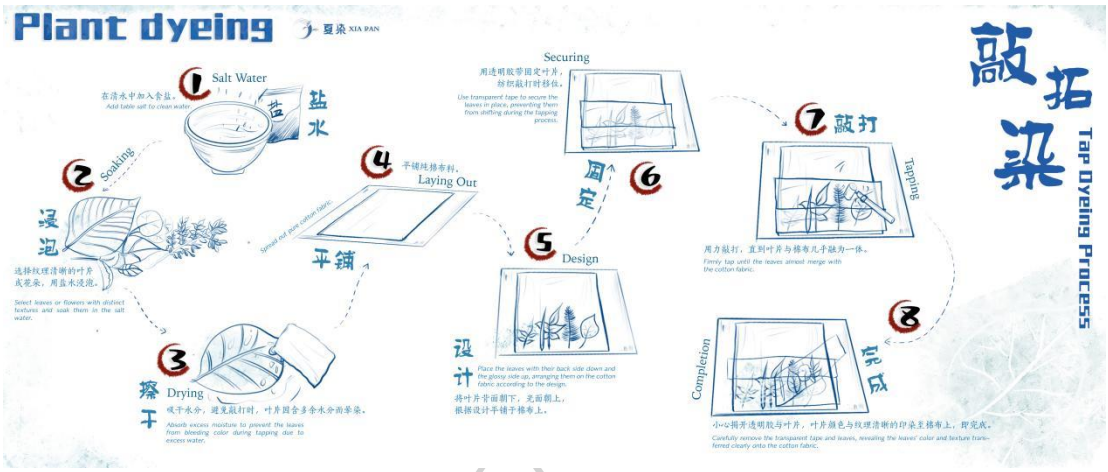
8. Rolling: Place a plastic tube or wooden rod at one end of the fabric and roll the fabric, leaves, and plastic film tightly around the rod.

9. Tying: Secure the rolled fabric tightly with strips of cloth.

10. Steaming: Use heating or steaming to extract the pigments from the plants into the fabric. After approximately 1.5 hours, allow it to cool to room temperature before unwrapping.

11. Completion: Unroll and air dry the fabric in a cool, shaded area.

Figure 69 Tapping Dyeing Visualization Process



Note. Illustrated by the researcher.

- **Botanical Hammer Printing Process - Visualization Workflow (Figure 69):**

1. Saltwater Preparation: Add table salt to clear water.

2. Soaking: Select leaves or flowers with distinct textures and soak them in the saltwater solution.

3. Drying: Absorb excess moisture to prevent smudging during the hammering process.

4. Laying Out: Spread out pure cotton fabric on a work surface.

5. Arranging: Place the leaves vein-side down, shiny side up, and arrange them on the cotton fabric according to the design.

6. Securing: Use transparent tape to secure the leaves to prevent them from shifting during the hammering.

7. Hammering: Vigorously hammer the leaves until they are nearly fused with the fabric.

8. Completion: Carefully peel off the tape and leaves. The clear imprint of the leaves' color and texture on the fabric indicates completion.

The results show that the visual design of plant dyeing culture, combined with storytelling and craft narratives, significantly enhances the audience's interest and awareness of plant dyeing. This study not only provides effective communication

strategies for the education and promotion of plant dyeing techniques but also offers valuable insights for the modern dissemination of other traditional crafts.

4.1.6 ANALYSIS OF TARGET AUDIENCE AWARENESS

During field surveys, the researcher conducted audience cognition studies across different regions and professions, formulating categories such as "General Information," "Plant Dye Issues," "Sustainable Fashion Innovation," and "Plant Dye + Sustainable Fashion Exhibition Issues." This comprehensive and extensive approach was aimed at understanding different target audiences' perceptions of plant dye culture and development, thereby providing strategic recommendations for further research and promotion. The results are analyzed as follows:

4.1.6.1 Demographic Variables Analysis

Based on the basic demographic variables of 253 sample respondents in Table 21, which include "gender," "age," "income range," and "educational background," the surveyed sample has a higher proportion of females (64.82%) compared to males (35.18%). In terms of age, respondents aged 25-34 years dominate, comprising 49.01% of the sample. The most common income range is from 100,001 to 400,000 yuan, representing 62.45% of the sample, and most respondents are educated to the master's level, making up 56.92% of the total.

Table 21 Audience Cognition Survey Sample

Name	Option	Frequency	Percentage (%)
Gender	Male	89	35.18
	Female	164	64.82
Your Age	Under 18 years old	19	7.51
	18-24 years old	30	11.86
	25-34 years old	124	49.01
	35-44 years old	12	4.74
	45-60 years old	68	26.88
Income Range (RMB/Year)	0 - 50,000 RMB	34	13.44
	50,001 - 100,000 RMB	40	15.81
	100,001 - 400,000 RMB	158	62.45

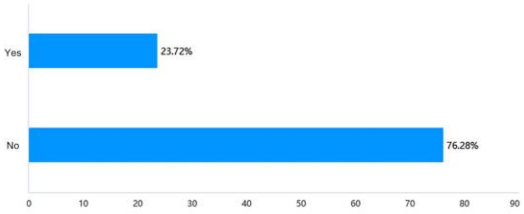
	400,001 - 1,000,000 RMB	21	8.30
Educational Background	High school and below	28	11.07
	Bachelor's degree	24	9.49
	Master's degree	144	56.92
	Doctoral degree	57	22.53

Note. Data collected and analyzed by the researcher.

4.1.6.2 Awareness and Preference Analysis

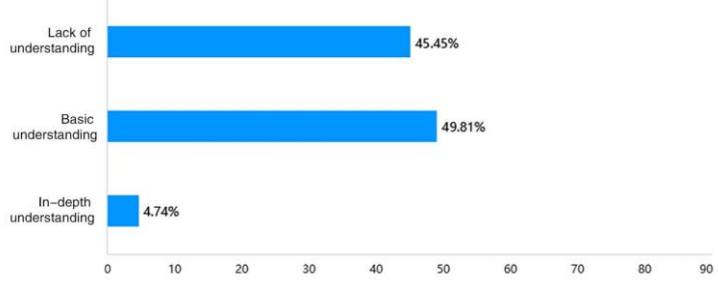
Awareness level: More than half of the target audience has some knowledge of plant dye techniques (Table 23), but a relatively small proportion deeply understands its cultural background and technical details, and even fewer have attempted to use plant dyes experimentally (Table 22). This indicates that although plant dyeing is known to some extent, its deeper cultural and technical essence is not widely recognized.

Table 22 Question 7: Have you ever tried dyeing with plant-based dyes?



Note. Data collected and analyzed by the researcher.

Table 23 Question 11: How familiar are you with plant dyeing techniques?



Note. Data collected and analyzed by the researcher.

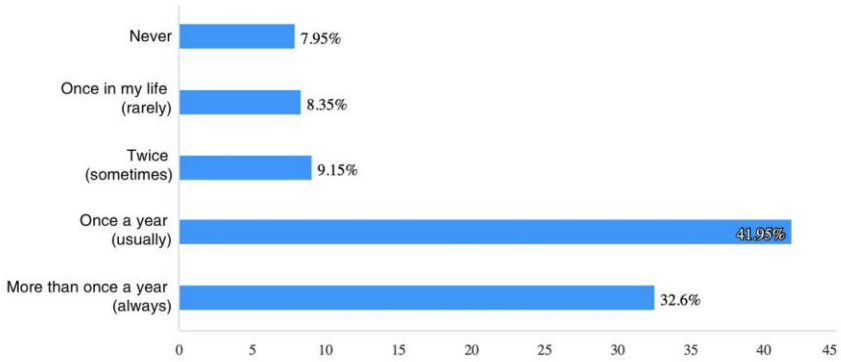
Preference and Interests: Most audiences show a high level of interest in plant dyeing techniques, particularly favoring their environmentally sustainable and non-toxic properties (Tables 24, 25)

4.1.6.3 Consumer Willingness and Influencing Factors

Consumer Willingness: Most of the target audience is willing to purchase plant-dyed products, especially those that integrate modern elements and exhibit personalized features. However, price and availability are the main factors influencing their purchasing decisions. Additionally, there is a marked curiosity and expectation regarding the application and innovation of plant dyes in modern design. (Tables 24)

Influencing Factors: The technical development and innovation of plant-dye products, along with the protection and transmission of traditional crafts, are perceived as urgent issues that need to be addressed. These factors also reflect the increasing influence of environmental consciousness and personal aesthetics among the audience.

Table 24 Question 9: How frequently do you purchase plant-dyed products?



Note. Data collected and analyzed by the researcher.

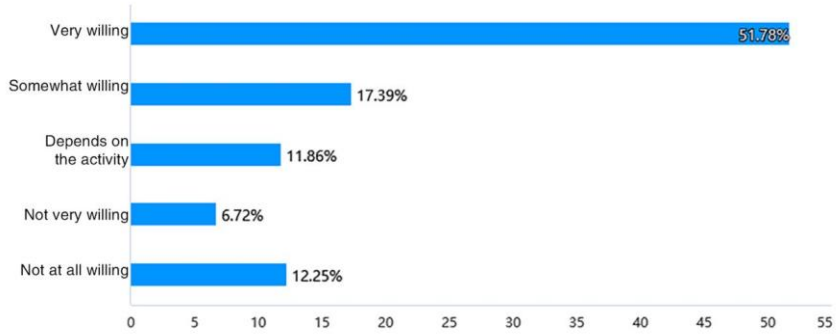
4.1.6.4 Cultural Awareness and Educational Needs

Cultural awareness: The audience shows definite interest and curiosity about sustainable activities related to plant dyes (Table 25). However, the lack of deep cultural and historical knowledge among the audience indicates that there is a need to

enhance education and dissemination about the cultural and historical aspects of plant dyes during its promotion.

Educational needs: The audience generally expressed a desire for clear consumer education and guidance through various channels, including online courses, workshops, and exhibition lectures. This indicates that in promoting plant dye culture, diverse educational and communication methods should be considered to meet the learning needs of different audiences.

Table 25 Question 19: Would you be willing to participate in community activities related to sustainable fashion, such as plant dye printing, or repurposing old clothes through dyeing?



Note. Data collected and analyzed by the researcher.

4.1.6.5 Strategic Recommendations

Based on the survey results, the following strategies are adopted to effectively enhance the target audience's awareness and willingness to consume plant-based dyes:

Enhance Education and Communication: By organizing diverse educational activities and cultural communication projects, public awareness and understanding of plant dyeing techniques can be enhanced.

Innovative Product Design: Develop plant-dyed products that meet modern aesthetic and functional needs by integrating contemporary design concepts to improve market competitiveness.

Enhance Brand Image: Build and communicate strong plant dye brand stories to enhance brand image and attract more consumer attention and interest.

Implementing these strategies is expected to significantly increase the target audience's awareness of plant dye culture, stimulate their purchase intentions, and thus promote the preservation and development of plant dyeing techniques.

4.1.7 SUMMARY

In this chapter, through a comprehensive analysis of data gathered from field surveys, focus group interviews, case studies, expert interviews, literature reviews, and surveys, we delved deeply into the structure of plant dye culture and its applications and impact in contemporary society. These diverse research methodologies revealed the rich variety and significance of sustainability in plant dye culture, as well as its widespread application and cultural value in modern design.

Field research has revealed the global nature and diversity of plant dyeing culture, emphasizing its significance as an element of sustainable fashion. Through focus group interviews and surveys, key terms and dominant factors in plant dye design research were identified, including the integration of tradition and modernity, environmental sustainability, and cultural heritage. Literature and case study analyses have demonstrated the innovative applications of plant dyeing techniques and provided important strategies and inspiration for promoting sustainable fashion development, constructing a theoretical framework for the heritage, development, and innovation of plant dyeing culture.

In-depth interviews with experts from various fields yielded valuable insights into the transmission of plant dye culture, technical innovation, marketing strategies, and educational dissemination. The opinions and feedback from these experts have provided theoretical and practical support for a sustainable innovation design model for plant dyes, as well as direction for the future development of sustainable fashion.

4.2 SUSTAINABLE INNOVATION DESIGN MODEL

4.2.1 MODEL COMPOSITION AND THEORETICAL FOUNDATIONS

This study, grounded in theories of sustainable development, design innovation, consumer behavior, and innovation theory, proposes a Sustainable Innovative Design Model aimed at integrating the cultural value, environmental attributes, and contemporary design demands of plant dyeing techniques. The essence of the model lies in the organic integration of plant dyeing skills with modern design. Sustainable

innovative forms principally encompass four stages: "Data Collection and Analysis, Problem Hypothesis, Design Knowledge, Induction" (Figure 70).

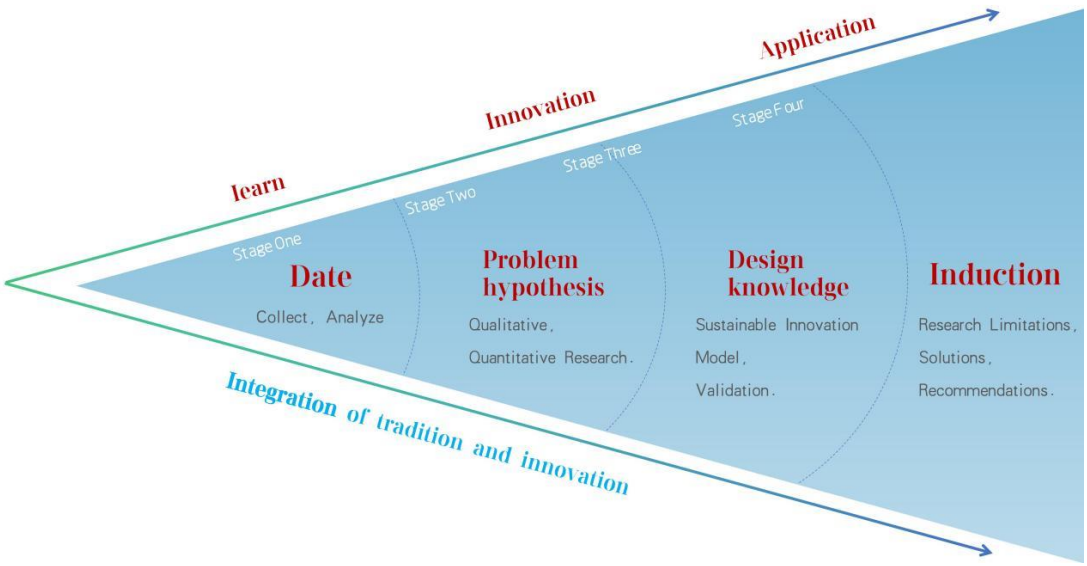
In the first phase, through field investigations, case analysis, and expert interviews, a preliminary framework of the sustainable innovation design model was established, highlighting the diversity of plant dye cultures and the significance of sustainability.

In the second phase, audience cultural cognition and market research, focus group interviews, and case studies were employed to identify the key themes and driving factors in plant dye design research, including the integration of tradition and modernity, environmental sustainability, and cultural heritage.

In the third phase, based on the transformation of sustainable brand and design symbols, a cultural and color resource repository for plant dyeing was created, providing a rich array of cultural and design resources for brand fashion design projects.

In the fourth phase, practical exploration of the sustainable innovation design model was conducted to reevaluate the cultural and fashionable value of plant dyeing, and through the research findings, the efficacy of the sustainable innovation design model was validated.

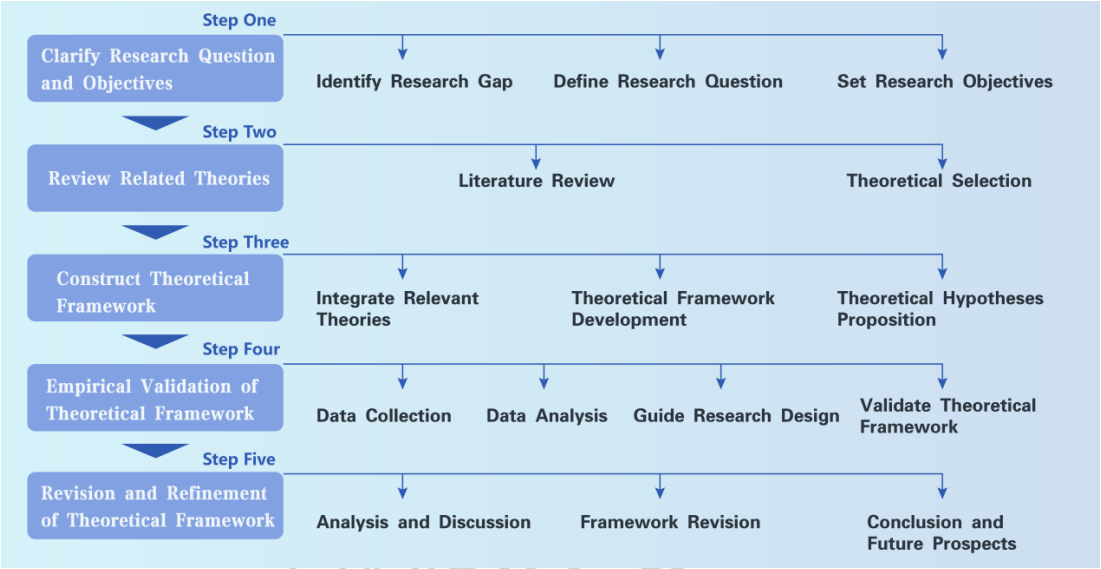
Figure 70 Sustainable innovative forms



Note. Illustrated by the researcher.

4.2.2 STEP TO CONSTRUCT THE THEORETICAL FRAMEWORK

Figure 71 Multidimensional Theoretical Framework of the Sustainable Innovation Design Model



Note. Illustrated by the researcher.

Constructing a robust theoretical framework is fundamental to scientific research (Figure 71). It not only supports the research questions and objectives but also guides the data collection and analysis processes, providing a solid foundation for the study and application of the sustainable innovation design model.

- **Step One: Clarifying Research Questions and Objectives**

• **Identifying Research Gaps:** Conduct an extensive literature review to identify gaps and areas that have not been adequately explored in existing research.

• **Defining the Research Question:** Clearly define the problem that the research intends to solve, ensuring that it is researchable and has practical significance.

• **Setting Research Objectives:** Based on the research question, establish specific, clear, and achievable objectives.

- **Step Two: Reviewing Related Theories**

• **Literature Review:** Conduct in-depth studies of theories and prior research in related fields, including theories of sustainable development, design innovation, consumer behavior, and innovation.

• **Theory Selection:** Choose theories closely related to the research question from the literature review to serve as the foundation for the study.

- **Step Three: Constructing the Theoretical Framework**

• **Integrating Relevant Theories:** Integrate the selected theories into a unified framework, ensuring coherence and logical consistency among them.

• **Developing the Theoretical Framework:** Develop a structured theoretical framework based on the integrated theories, clearly outlining the relationships among them, including causal relationships and interactions.

• **Formulating Theoretical Hypotheses:** Based on the theoretical framework, formulate hypotheses or research questions that can be empirically tested.

- **Step Four: Empirical Validation of the Theoretical Framework**

• **Data Collection:** Design data collection methods according to the theoretical framework and research hypotheses, which may include quantitative, qualitative, or mixed methods.

• **Data Analysis:** Apply appropriate statistical analysis, content analysis, or other methods to process and analyze the collected data.

• **Guiding Research Design:** Use the theoretical framework to guide the methods for data collection and analysis, ensuring that the research design aligns with theoretical expectations.

• **Validating the Theoretical Framework:** Based on the results of the data analysis, confirm whether the hypotheses of the theoretical framework hold and whether the framework can explain the research question.

- **Step Five: Refinement and Improvement of the Theoretical Framework**

• **Analysis and Discussion:** Based on the results of the empirical study, analyze deficiencies within the theoretical framework and discuss the verification of the theoretical hypotheses.

• **Framework Modification:** If necessary, modify the theoretical framework based on the research findings to enhance its explanatory power and applicability.

• **Conclusion and Prospects:** Summarize the main contributions of the theoretical framework and suggest directions for future research.

4.2.3 STRATEGIES FOR IMPROVING RESEARCH QUESTIONS

The Sustainable Innovation Design Model offers new approaches to addressing the challenges of preserving plant dyeing techniques and overcoming market application limitations. The strategies for improving the research questions include:

4.2.3.1 Strengthening Education and Training to Disseminate the Cultural Value of Plant Dyes

This model is committed to transforming the cultural value of plant dyes into cultural products and activities that are perceptible and experiential for the public. To achieve this goal, the model employs the following strategies:

Storytelling: By narrating the historical background, production techniques, cultural significance, and applications in various cultures of plant dyes, the storytelling approach enhances the attractiveness and impact of cultural dissemination of plant dyes.

Interactive Experiences: Utilizing workshops, exhibitions, and interactive platforms to invite the public to participate in the plant dyeing process, enabling them to understand and appreciate the art and technique of plant dyes through firsthand experience.

Digital Displays: Integrating modern information technology to expand the reach of plant dye culture through virtual exhibitions, online courses, and social media channels, attracting a broader audience.

4.2.3.2 Transforming Plant Dye Strategies Based on Audience Expectations

Based on understanding audience expectations for plant dyes, the model proposes strategies to transform plant dyes to meet modern market demands. It focuses on audience demands for environmental sustainability, original design,

personalized products, and cultural value, translating these into development and marketing strategies for plant dye products:

Environmental Sustainability: Emphasize the eco-friendly attributes and sustainable production processes of plant dye products to meet consumer demand for environmentally friendly products.

Design Innovation: Combine modern design principles to develop creative and contemporary plant dye fashion and lifestyle products that attract consumers seeking style and personalization.

Brand Storytelling: Build brand narratives that communicate the cultural and artistic value of plant dyes, establishing an emotional connection between the brand and consumers.

Market Segmentation: Develop plant dye product lines tailored to the specific needs and preferences of different target markets and consumer groups to implement market segmentation strategies.

4.2.3.3 Effectiveness of Sustainable Design in Plant Dyeing

The sustainability of plant dyeing is not only reflected in eco-friendly production processes but also demonstrated through the implementation of innovative designs and market strategies, showcasing its widespread application and social impact in modern society.

Social Impact: Plant dyeing enhances public awareness of environmental protection and cultural appreciation, facilitating the spread of sustainable development principles.

Economic Contribution: The commercialization of plant dyes brings new economic value to traditional crafts while also promoting the development of related industries and employment opportunities.

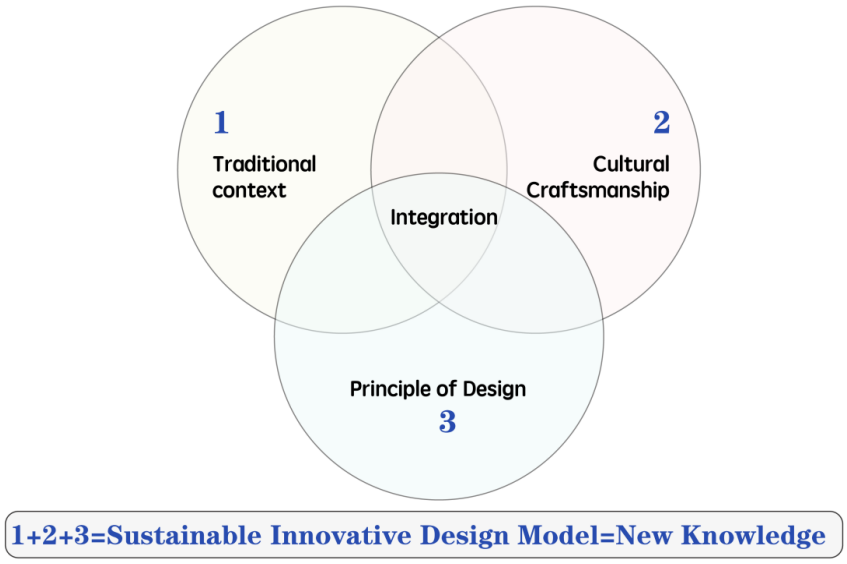
Cultural Heritage: By integrating modern design with traditional techniques, the sustainable design model for plant dyeing fosters cultural heritage and enhances national cultural confidence.

4.2.4 SUMMARY

This study proposes a sustainable innovation design model, which constructs a multidimensional theoretical framework through an in-depth analysis of key dimensions (Traditional context, Cultural craftsmanship, principle of design). This

framework facilitates the integration of plant dyeing techniques with modern design, promoting the practical application of sustainable fashion concepts. It achieves a win-win situation for environmental, economic, and social values, demonstrating significant practical effectiveness in the modern application of plant dyeing techniques and the advancement of sustainable fashion. In the future, this model is expected to be applied and promoted in broader fields, contributing more to achieving sustainable development goals.

Figure 72 Sustainable Innovative Design Model



Note. Illustrated by the researcher.

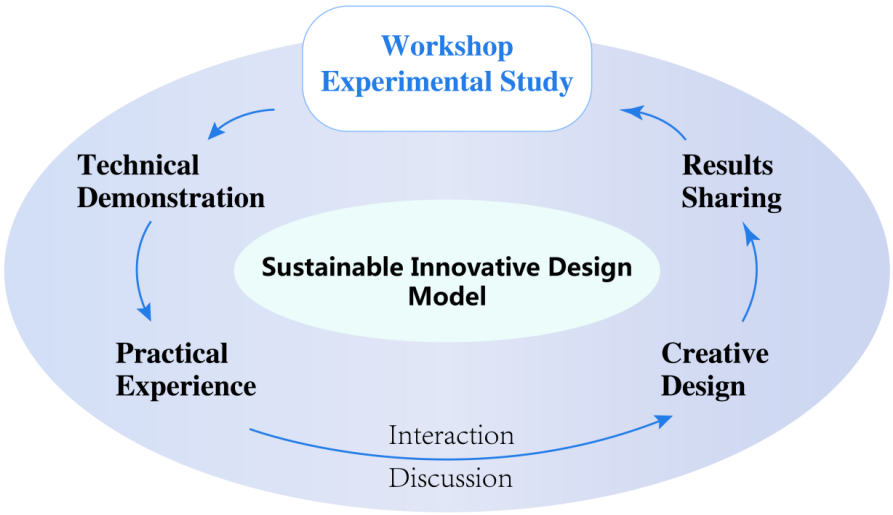
4.3 WORKSHOP EXPERIMENTAL STUDY ANALYSIS

4.3.1 ACTIVITY FORMAT

The purpose of the workshop is to validate and evaluate the research outcomes based on the sustainable innovation model. Initially, a plant dye seminar is organized, involving relevant experts, academics, and industry professionals to discuss topics related to plant dye culture, techniques, creative design, and market expectations. This is followed by practical workshops that provide empirical evidence through hands-on dyeing activities, technical demonstrations, interactive discussions, and creative displays. Participants personally experience the plant dyeing process and deepen their understanding of the techniques, cultural significance, and environmental implications

of plant dyes through expert guidance and discussions. The specific activities include technical demonstrations, hands-on experience, creative design, and sharing of outcomes. (Figure 73)

Figure 73 Workshop Activity Format



Note. Illustrated by the researcher.

4.3.2 SEMINAR PARTICIPANTS

Seminar experts include (see section 4.1.4): Zou Liulan, a plant dye expert; Ouyang Xian, a fashion design expert; and Chen Peng, an expert in sustainable design.

The workshop recruits students from fashion and arts colleges and volunteers advocating for sustainable craftsmanship on a voluntary basis to participate in the Sustainable Innovation Design Workshop for plant dyeing.

First group: Liu Rong, Liu Ting, Bao Yilin, Luo Wenrong, Ma Jiaolan, Huang Yonghong, Tang Wenhui.

Second group: Cui Qiang, Liu Chang, Liu Yue, Li Meimei, Liu Qi, Tang Wenhui, Hu Rongrong, Liu Jiao.

Third group: Students from the 2019 cohort of the Fashion Department at Changsha Normal University.

The workshop is divided into four segments: theoretical introduction and background education, technical demonstrations and practice preparation, group practical operations, and results discussion and feedback.

- **Step One: Theoretical Introduction and Background Education (Figure 74)**

·Explanation of the historical background, theoretical foundations, and environmental value of plant dyeing.

·Exploration of the use of plant dyes across various cultures and epochs, and their cultural significance.

·Discussion on the positive environmental impacts of using natural dyes compared to chemical dyes, including pollution reduction and enhancement of biodiversity. Introduction to the chemical components of colors in plant dyes and how to effectively extract dyes from plants.

·Discussion on the innovative applications of plant dyes in contemporary fashion and design, and how to integrate traditional techniques with modern technology.

Figure 74 Theoretical Introduction and Background Education

Note. Photographed by the researcher.

- **Step Two: Technical Demonstration and Practical Preparation (Figure 75)**

Transforming theoretical knowledge into practical skills through demonstration:

·Describing how to extract colors from various plant materials.

·Explaining how to treat fabrics to ensure even dyeing and lasting color retention, including pretreatment and soaking techniques.

·Demonstrating various dyeing techniques such as tie-dye, batik, or resist dyeing, and how to control the depth of colors and complexity of patterns.

Figure 75 Technical Demonstration and Practical Preparation

Note. Photographed by the researcher.

- **Step Three: Group Practical Activities (Figure 76)**

Guide participants to form groups for hands-on activities, with each group selecting a type of dye and technique:

·Participants choose fabrics and dyes based on their design ideas, crafting unique patterns and color combinations.

·Supervise each participant as they apply theoretical knowledge in practice, personally carrying out the dyeing process to deepen their understanding of the materials and techniques.

·During the dyeing process, participants may encounter technical issues or results that do not meet expectations; provide technical support and creative adjustment advice at these times.

Figure 76 Group Practical Activities

Note. Photographed by the researcher.

- **Step Four: Results Discussion and Feedback**

After completing the dyeing process, all participants will display and discuss their works:

·Each group presents their results and shares the creative inspirations and challenges they encountered during the design and dyeing processes.

·Experts and other participants provide feedback, discussing the technical execution, color application, and innovative elements of each piece.

·Participants exchange insights on techniques learned and problem-solving approaches used during the dyeing process, fostering mutual understanding and learning (Figure 77).

Figure 77 Workshop

Note. Photographed by the researcher.

The workshop activities enabled participants to deeply explore the culture and art of plant dyeing, sparking interest in innovation and practice within the field of sustainable fashion, achieving multiple objectives in education, technical transmission, and cultural exchange.

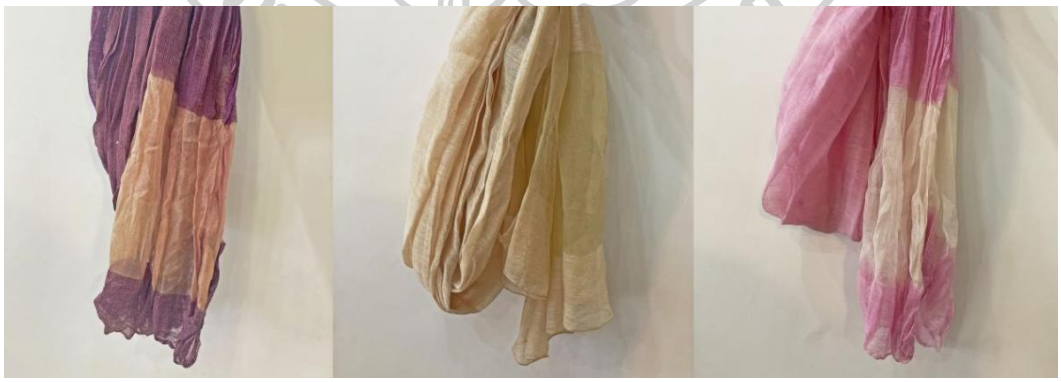
4.3.3 EVENT OUTCOMES

By evaluating the progress of the workshop study and providing feedback from industry professionals and myself, guidance was given to students to adjust and refine their research outcomes, culminating in the completion of the event's results. Below is a selection of group student works (Figures 78-83):

Figure 78 Group's indigo tie-dye creations

Note. Photographed by the researcher.

Figure 79 Plant-dyed scarf projects



Note. Photographed by the researcher.

Figure 80 Workshop works: The "Rebirth" series

Note. Group members: Cui Qiang, Liu Chang, Liu Yue. Guided by the researcher. Figure 80, "Rebirth" series, showcases accessories and hats, using tie-dye techniques to convey Gothic elements such as time, spider webs, floral walls, and mad hatters. Boldly utilizing red, white, and black colors, it achieves a rebirth through plant dyeing.

Figure 81 Workshop works: "Collage" Series

Note. Group members: Tang Wenhui, Li Meimei, Liu Qi. Guided by the researcher. Figure 81, "Collage," represents the popularity of collage art, where cutting and integrating fragments has become a hallmark of postmodernism. This series combines plant tie-dyeing with leather to achieve a fusion and innovation of traditional crafts.

Figure 82 Workshop works: "Formless" Installation Art Series

Note. Group members: Luo Wenrong, Ma Jiaolan, Huang Yonghong, Tang Wenhui. Guided by the researcher. Figure 82, the "Formless" series uses wax dyeing and indigo flowers to depict plants and landscape installations in nature, calling for public attention to sustainable fashion and environmental protection.

Figure 83 Workshop works: "Geometric" Accessories Series

Note. Group members: Hu Rongrong, Liu Jiao. Guided by the researcher. Figure 83, "Geometric" series features classic Chinese rhombus patterns as the main element, combined with natural indigo dyeing. The design is orderly, minimalist yet aesthetically rich, representing a fusion of tradition and fashion.

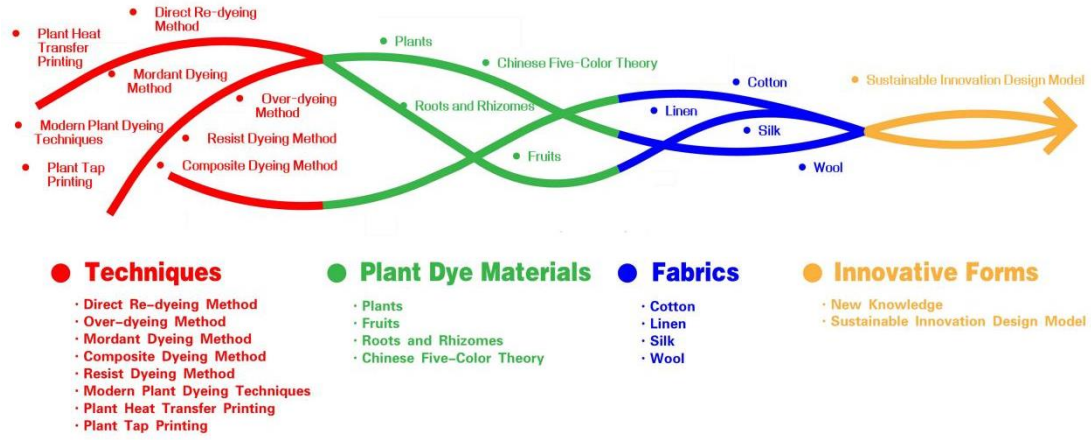
4.3.4 SUMMARY

The experimental workshop encourages participants to innovate during the design process, exploring the possibilities of combining traditional techniques with modern design elements. This approach is reflected in the final works of the participants. It demonstrates that integrating plant dyeing techniques with contemporary design education can effectively promote the modernization of cultural skills. Therefore, the successful implementation of the workshop not only raises public awareness of plant dyeing culture and technology but also showcases the practicality and promotional value of plant dyeing technology in modern design education. This provides practical examples and theoretical support for advancing sustainable fashion.

4.4 INTEGRATION OF TRADITION AND INNOVATION: DESIGN CONCEPTS AND EXHIBITION DISPLAYS

4.4.1 "XiaRan" BRAND DESIGN

Figure 84 Sustainable Innovative Design Study



Note. Illustrated by the researcher.

Through the extraction of traditional and contemporary botanical dyeing techniques, using various dye materials and mediums such as fruits, roots, and rhizomes, and aligning with Chinese traditional concepts, this study utilizes natural fibers—cotton, linen, silk, and wool—for the dye card experiments, ultimately constructing a framework for sustainable innovative design. This research

incorporates literature reviews, data collection, and artistic botanical dye creations, alongside branding and exhibitions, to enhance cultural dissemination among target audiences and establish a sustainable innovative design study (Figure 84).

4.4.1.1 Audience Targeting

·Brand Demographics

The "XiaRan" brand, merging traditional plant dyeing techniques with modern design philosophies, aims to set a new standard for sustainable fashion brands. The target audience primarily consists of consumers between the ages of 25 and 45 who have a high awareness and willingness to purchase sustainable and environmentally friendly fashion and value design uniqueness and quality. This demographic generally possesses a stable income and is willing to pay a premium for high-quality, eco-friendly products.

·Market Segmentation and Personalization

Given the uniqueness and customization potential of plant dyeing, brands focus on offering highly personalized product options to meet consumers' desires for unique items. This includes custom services to attract customers who seek personalized and distinctive styles. Additionally, it serves the promotion of plant dyeing culture through displays at tourist attractions, helping more people understand the cultural and technical value of plant dyeing.

4.4.1.2 "XiaRan" Design Concepts

·Brand Design Philosophy

Inspired by a modern interpretation of traditional plant dyeing techniques, the integration of modern aesthetic elements ensures each product possesses unique textures and colors. The design concept emphasizes "returning to nature and highlighting true colors." By employing contemporary design methods, traditional dyeing techniques are made more compatible with modern consumers' aesthetics and expectations. (Figure 85)

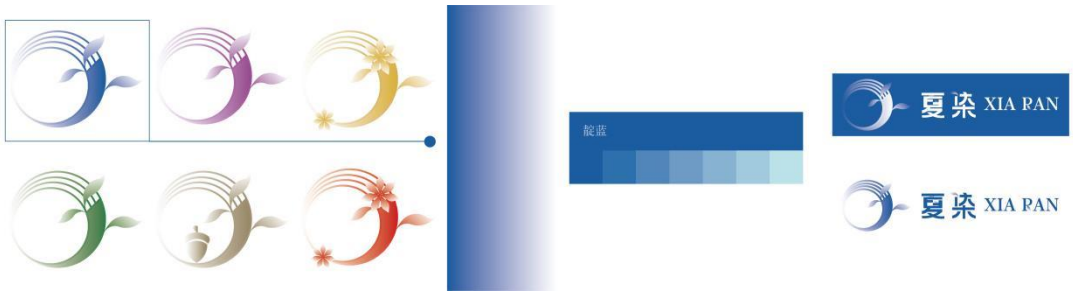
Figure 85 XiaRan Brand Logo Visual Design

Note. Illustrated by the researcher.

·Brand Color Philosophy

Based on expert interviews, the core color for the XiaRan brand is identified as "China Blue," serving as a signature for the brand's visual identity. Utilizing this shade of indigo pays homage to the history and creativity of Chinese plant dyeing, conveying a sustainable lifestyle in harmony with nature and providing solace in the fast-paced modern world. (Figure 86)

Figure 86 XiaRan Brand Primary Colors



Note. Illustrated by the researcher.

·Material and Technological Choices

High-quality natural fibers such as organic cotton, silk, and hemp are selected for their superior ability to absorb plant dyes, enhancing the comfort and durability of the finished products. Eco-friendly plant dyeing techniques ensure sustainability in production.

·Cultural Integration and Modern Expression

While preserving traditional dyeing crafts, the design team strives to integrate plant dyeing skills with contemporary design concepts, combining traditional methods with modern fashion designs to create products that are culturally rich and align with modern aesthetics. (Figure 87)

Figure 87 XiaRan Brand Accessories

Note. Illustrated by the researcher.

·Sustainability and Social Responsibility

Emphasizing social responsibility and environmental consciousness, the brand collaborates with local artisans and conducts educational campaigns to increase public awareness of the sustainability of plant dyes, promoting an environmentally friendly lifestyle.

4.4.2 PLANT DYE COLOR SYSTEM

Within the framework of the Sustainable Innovation Design Model, the "Plant Dye Color System" was developed through expert discussions as a key tool. It features 8 representative plant dye materials, 4 types of fabric (cotton, linen, silk, wool), and 3 mordants (alum, blue vitriol, green vitriol), across 9 mordanting techniques, creating a systematic reference for designers and cultural researchers

(Figures 88-95). To ensure the practicality and accuracy of the color cards, all color samples underwent rigorous testing, including colorfastness and stability under light exposure and washing, to evaluate the effects of different materials on dye results.

Figure 88 Color Card: Saffron - Crocus sativus

Note. Illustrated by the researcher.

Figure 89 Color Card: Black Soybean Hull - Glycine max

Note. Illustrated by the researcher.

Figure 90 Color Card: Pagoda tree flower - Sophora japonica

Note. Illustrated by the researcher.

Figure 91 Color Card: Madder - Rubia tinctorum

Note. Illustrated by the researcher.

Figure 92 Color Card: Indian Madder - Rubia cordifolia

Note. Illustrated by the researcher.

Figure 93 Color Card: Sappanwood - Caesalpinia sappan

Note. Illustrated by the researcher.

Figure 94 Color Card: Gardenia - Gardenia jasminoides

Note. Illustrated by the researcher.

Figure 95 Color Card: Purple Gromwell - Lithospermum erythrorhizon

Note. Illustrated by the researcher.

The plant dye color card system serves not only as a tool but also as a resource for education and design. Through this systematic plant dye color card, the "XiaRan" brand and other designers can explore the various possibilities of plant dyes more deeply, applying these dyeing techniques to contemporary designs, thereby promoting more environmentally friendly and culturally rich fashion products.

4.4.3 SUSTAINABLE PLANT DYE FASHION DISPLAY ONE

This series of designs focuses on the integration of traditional plant dye techniques with modern fashion design, demonstrating how innovative design concepts can apply plant dyes to fashion design and display. The theme of this fashion series is "Indigo Impressions," aimed at utilizing purely natural dyes and sustainable materials to echo the principles of nature conservation. The design concept revolves around showcasing the diversity and aesthetic appeal of plant dyeing, emphasizing the visual appeal and tactile comfort of the clothing. Cotton-linen and denim materials are used for indigo dyeing. Various patterns are employed in the dyeing process, with embellishments of Chinese red from the plant color card, crafting a nostalgic yet simplistic design style (Figure 96).

Figure 96 Design Effect of the "Indigo Impressions" Fashion Series

Note. Illustrated by the researcher.

Figure 97 Garment Prototype Experiment

Note. Photographed by the researcher.

Garment Prototype Production (Figure 97): This stage involves the adjustment of garment patterns to finalize the designs, followed by proceeding to dye experiments on the cut pieces.

Garment Section Stitch-Dyeing (Figure 98): The process involves designing tie-dye patterns, stitching and tightening the fabric pieces accordingly. The fabric is then soaked in clean water to ensure even dye uptake. Place the material into the dyeing vat for coloring, then remove it for oxidation. Observe through gaps to check if the desired color has been achieved. If the result is not as expected, repeat the dyeing process until the desired color is obtained.

Figure 98 Garment Section Stitch-Dyeing

Note. Photographed by the researcher.

Figure 99 Gradient Dip-Dyeing

Note. Photographed by the researcher.

Gradient Dip-Dyeing (Figure 99): Begin by wetting the fabric with clean water, then gradually immerse it into the dye vat. Slowly lift the fabric upwards, allowing the color to naturally gradient, with the deepest color being where the fabric remained in the dye the longest. After dyeing, rinse the fabric with clean water to remove excess dye and allow it to air dry. If the desired effect is not achieved, the fabric willbe dyed again.

Cloud Dyeing Tie-Dye (Figure 100): Secure the fabric with cotton threads according to the design and immerse it in the dye bath, continuously stirring to ensure thorough contact between the fabric and the dye. After removing the fabric to oxidize, untie the threads. For trouser panels, after untieing from the cloud dyeing process, they are subjected to over-dyeing to deepen the coverage.

Figure 100 Cloud Dyeing Tie-Dye

Note. Photographed by the researcher.

Garment Construction (Figure 101): Assemble all the dyed fabric pieces through sewing to complete the finished garment effect.

Figure 101 Garment Construction

Note. Photographed by the researcher.

In fashion design, deconstructionism is employed to dismantle, combine, and innovate, creating a new structural form. The design elements mainly incorporate patchwork, asymmetry, ruffles, exaggerated silhouettes, asymmetrical collars, and double-layer collars. Through multidimensional design and presentation methods, the importance of sustainable fashion in environmental protection and cultural heritage is emphasized. This showcases how the fashion industry is driving the future of sustainable development through the fusion of innovation and tradition. (Figure 102 ,103)

Figure 102 "Indigo Impressions" Fashion Showcase 1

Note. Photographed by the researcher, Liu Rong

Figure 103 "Indigo Impressions" Fashion Showcase 2

Note. Illustrated by the researcher, Liu Rong

4.4.4 SUSTAINABLE PLANT DYE FASHION DISPLAY TWO

Design Sketches and Renderings (Figures 104, 105): The theme of this series is "Natural Fusion," which combines traditional indigo dye techniques with wool felting crafts to explore the interaction of these materials and techniques in contemporary fashion design. It highlights the beauty of natural materials and the unique value of craftsmanship, guiding fashion towards a more environmentally friendly and sustainability through innovative integration.

Figure 104 Design Sketch

Note. Illustrated by the researcher.

Figure 105 "Natural Fusion" Fashion Series Design Effect

Note. Illustrated by the researcher.

Fabric Selection (Figure 106): The textural appeal and natural beauty of cotton-linen fabrics, combined with creative wool felting, break away from conventional and subdued styles. Soft and lightweight cotton-linen materials are used, undergoing a second dyeing process to achieve various shades of blue; accessories primarily consist of plain-colored wool, further enhanced through second dyeing, wet felting, and needle punching to recreate the fabric.

Figure 106 Fabric Selection: Plain Weave Linen, Natural Wool

Note. Photographed by the researcher.

Dyeing and Fabrication (Figure 107): Utilizing the wet felting technique to craft thematic irregular curves, an abstract pattern reminiscent of ocean waves is created. A mesh cover is placed over the fabric, followed by pouring soapy water to saturate it, then repeatedly massaged to shape. Once formed, the fabric is rinsed and air-dried to enhance textural details.

Figure 107 Dyeing and Fabrication

Note. Photographed by the researcher.

Garment Effect Display (Figure 108): The depth of the indigo color varies, achieved through different dyeing durations, techniques, and materials, creating varied visual experiences. The exhibition enhances public awareness of the application of traditional crafts in modern sustainable fashion and provides compelling examples and insights for the modern transformation of traditional crafts.

Figure 108 "Natural Fusion" Fashion Display

Note. Illustrated by the researcher, Liu Ting

4.4.5 SUSTAINABLE PLANT DYE DESIGN EXHIBITION

The "Integrating Tradition and Innovation" sustainable plant dye exhibition, organized both online and offline, effectively enhances public awareness of plant dye culture and techniques through a combination of cultural education and interactive experiences. This initiative sparks interest in traditional culture and raises awareness about its preservation.（Figure 109）

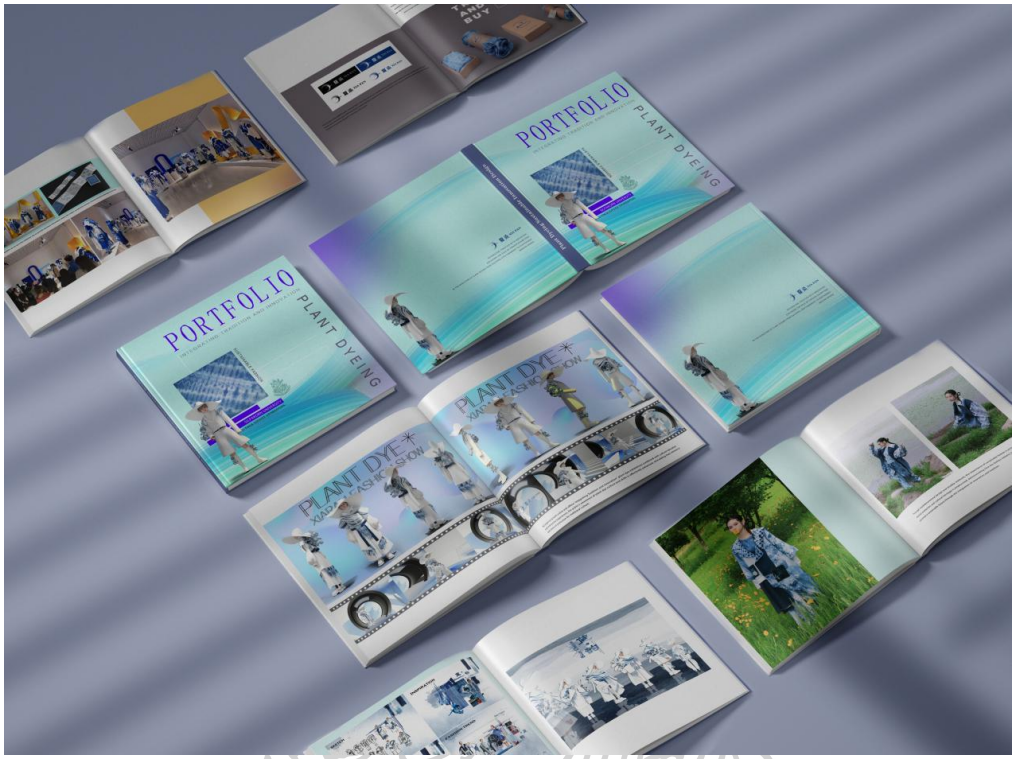
Figure 109 Sustainable Plant Dye Design Exhibition

Note. Illustrated by the researcher.

4.4.5.1 Offline Static Exhibition

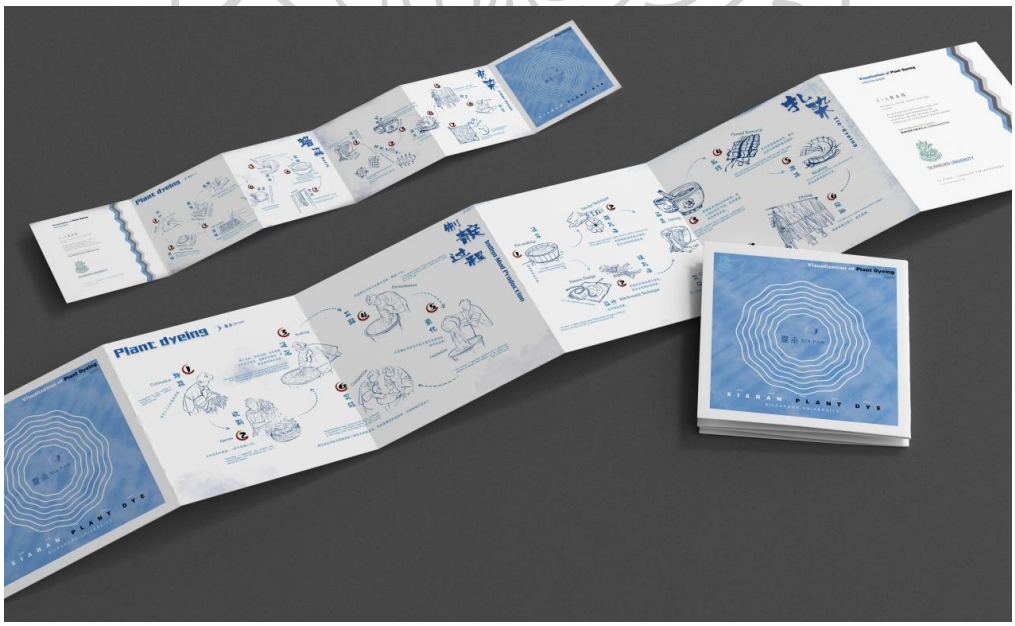
Through physical exhibitions, visitors can closely experience the texture and color of plant dyes, gaining a deeper understanding of the cultural and technical value of plant dyeing. The exhibition site features visual infographics (Figures 110-111) that detail the sources, production process, and environmental advantages of plant dyes. Guided tours and on-site explanations enhance visitors' awareness of sustainable fashion, encouraging support and participation in eco-friendly fashion practices. Additionally, the exhibition collaborates with local educational institutions, inviting students to participate in the design and preparation of displays, organizing student group visits, and providing practical learning opportunities. This promotes interest and understanding of sustainable fashion among the new generation of designers.

Figure 110 Plant Dye Creative Promotion Manual



Note. Illustrated by the researcher.

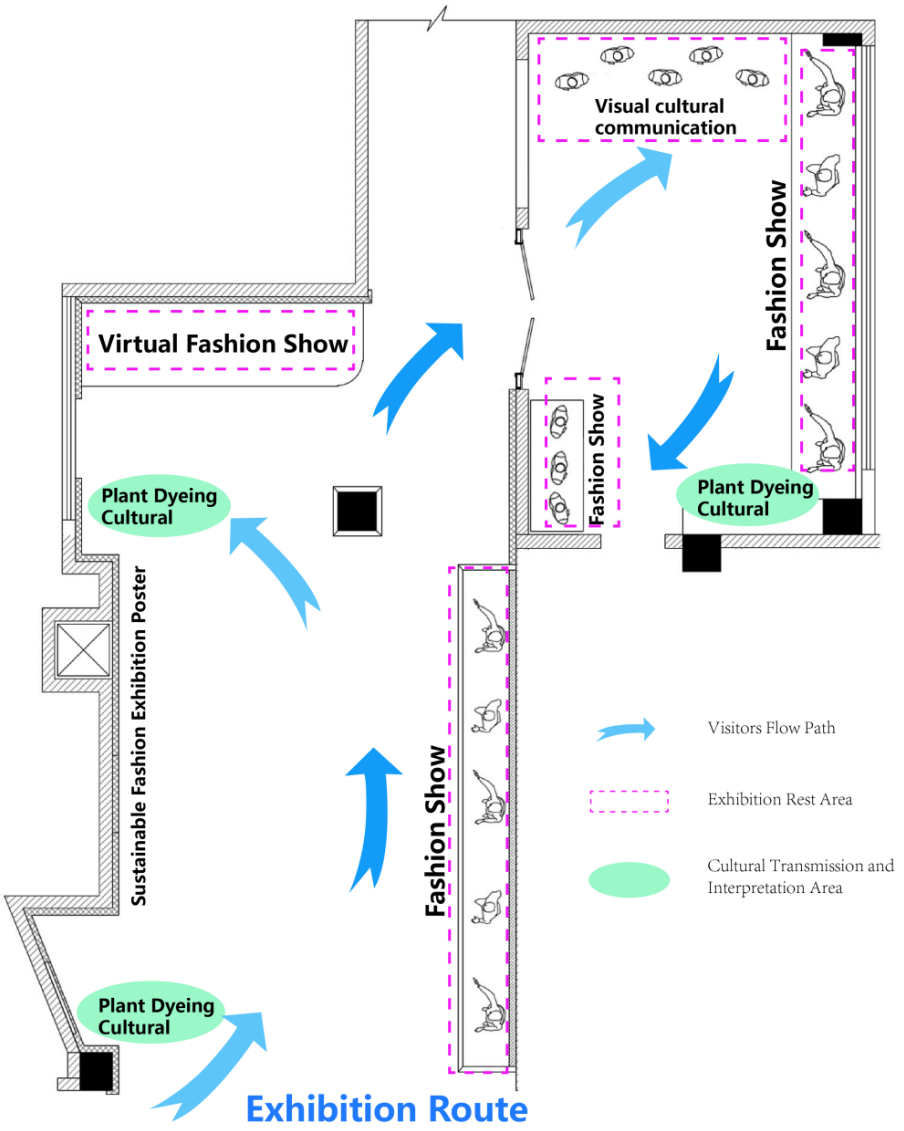
Figure 111 Plant Dye Culture and Craft Promotion Manual



Note. Illustrated by the researcher.

The offline static exhibition is a critical component in presenting the outcomes of the sustainable plant dyeing project, offering attendees the opportunity for direct engagement and in-depth exploration of plant-dyed works. The exhibition design, which includes visitor circulation routes, viewing exhibition areas, and zones for cultural dissemination and interpretation, enhances the learning, experiential, and interactive opportunities for visitors.

Figure 112 Exhibition Visitor Circulation Diagram



Note. Illustrated by the researcher.

The exhibition includes plant-dyed clothing, accessories, and process workflows. Through seminars, it introduces the sources of dyes used, dyeing techniques, design concepts, and their potential environmental impacts. Multimedia presentations of online fashion shows help visitors better understand the sustainable attributes and cultural value of the products. This deepens the audience's understanding and appreciation of plant dyeing techniques, enhancing the educational significance of the exhibition. (Figure 113).

Figure 113 Sustainable Plant Dye Exhibition

Note. Photographed by the researcher.

This multi-layered, multisensory exhibition approach effectively conveys the aesthetics, techniques, and sustainable values of plant dyeing, while also promoting a deeper understanding and widespread acceptance of the integration of traditional crafts and modern design among the public (Figures 114-115).

Figure 114 Sustainable Exhibition Poster

Note. Photographed by the researcher.

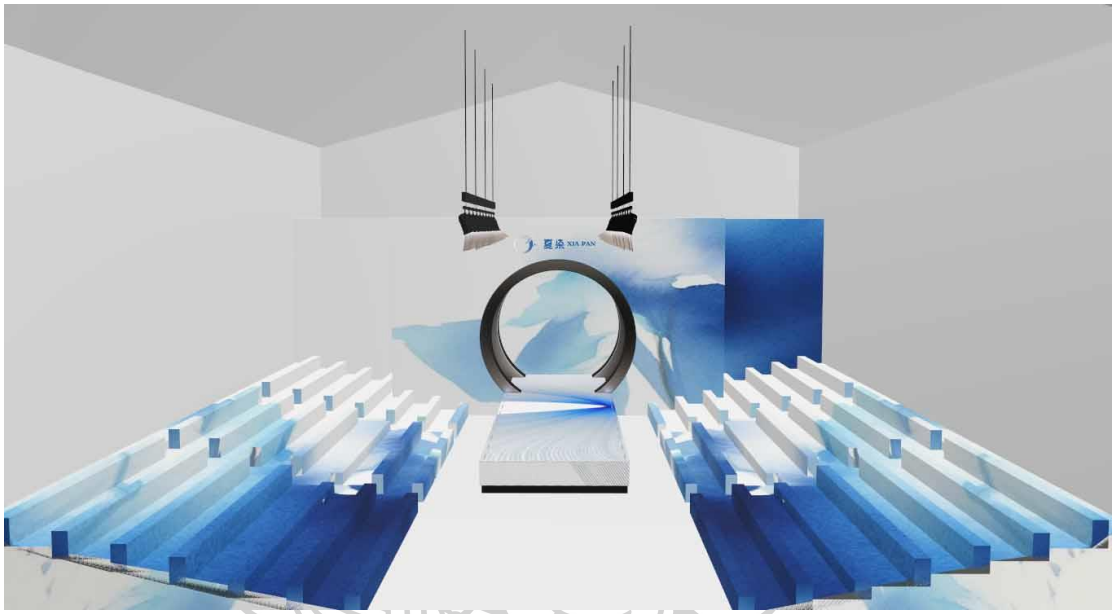
Figure 115 Live Shot of Sustainable Plant Dye Exhibition

Note. Photographed by the researcher.

4.4.5.2 Online Virtual Fashion Show

By utilizing CLO 3D virtual fashion design software (Choi, 2022), an online virtual fashion show is created to display a collection made from plant dyes (Figures 116). This digital format allows the sustainable plant-dyed fashion to be showcased to a global audience while reducing the environmental footprint of physical exhibitions.

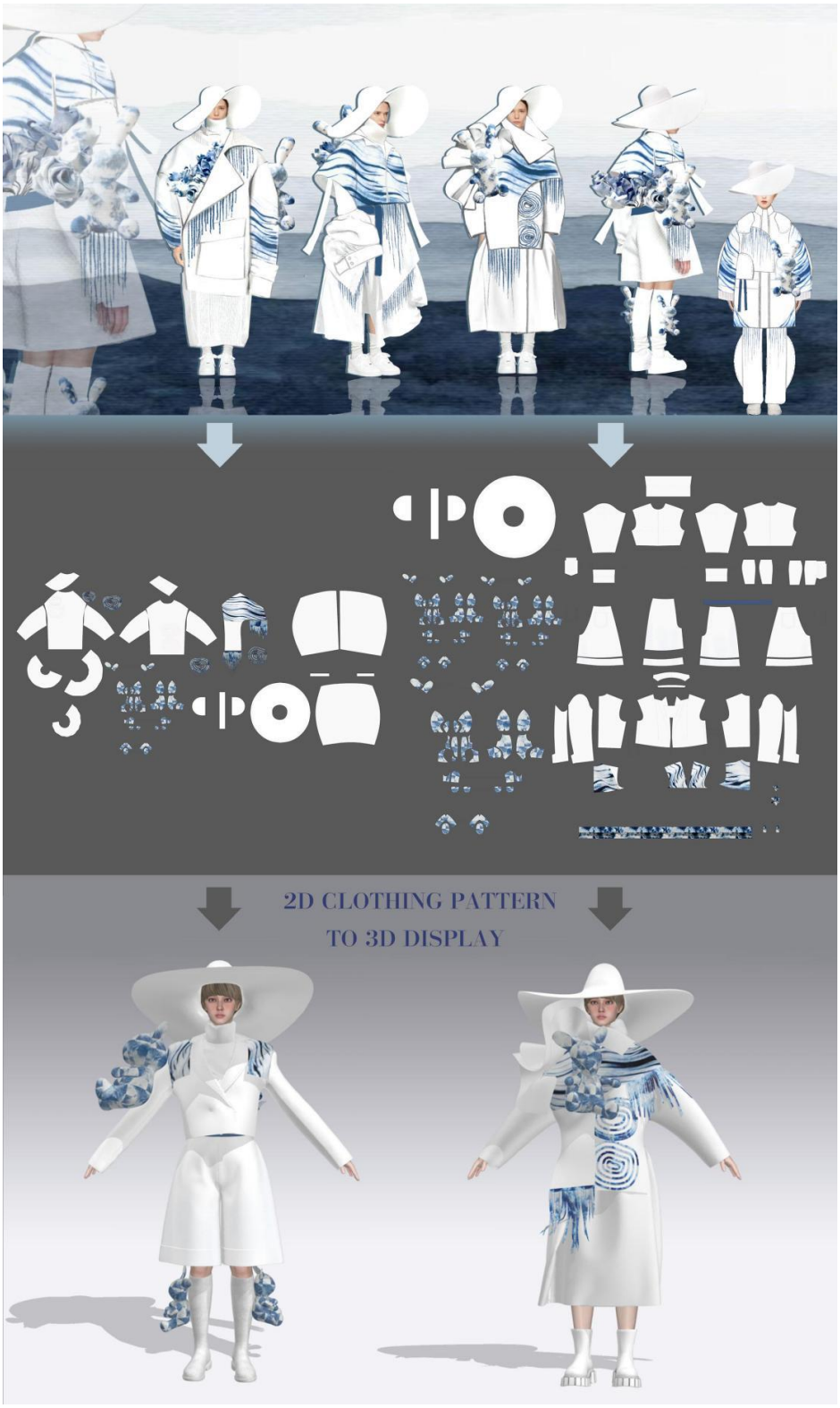
Figure 116 Construction of the CLO virtual fashion show stage



Note. Illustrated by the researcher.

Using CLO3D to build sustainable virtual fashion resources enables low-cost dissemination and promotion by converting 2D garment patterns into 3D displays. Through fashion shows, 3D showrooms, and virtual displays, this approach helps fashion companies achieve comprehensive and extensive digital transformation across all channels. (Figures 117-119).

Figure 117 Conversion from 2D garment patterns to 3D display

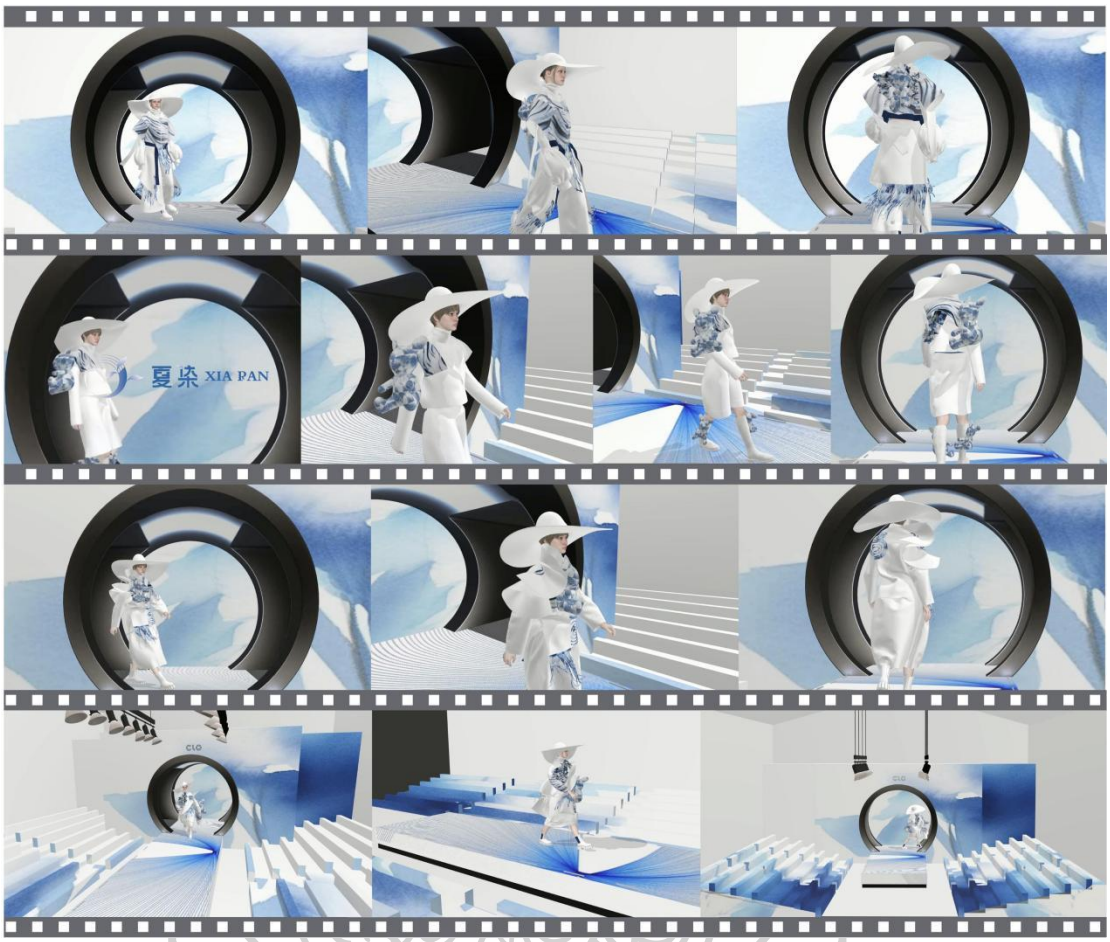


Note. Illustrated by the researcher.

Figure 118 3D Sustainable Plant Dye Fashion Display

Note. Illustrated by the researcher.

Figure 119 Dynamic Virtual Fashion Show



Note. Illustrated by the researcher.

After the show, the organizers will collect feedback from the audience through online surveys and data analysis tools to assess the acceptance of the virtual fashion show, audience engagement, and achievement of educational goals, providing data for continuous improvement of the content and technology of the virtual fashion show.

4.4.6 FEEDBACK: PRE-AND POST-EXHIBITION SPSS ANALYSIS

To assess the impact of the sustainable plant dye design exhibition on audience cognition, the study employed SPSS statistical software for a pre- and post-test comparative analysis (Table 26). Structured questionnaires were used to collect visitor data before (pre-test) and after (post-test) the exhibition. Paired sample t-tests were used to evaluate whether the changes in audience knowledge before and after the exhibition were statistically significant (Kim, 2015). This test assesses the differences

in scores of the same respondents at two time points, helping to determine the impact of the exhibition.

Table 26 Results of Paired Sample t-Test Analysis

t-Test Analysis Results				
	Group (Mean ± Standard Deviation)		*t*	*p*
	Pre-test (n=150)	Post-test (n=150)		
Part One: Score for Simple Questions	1.84±1.03	3.06±1.02	-10.283	0.000**
Part Two: Score for Medium Difficulty Questions	1.77±0.92	2.44±0.88	-6.417	0.000**
Part Three: Score for Difficult Questions	1.28±0.85	2.06±1.14	-6.702	0.000**
Total Score	4.89±1.74	7.56±1.70	-13.429	0.000**

Note. Data collected and analyzed by the researcher.

The questionnaire is divided into three parts: simple questions about Chinese plant dyeing, medium difficulty questions, and high difficulty questions.

Utilizing an independent samples t-test to investigate the differences in scores between pre-test and post-test for four components: the first part score, the second part score, the third part score, and the total score.The comparative analysis before and after the exhibition shows a significant improvement in visitors' knowledge about plant dyeing and its sustainability. Paired sample t-tests indicate that this increase in knowledge scores is statistically significant ($p < 0.05$), and effect size analysis indicates that this change has a moderate to high practical significance, demonstrating that the exhibition effectively changed people's perceptions. Data analysis of behavioral intentions to purchase plant-dyed products or recommend them to others also showed positive improvements post-exhibition (Manfei et al., 2017). These analytical results support the exhibition's effectiveness in enhancing consumer awareness of sustainable consumption.

The pre- and post-test comparative analysis via SPSS distinctly demonstrates the tangible effects of the plant dye sustainable design exhibition in educating the public,

enhancing environmental awareness, and promoting traditional crafts. These analytical outcomes not only validate the success of the exhibition's design and implementation but also provide crucial data support and practical guidance for planning future similar exhibitions. Through systematic data analysis, the research team can continue to optimize exhibition content, increase public engagement and educational impact, thereby advancing the sociocultural goals of sustainable development.

4.4.7 SUMMARY

Integrating tradition with innovation is a key pathway to driving sustainable development. By establishing the "XiaRan" brand and developing the plant dye color card system, traditional plant dye techniques were successfully merged with modern design principles, establishing a unique brand positioning and market segmentation strategy that enhanced educational and cultural dissemination. Whether through physical static exhibitions or online virtual fashion shows, audiences were able to more comprehensively experience and understand the aesthetic and sustainability values of plant dyeing. Finally, SPSS comparative analysis of pre- and post-tests revealed that the exhibition successfully enhanced visitors' recognition of the craftsmanship and sustainability aspects of plant dyeing, confirming the exhibition's effectiveness in educating and influencing the public.

4.5 AUDIENCE PERCEPTION AND WILLINGNESS TO ORGANIZE SURVEY ANALYSIS OF PLANT DYE CULTURE

4.5.1 DESCRIPTIVE STATISTICAL ANALYSIS

- **Demographic Variable Analysis**

This study explored audience perceptions of traditional plant dye fashion exhibitions and their cultural cognition through a survey on their willingness to participate in such exhibitions (Hayes et al., 2005). The analysis of the results, based on demographic variables from 320 survey responses, is presented below:

Based on Table 27, which includes demographic data from 320 survey respondents, variables such as gender, age, income range, educational background, understanding of plant dyeing, and frequency of purchasing plant dye products were analyzed. The gender distribution showed a higher percentage of male respondents at

52.19%, compared to 47.81% female. The most represented age group was 25-34 years, comprising 159 individuals or 49.69% of the sample. In terms of income, the range from 100,001 to 400,000 yuan had the most respondents, with 183 individuals making up 57.19% of the sample. The most common level of education was a master's degree, held by 162 respondents, accounting for 50.63% of those surveyed. Regarding familiarity with plant dyeing, the largest group, comprising 100 individuals or 31.25% of respondents, had a lack of understanding. The frequency of purchasing plant dye products was typically once a year, as reported by 96 respondents, representing 30% of the sample.

Table 27 Demographic Variables Analysis

Name	**Options**	**Frequency**	**Percentage (%)**
Gender	Male	167	52.19
	Female	153	47.81
Age	Under 18 years old	19	5.94
	18-24 years old	39	12.19
	25-34 years old	159	49.69
	35-44 years old	25	7.81
	45-60 years old	44	13.75
	Over 60 years old	34	10.63
Income Range	0 - 50,000RMB	29	9.06
	50,001 - 100,000RMB	67	20.94
	100,001 - 400,000RMB	183	57.19
	400,001 - 1,000,000RMB	41	12.81
Educational Background	High school and below	41	12.81
	Bachelor's degree	88	27.50
	Master's degree	162	50.63
	Doctoral degree	29	9.06
Understanding of Plant Dyeing	No understanding	69	21.56
	Lack of understanding	100	31.25
	Moderate understanding	69	21.56

	Fairly in-depth understanding	82	25.62
Frequency of Purchasing Plant-Dyed Products	Never	56	17.50
	Once in my lifetime (rarely)	55	17.19
	Twice (sometimes)	56	17.50
	Once a year (usually)	96	30.00
	More than once a year (always)	57	17.81

Note. Data collected and analyzed by the researcher.

- **Statistical Analysis of Research Variables**

According to the descriptive analysis of research variables, this study conducted an analysis of two primary variables from the survey: the design perception and cultural cognition of plant dye fashion exhibitions (in terms of artistic quality, cultural depth, authenticity, and emotional appeal) and the willingness to participate in plant dye fashion exhibitions (Myers et al., 2013). (Table 28)

Mean and Standard Deviation: Reviewing the data from various measurement items in the table, the mean scores for design perception and cultural cognition related to plant dye fashion exhibitions range from 3.553 to 3.931, with standard deviations from 1.027 to 1.291. This indicates that respondents perceive the design and cultural aspects of these exhibitions as moderately high. The mean scores for willingness to participate in plant dye fashion exhibitions range from 3.500 to 3.644, with standard deviations from 1.224 to 1.336. Overall, these results suggest a clear central tendency among variables, with similar dispersion across measurement items, indicating stable data.

Kurtosis and Skewness: The primary criteria for judging the normality of sample data are skewness and kurtosis. Analysis results show that the absolute values of skewness are less than 1 and kurtosis absolute values do not exceed 3, meeting the standard requirements for a normal distribution.

Table 28 Descriptive Statistics Analysis of Research Variables

	Name	Sample Size	Mean	Standard Deviation	Kurtosis	Skewness
Artistry	F1	320	3.638	1.291	-0.604	-0.698
	F2	320	3.669	1.278	-0.486	-0.775
	F3	320	3.563	1.268	-0.635	-0.610
Culturality	F4	320	3.862	1.108	0.553	-1.032
	F5	320	3.931	1.027	0.048	-0.770
	F6	320	3.922	1.141	0.596	-1.096
Traditionality	F7	320	3.634	1.272	-0.594	-0.658
	F8	320	3.553	1.271	-0.598	-0.655
	F9	320	3.681	1.279	-0.557	-0.726
Authenticity	F10	320	3.663	1.221	-0.329	-0.735
	F11	320	3.628	1.265	-0.373	-0.777
	F12	320	3.653	1.290	-0.520	-0.753
Emotionality	F13	320	3.712	1.231	-0.204	-0.847
	F14	320	3.778	1.173	-0.048	-0.861
	F15	320	3.719	1.245	-0.435	-0.747
Willingness to Participate in Plant Dye Fashion Exhibitions	D1	320	3.616	1.224	-0.521	-0.647
	D2	320	3.500	1.291	-0.770	-0.536
	D3	320	3.556	1.309	-0.700	-0.621
	D4	320	3.591	1.308	-0.588	-0.707
	D5	320	3.587	1.266	-0.646	-0.622
	D6	320	3.591	1.271	-0.695	-0.615
	D7	320	3.644	1.278	-0.561	-0.704
	D8	320	3.556	1.336	-0.712	-0.666

Note. Data collected and analyzed by the researcher.

4.5.2 RELIABILITY AND VALIDITY ANALYSIS

This study utilizes the Cronbach's Alpha coefficient as an indicator of reliability, with higher values indicating better data reliability. Particularly, a Cronbach's Alpha coefficient above 0.8 suggests that the reliability of the scale is highly satisfactory (Tavakol & Dennick, 2011). For this analysis, SPSS was employed to conduct a reliability analysis on the 306 samples gathered for this study. Specific results of this verification are presented in Table 29.

Table 29 Reliability Results Analysis

Reliability Analysis Results				
Name	Item	Corrected Item-Total Correlation (CITC)	Alpha if Item Deleted	Cronbach's Alpha Coefficient
Artistry	F1	0.645	0.731	0.802
	F2	0.658	0.718	
	F3	0.637	0.739	
Culturality	F4	0.613	0.598	0.741
	F5	0.546	0.679	
	F6	0.542	0.686	
Traditionality	F7	0.660	0.743	0.812
	F8	0.661	0.743	
	F9	0.664	0.740	
Authenticity	F10	0.608	0.740	0.791
	F11	0.611	0.737	
	F12	0.677	0.665	
Emotionality	F13	0.669	0.662	0.786
	F14	0.607	0.730	
	F15	0.603	0.736	
Willingness	D1	0.708	0.913	0.921

to Participate in Plant Dye Fashion Exhibitions	D2	0.734	0.911
	D3	0.742	0.911
	D4	0.744	0.910
	D5	0.738	0.911
	D6	0.750	0.910
	D7	0.728	0.912
	D8	0.744	0.911

Note. Data collected and analyzed by the researcher.

According to Table 29, the Cronbach's Alpha coefficients for the measurement items within the variables of artistic, cultural, traditional, authentic, emotional dimensions, and the willingness to participate in plant dye fashion exhibitions are all greater than 0.70. Furthermore, in the CITC, the minimum value is 0.5421, which exceeds 0.5. Removing any single item from the variables does not increase the Cronbach's Alpha coefficient, indicating that the questionnaire possesses good reliability (Bujang et al., 2018).

To further ensure the accuracy of the study, this paper will perform a validity test on the survey questionnaire (Table 30). Validity testing of the questionnaire data is conducted using the KMO and Bartlett's Test of Sphericity through the SPSS statistical analysis software. The KMO value ranges from 0 to 1, with values above 0.6 indicating acceptable validity; the closer this value is to 1, the more suitable it is for factor analysis. If the Bartlett's Test of Sphericity statistic is significant within a 5% confidence interval, it suggests that the scale is appropriate for further factor analysis. The results of the validity tests are as shown in the table.

Table 30 Validity Results Analysis

	KMO Statistic Value	Bartlett's Test of Sphericity		
		Approx. Chi-Square	df	Sig
Artistry	0.712	299.141	3	.000
Culturality	0.679	214.503	3	.000
Traditionality	0.716	318.157	3	.000
Authenticity	0.697	285.027	3	.000
Emotionality	0.697	277.890	3	.000
Willingness to Participate in Plant Dye Fashion Exhibitions	0.944	1502.074	28	.000

Note. Data collected and analyzed by the researcher.

According to the results of the validity tests shown in Table 30, the KMO values for the dimensions of design perception and cultural cognition in the plant dye fashion exhibitions are as follows: 0.712, 0.679, 0.716, 0.697, and 0.697 respectively (Fried & Ferris, 1987). The chi-square values for Bartlett's Test of Sphericity for these dimensions are 299.141, 214.503, 318.157, 285.027, and 277.890 respectively. The KMO value for the willingness to participate in plant dye fashion exhibitions among respondents is 0.944, with a chi-square value of 1502.074 for Bartlett's Test of Sphericity. The significance of these validity tests is marked as 0.000, indicating a P-value less than the significance level of 0.01. Thus, it can be concluded that the sub-scales used in this study exhibit good validity.

4.5.3 REGRESSION ANALYSIS

From Table 31, a linear regression analysis was conducted with aesthetic, cultural, traditional, authenticity, and emotional attributes as independent variables, and the willingness to participate in plant dye fashion exhibitions as the dependent variable. The resulting model equation is: Willingness to Participate = 0.319 + 0.216Aesthetic + 0.121Cultural + 0.189Traditional + 0.199Authenticity + 0.159*Emotional. The model's R-squared value is 0.448, indicating that these variables explain 44.8% of the variance in willingness to participate in plant dye fashion exhibitions. The model passed the F-test ($F = 50.885$, $p = 0.000 < 0.05$), indicating that at least one of the independent variables significantly influences the

willingness to participate. Further testing for multicollinearity revealed that all VIF values are below 5, suggesting no multicollinearity issues. The Durbin-Watson statistic is near 2, indicating no autocorrelation in the model, confirming the model's robustness (Montgomery et al., 2021).

Table 31 Linear Regression Analysis

Linear Regression Analysis Results (n=320)							
	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Diagnostics	
	B	Standard Error	Beta			VIF	Tolerance
Constant	0.319	0.224	-	1.425	0.155	-	-
Artistic Quality	0.216	0.052	0.227	4.173	0.000**	1.679	0.596
Cultural Quality	0.121	0.060	0.104	2.023	0.044*	1.506	0.664
Traditional Quality	0.189	0.048	0.199	3.943	0.000**	1.441	0.694
Authenticity	0.199	0.052	0.203	3.841	0.000**	1.591	0.629
Emotional Quality	0.159	0.051	0.157	3.140	0.002**	1.423	0.703
R^2	0.448						
Adjusted R^2	0.439						
F-statistic	F (5,314)=50.885,p=0.000						
Durbin-Watson value	1.914						
Dependent Variable: Willingness to Participate in Plant Dye Fashion Exhibitions							
*** p<0.05 ** p<0.01**							

Note. Data collected and analyzed by the researcher.

In summary, aesthetic, cultural, traditional, authenticity, and emotional attributes all have a significant positive impact on the willingness to participate in plant dye fashion exhibitions.

4.6 QUALITATIVE AND QUANTITATIVE RESEARCH ANALYSIS

This section involves detailed qualitative and quantitative analyses of the audience's perception of plant dye culture and their willingness to participate in plant dye fashion exhibitions. The goal is to thoroughly investigate the awareness, acceptance, and effectiveness of cultural value dissemination of plant dye in contemporary society. The main findings from both types of analyses are summarized below.

4.6.1 QUALITATIVE ANALYSIS SUMMARY

The qualitative analysis, primarily through focus group discussions and in-depth interviews, explored participants' deep perceptions and understandings of plant dye culture and its application in fashion exhibitions (Fossey et al., 2002). The findings revealed:

· **Emphasis on Cultural and Artistic Values:** Participants widely acknowledged that plant dyeing techniques represent a quintessentially traditional folk culture in China, embodying rich cultural significance and artistic value as an intangible cultural heritage.

·**Increased Environmental Awareness:** Participants highly recognized the eco-friendly characteristics of plant dyes, noting that natural dyeing methods align well with the sustainable lifestyles advocated in contemporary society.

·**Diversity in Participation Willingness:** Various factors influence people's willingness to participate in plant dye fashion exhibitions, including personal interest in art and culture, environmental concerns, and a desire to enhance their experience and knowledge of plant dyeing.

4.6.2 QUANTITATIVE ANALYSIS SUMMARY

The quantitative analysis utilized descriptive statistics, reliability and validity tests, and regression analysis to evaluate audience perceptions and intentions from a quantitative perspective, based on data collected through survey questionnaires (Snyder & Bish, 1989). The key findings include:

·**High Recognition of Artistic and Cultural Values:** Statistical analysis of perceptions and cultural cognizance related to plant dye fashion exhibitions revealed a high level of audience appreciation for the artistic and cultural aspects of plant dye exhibitions.

·**Positive Influencing Factors on Participation Willingness:** Regression analysis indicated that factors such as artistic quality, cultural significance, traditionality, authenticity, and emotionality have significant positive effects on the willingness to participate in plant dye fashion exhibitions.

·**Potential for Plant Dye Culture Dissemination:** The data analysis highlighted the public's high receptivity and willingness to engage with plant dye culture and sustainable fashion, demonstrating the potential for spreading plant dye culture.

4.7 CHAPTER SUMMARY

Chapter Four, "Data Analysis and Results," is the cornerstone of this thesis, aimed at comprehensively exploring the sustainable innovation design model of plant dyeing through a synthesis of empirical research and various qualitative and quantitative methods. This chapter meticulously analyzes the cultural value, market strategies, socio-economic impacts, and audience perceptions related to plant dyeing.

The chapter begins with an in-depth understanding of the diversity and sustainability of plant dye culture, constructed through an amalgamation of field surveys, focus group discussions, case studies, expert interviews, and literature reviews. In the empirical section, consumer expectations and preferences for plant-dyed products are assessed through surveys and Kano model analysis, revealing consumer emphasis on the integration of traditional and modern designs, environmental conservation, and cultural heritage.

Furthermore, the chapter discusses the implementation strategies of the sustainable innovation design model, emphasizing the importance of education and training, and enhancing public engagement and awareness of plant dye culture through storytelling, interactive experiences, and digital displays. Additionally, market strategies based on audience expectations are explored, focusing on environmental consciousness, design innovation, brand development, and market segmentation.

In the data analysis section, descriptive statistical analysis, reliability and validity tests, and regression analyses thoroughly evaluate the audience's perceptions and willingness to participate in plant dye fashion exhibitions. The results demonstrate that the artistic, cultural, traditional, authentic, and emotional qualities significantly

positively impact participation intent, confirming the acceptance of plant dye techniques in modern society and their potential for cultural dissemination.

Workshops and case studies further validate the model's practicality and educational value. By organizing hands-on dyeing activities and creative displays, participants not only experience the process of plant dyeing but also gain a deep understanding of its environmental and cultural significance. Exhibitions and design presentations showcase the seamless integration of plant dye techniques with modern design, successfully transforming traditional crafts into sustainable fashion products.

In conclusion, the sustainable innovation design model for plant dyeing not only strengthens cultural heritage and innovation but also, through practical market applications and public educational activities, effectively enhances public appreciation and awareness of plant dye techniques. This provides a new perspective and robust case studies for the sustainable fashion industry. Moving forward, these strategies and practices will continue to promote the application and popularization of plant dye techniques in broader fields, contributing to the achievement of global sustainable development goals.

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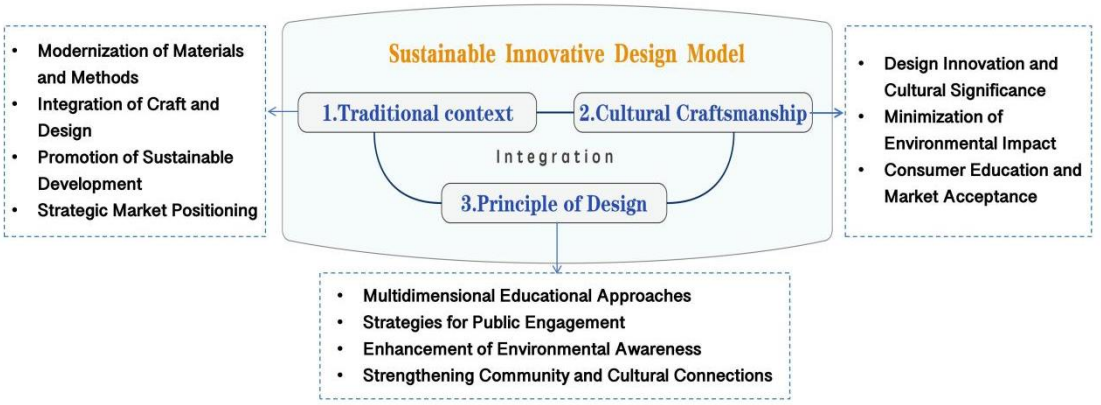
CHAPTER 5

DISCUSSIONS AND OUTCOMES

5.1 CONCLUSIONS

The study aims to explore the application of plant dye techniques in modern sustainable fashion and to evaluate their potential in promoting environmental awareness and cultural heritage. Through a series of experimental workshops, brand design schemes, and both online and offline fashion exhibitions, this research conducts an in-depth analysis of the modern applications, educational value, and market acceptance of plant dye techniques, constructing a new knowledge system of sustainable innovative design models (Figure 120). Key findings related to the research objectives are as follows:

Figure 120 New Knowledge



Note. Illustrated by the researcher.

5.1.1 RESEARCH OBJECTIVES

5.1.1.1 Traditional Context

Research confirms that the modernization of plant dyeing techniques not only preserves their traditional cultural value but also meets the demands of the modern market. Experimental workshops show that participants can learn traditional skills

through hands-on practice while understanding their application in contemporary design.

·**Modernization of Materials and Methods:** The study showcased the modern applications of botanical dye techniques by systematizing the extraction of dyes from traditional plants, developing a color card system, and applying these to garments, thus fostering environmental sustainability and confirming the adaptation of botanical dye techniques to modern market demands.

·**Integration of Craft and Design:** The fusion of traditional botanical dye techniques with contemporary design principles resulted in the development of garments and textiles that are both culturally rich and align with modern aesthetics, enhancing the market competitiveness of botanical dye products and providing a platform for designers to display creativity and innovation.

·**Promotion of Sustainable Development:** By engaging in educational and public participation activities, the research increased societal awareness of the environmental benefits of botanical dye techniques. Workshops, exhibitions, and social media campaigns served as effective means to promote botanical dye culture and educate the public, further solidifying the role of botanical dyes as a sustainable option in fashion.

·**Strategic Market Positioning:** Botanical dye products were strategically positioned in the market by promoting their uniqueness through fashion brands and incorporating botanical dyes in eco-tourism and cultural heritage conservation projects, thereby attracting consumers with deep-seated environmental and cultural interests and stimulating local economic development.

5.1.1.2 Clutural Craftsmanship

Combining traditional botanical dye techniques with contemporary design principles can create products that meet the needs of modern consumers. This integration not only reduces environmental impact but also enhances the market appeal of the products. The practical application of botanical dyes promotes innovation in sustainable design, demonstrating the potential to enhance consumer goods quality and market competitiveness through natural source dyes.

·**Design Innovation and Cultural Significance:** By utilizing traditional botanical dye techniques combined with contemporary art and fashion elements, unique garments and textiles are created. By employing natural textures and colors,

these products convey messages of environmental protection, making each item narratively and educationally rich.

·**Minimization of Environmental Impact:** The use of sustainably sourced botanical materials and processing methods ensures the minimization of environmental impact throughout the production process, promoting the concept of slow fashion to consumers.

·**Consumer Education and Market Acceptance:** Through educational activities, workshops, and exhibitions, consumer awareness and understanding of botanical dye products are enhanced. This not only increases the demand for sustainable products but also raises environmental consciousness among consumers.

5.1.1.3 Principle of Design

The study has successfully raised public awareness and environmental consciousness about botanical dye techniques through exhibitions, interactions, and visual communication tools, affirming the crucial role of education in promoting eco-friendly fashion, particularly enhancing the interest and respect for traditional crafts among the younger generation.

·Multidimensional Educational Approaches: Education on botanical dyes and techniques is disseminated to people of various ages and backgrounds through school education, workshops, seminars, and online courses.

·Strategies for Public Engagement: By fostering public participation in spreading and practicing botanical dye culture, the research showcased the aesthetic and practical values of botanical dyes through exhibitions and fashion shows, allowing the public to experience the dyeing process firsthand, increasing their appreciation for traditional crafts and actual participation in environmental preservation.

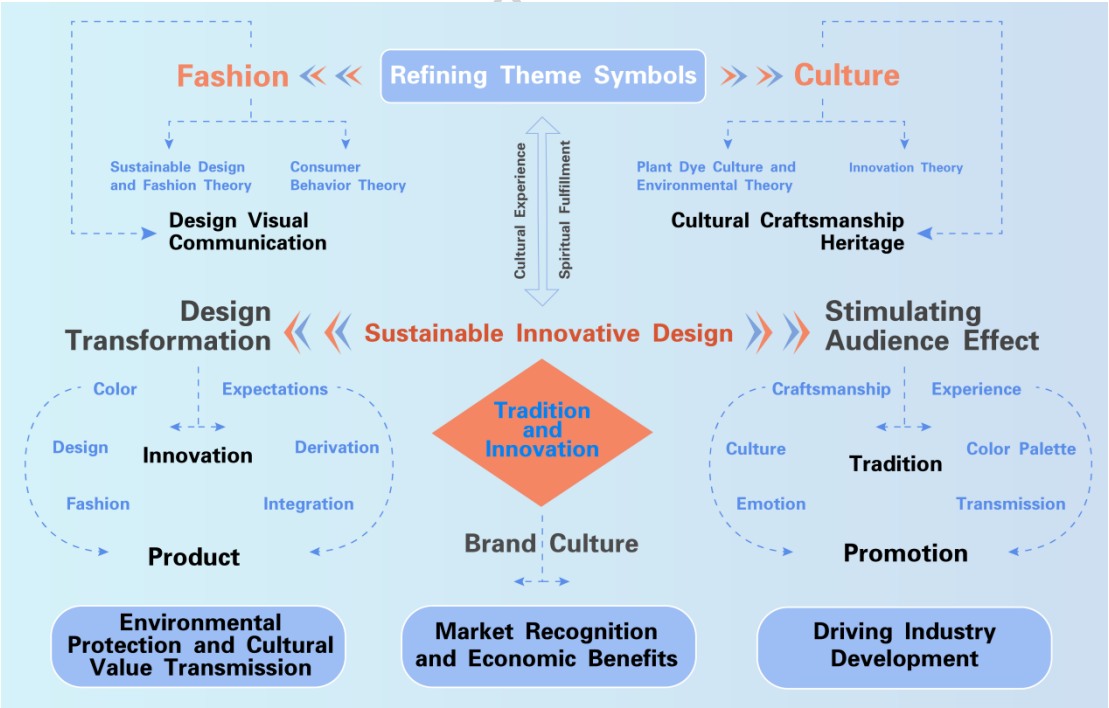
·Enhancement of Environmental Awareness: In educational and public activities, the environmental benefits of botanical dyes are emphasized. Through case studies and success stories, the use of chemical dyes is reduced, decreasing water pollution and ecosystem disruption, and encouraging support for and participation in sustainable fashion initiatives.

·Strengthening Community and Cultural Connections: The promotion of botanical dye techniques serves as a revival of local culture and economy.

5.1.2 RESRARCH FINDINGS

This research strategy validated the effectiveness of the Sustainable Innovative Design Model through a series of case studies and experimental studies (Figure 121). Practical results show that plant dye products designed using this model have not only won consumer recognition and affection but also achieved a win-win situation for commercial value and environmental responsibility.

Figure 121 Effectiveness of the Sustainable Innovative Design Model



Note. Illustrated by the researcher.

Additionally, through fashion exhibitions and cultural educational activities, public awareness and support for botanical dye techniques and sustainable fashion were effectively enhanced, showcasing the possibilities for transferring environmental and cultural values through innovative design, gaining market recognition and economic benefits, and driving the development of the botanical dye industry. This provides valuable experience and insights for future design practices.

·Model Framework and Implementation: By systematically integrating botanical dye techniques, eco-friendly material selection, and innovative design methods, a new product development process was created.

·Case Application: Detailed documentation of each step from concept to product realization, including material selection, design process, application of dyeing techniques, and market feedback of the final product.

·Practical Outcomes: Practical outcomes demonstrate that products designed with the sustainable innovation model have not only received consumer approval in the market but have also greatly increased environmental responsibility. This validates the commercial feasibility of sustainable design.

·Education and Cultural Dissemination: The implementation of this model also strengthened the educational promotion of botanical dye and sustainable design awareness. Through exhibitions and seminars, the public gained a deeper understanding and interest in the modern application of botanical dyes. Such educational promotion activities helped enhance public support for sustainable fashion, as well as promoted the preservation and transmission of cultural crafts.

In summary, market surveys and participant feedback indicate that consumer acceptance of botanical dye products is continually increasing through effective innovative design, brand storytelling, and educational outreach. This research not only reveals the sustainability and practicality of botanical dye techniques but also emphasizes the importance of integrating traditional crafts with modern technology in promoting eco-friendly fashion globally, enhancing the understanding and utilization of botanical dye techniques to encourage their application and development worldwide.

5.2 DISCUSSIONS

Based on the results and findings, this section delves into the multifaceted impact and potential challenges of botanical dyes in the realm of sustainable fashion:

5.2.1 INTEGRATION OF TECHNOLOGY, CULTURE, AND MARKET

The preservation of traditional techniques requires integrating modern design thinking, which involves not only aesthetic adaptation but also considerations of functionality and sustainability. Combining traditional techniques with modern design needs to maintain their cultural essence while meeting the dual demands of modern consumers for fashion and environmental friendliness. Additionally, future research

should focus on how technological innovation can address the production efficiency of plant dyeing (Gokhale et al., 2004).

Leveraging Cultural and Market Interactions: The interaction between culture and market dynamics is a key driver for the sustainable development of botanical dyes. However, broader market acceptance requires sustained brand building and market education, especially in the highly competitive global fashion industry (Pookulangara & Shephard, 2013).

5.2.2 SUSTAINABLE GLOBALIZATION CHALLENGES

To better promote plant dyeing, it is necessary to implement more unified and standardized production and certification standards globally, while strengthening international cooperation to share successful experiences and strategies for addressing challenges. Market research shows that although sustainable products typically cost more, consumers are willing to pay a premium for these products through education and proper market positioning.

Maintaining the stability and color diversity of dyes, as well as improving production efficiency, are key issues that need to be addressed in future development. Additionally, the market acceptance of sustainable products is closely related to consumer education. Continuous market education and brand building are needed to enhance consumers' purchasing motivation.

5.2.3 THE ROLE OF EDUCATION AND PUBLIC ENGAGEMENT

This study effectively enhanced public awareness of plant dye culture and technology through various exhibitions and interactive activities. It promoted the recognition and appreciation of traditional dyeing techniques among the public. Effective public education, including the promotion of the environmental advantages of plant dyes, not only increased the emotional value of the products for consumers but also fostered overall societal acceptance of eco-friendly lifestyles. To achieve the transition from knowledge dissemination to behavior change, it is necessary to design targeted and practically applicable educational programs.

5.2.4 PRACTICAL EFFICACY OF THE MODEL AND FUTURE SUSTAINAILITY

The successful implementation of the Sustainable Innovative Design Model demonstrates how integrating traditional and modern elements can effectively

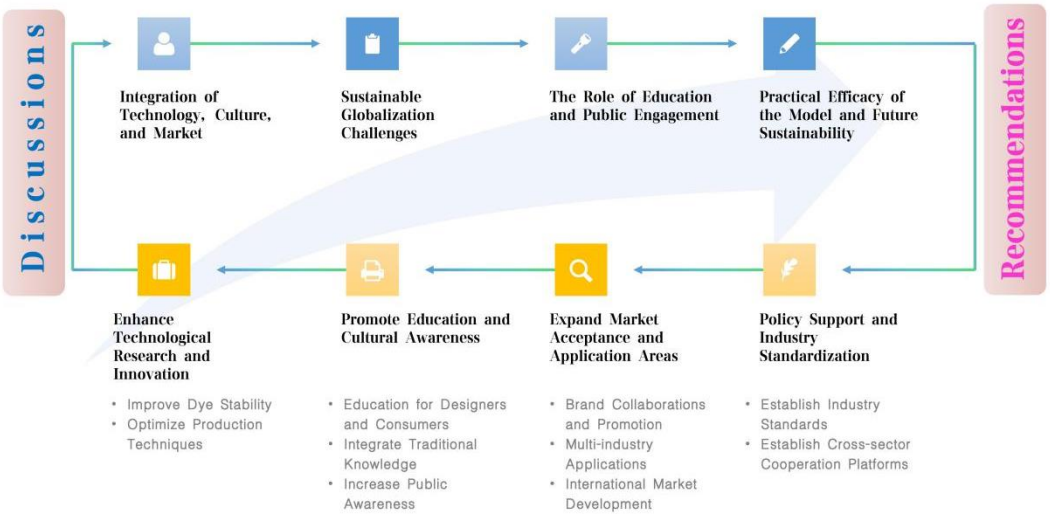
promote the transmission of environmental and cultural values. Practically, the success of this model depends on multidisciplinary cooperation, including the joint efforts of designers, craftsmen, educators, and marketing experts. Looking ahead, maintaining the vitality and adaptability of this model will require continuous innovation and strategic adjustments, especially when facing the challenges and competition brought by globalization.

Through these discussions, this study not only comprehensively assesses the current state of botanical dye techniques but also proposes specific strategies and recommendations for their future development. These discussions provide scientific theoretical support and practical guidance for the application of botanical dyes in the field of sustainable fashion.

5.3 RECOMMENDATIONS

Following an in-depth exploration of the sustainable development and practical applications of botanical dyes, these recommendations aim to promote the widespread adoption and further development of botanical dye technologies to realize their greater potential in the field of sustainable fashion (Figure 122).

Figure 122 Discussions and Recommendation



Note. Illustrated by the researcher.

5.3.1 ENHANCE TECHNOLOGICAL RESEARCH AND INNOVATION

It is recommended to enhance research on the stability and application techniques of botanical dyes, develop new dyeing technologies and equipment to improve the production efficiency and cost-effectiveness of botanical dyes (Harsito et al., 2021).

·**Improve Dye Materials' Stability:** Research and develop new dye fixatives and improve existing dye formulations to enhance the colorfastness and lightfastness of plant dyes on fabrics.

·**Optimize Production Techniques:** Explore more energy-efficient dye extraction and dyeing processes, including the use of more environmentally friendly solvents and energy recovery systems, to reduce the environmental footprint of the entire production process.

5.3.2 PROMOTE EDUCATION AND CULTURAL AWARENESS

Expand educational and training programs on botanical dyes and sustainable fashion through workshops, exhibitions, and interactive learning platforms to increase public understanding and interest in this field.

·**Education for Designers and Consumers:** Educate designers and consumers about the environmental benefits and cultural values of botanical dyes through seminars, online courses, and workshops, increasing market acceptance of botanical dye products.

·**Integrate Traditional Knowledge:** Collaborate with traditional dye artisans to integrate traditional knowledge with modern technology, developing innovative designs with cultural depth.

·**Increase Public Awareness:** Use media and public platforms to raise public awareness about botanical dyes and their environmental benefits, particularly fostering a awareness of sustainable consumption among younger consumers.

5.3.3 EXPAND MARKET ACCEPTANCE AND APPLICATION AREAS

Encourage cross-industry collaborations to jointly promote the development of botanical dyes and sustainable fashion, providing more innovative opportunities and marketing platforms for botanical dyes.

·**Brand Collaborations and Promotion:** Partner with well-known fashion brands to promote botanical dye products through limited edition designs or specific collections, enhancing their market visibility and consumer awareness.

·**Multi-industry Applications:** Explore the application of botanical dyes in home décor, art, and other consumer goods sectors, expanding market demand and application scope.

·**International Market Development:** Study international market demands, adapt to different cultural backgrounds' consumption habits and aesthetics, and promote botanical dye products in regions with high environmental awareness.

5.3.4 POLICY SUPPORT AND INDUSTRY STANDARDIZATION

Seek government financial support and policy initiatives for the research and application of plant dyeing technology. This can include tax reductions, subsidies, and other measures to lower production costs and encourage companies to promote the technology.

·**Establish Industry Standards:** Collaborate with industry associations to set standards and certifications for botanical dyes, ensuring product quality and environmental friendliness, and increasing consumer trust.

·**Establish Cross-sector Cooperation Platforms:** Establish cooperation platforms among industries, academia, and government to promote the research and commercialization of botanical dye technologies.

By implementing these recommendations, the promotion and application of botanical dye technologies on a global scale can be enhanced, achieving long-term development goals for the sustainable fashion industry. This research aims to provide guidance and insights for the sustainable development and modern application of botanical dyes, offering references and foundations for future research and practice in related fields.

APPENDIX

Survey Questionnaire on Target Audience Perception

Part 1: General information issues

1. Gender

(1) Male

(2) Female

(3) Non-binary

2. Your age

(1) Under 18 years old

(2) 18-24 years old

(3) 25-34 years old

(4) 35-44 years old

(5) 45-60 years old

(6) Over 60 years old

3. Income Range（CNY/Year）

(1) 0 - 50,000Yuan

(2) 50,001 - 100,000Yuan

(3) 100,001 - 400,000Yuan

(4) 400,001 - 1,000,000Yuan

(5) 1000000+Yuan

(6) Prefer not to answer

4. Educational Background

(1) High School or below

(2) Bachelor’s Degree

(3) Master’s Degree

(4) Doctoral Degree

(5) Other

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Part 2: "Plant dyeing" issues

5. Are you familiar with "plant dyeing"?

(1) Yes

(2) No

6. What do you consider to be the advantages of plant dyeing? (Multiple choices allowed)

(1) Environmentally sustainable

(2) Harmless to health

(3) Natural and rich dyeing effects

(4) Preservation and inheritance of traditional culture

(5) Other, please specify:

_____

7. Have you ever tried dyeing with plant dyes?

(1) Yes

(2) No

8. If you have used plant dyes, what was your purpose? (Multiple choices allowed)

(1) Personal hobby

(2) Commercial use

(3) Cultural and artistic activities

(4) Education and learning

(5) Other, please specify:

_____

9. How frequently do you purchase plant dye products?

(1) Never

(2) Once in my life (rarely)

(3) Twice (sometimes)

(4) Once a year (usually)

(5) More than once a year (always)

10. How much are you willing to spend on plant dye products? (CNY)

(1) 0-400

(2) 401-800

(3) 801-2000

(4) 2001+

(5) Prefer not to answer

11. How would you describe your level of knowledge about plant dyeing?

(1) Lack of understanding

(2) Basic understanding

(3) In-depth understanding

12. What do you think are the main challenges facing the field of plant dyeing today? (Multiple choices allowed)

(1) Insufficient technological research and innovation

(2) Difficulties in market promotion

(3) Unstable supply of raw materials

(4) Pollution management and environmental protection issues

(5) Difficulties in preserving and inheriting traditional techniques

(6) Other, please specify:

_____

13. What areas of research or technology do you think could further promote the development and application of plant dyes? Please select all applicable options and provide your specific insights where necessary.

(1) Extraction and separation technologies for plant dyeing agents

(2) Stability and durability studies of plant dyes

(3) Optimization and innovation of plant dyeing techniques

(4) Application research of plant dyes in the fashion industry

(5) Application research of plant dyes in environmental management

(6) Other, please specify:

_____

14. Would you recommend others to purchase plant dye products?

(1) Strongly disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly agree

Part 3: "Sustainable Fashion Innovation" issues

15. When choosing clothing, do you consider its sustainability or eco-friendly characteristics?

(1) Always

(2) Often

(3) Sometimes

(4) Rarely

(5) Never

16. What criteria do you typically use to judge the sustainability of fashion products? (Multiple choices allowed)

(1) The fabrics used

(2) The environmental impact of the production process

(3) The healthiness and comfort of the fabric

(4) The brand's social responsibility

(5) The durability and renewability of the product

(6) The sustainability of the packaging

17. In which of the following aspects do you think garments dyed with plant-based dyes have advantages over those dyed with traditional chemical dyes? (Multiple choices allowed)

(1) Lesser environmental impact

(2) More skin-friendly/low allergenic

(3) More natural and unique colors

(4) Promotion of the preservation of traditional crafts

(5) No apparent advantages

18. What approaches do you think could effectively increase the use of plant dyes in the fashion industry? (Multiple choices allowed)
(1) Increasing consumer education and awareness
(2) Reducing production costs to make prices more competitive
(3) Improving dyeing technology for greater color diversity and stability
(4) Strengthening collaboration with designers and brands to increase market recognition
(5) Policy support and incentives from governments and industries

19. Would you be willing to participate in sustainable fashion community activities, such as plant dyeing workshops or upcycling old clothes through dyeing?
(1) Very willing
(2) Somewhat willing
(3) Depends on the activity
(4) Not very willing
(5) Not at all willing

20. How do you view the use of virtual fashion products (such as digital fashion shows) as a way to reduce physical production?
(1) Strongly support
(2) Somewhat support
(3) Neutral
(4) Somewhat oppose
(5) Strongly oppose

21. What should sustainable fashion products strive for in design? (Multiple choices allowed)
(1) Simplicity and durability, transcending fashion trends
(2) Innovation and artistic expression, reflecting unique value
(3) Functionality and practicality, meeting everyday needs
(4) Recyclability or biodegradability, minimizing environmental impact
(5) Cultural and narrative significance, conveying deeper meaning

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22. In the area of sustainable fashion, what improvements or innovations do you most hope to see?

(1) More economically affordable sustainable fashion options

(2) Broader innovations in materials and technology

(3) Clearer consumer education and guidance

Part 4: "Plant Dyeing+Sustainable Fashion Exhibition" issues

23. What factor is most important to you when attending an offline exhibition?

(1) Diversity of the exhibition content

(2) Interactivity and experiential aspects

(3) Convenience of the location

(4) Creativity of the works

24. Which elements do you think could enhance cultural dissemination in fashion exhibitions?

(1) Expert lectures and seminars

(2) Hands-on workshops

(3) Cultural performances

(4) Audience interaction areas

(5) Hybrid (online and offline) exhibitions

25. Do you think creating an online sustainable exhibition on plant dyeing is appropriate?

(1) Strongly disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly agree

26. For online exhibitions, which type of content presentation do you prefer?

(1) Video explanations and demonstrations

(2) Virtual fashion shows

(3) Live online seminars

(4) Digital galleries and textual materials

27. Are you interested in participating in a virtual fashion exhibition about plant dyeing?

(1) Very interested

(2) Somewhat interested

(3) Neutral

(4) Not interested

28. What is your main motivation for attending such exhibitions?

(1) To increase personal knowledge or skills

(2) To enjoy art and design

(3) To support environmental protection and sustainable development

(4) For socializing and entertainment

29. After attending an exhibition, which actions might you take?

(1) Change personal consumption habits to support sustainable fashion

(2) Participate in more related educational or training activities

(3) Share the exhibition experience on social media

(4) No specific action

30. Are you interested in attending such exhibitions?

A. Very interested

B. Somewhat interested

C. Unsure

D. Not interested

Survey Questionnaire on Perception Feedback for the Sustainable Plant Dye Innovation Exhibition (Pre-test and Post-test)

Part 1: Simple questions of Chinese plant dyeing

1. Is plant dyeing a method that uses natural plants as dyes?
(1) Yes
(2) No

2. Can all types of plants be used in the dyeing process?
(1) Yes
(2) No

3. Does plant dyeing have a smaller environmental impact compared to chemical dyes?
(1) Yes
(2) No

4. In traditional Chinese culture, is plant dyeing primarily used for dyeing ceramics?
(1) Yes
(2) No

5. In the plant dyeing process, is the use of a mordant necessary?
(1) Yes
(2) No

Part 2: Medium difficulty questions of Chinese plant dyeing

6. Can the use of a fixative enhance the color brightness of dyed fabrics?
(1) Yes
(2) No

7. Can plant dyeing be performed on any type of fabric?
(1) Yes
(2) No

8. Do some of the plants frequently used in plant dyeing processes, besides being used for dyeing, also possess medicinal values?
(1) Yes
(2) No

9. Which of the following plants is widely used to produce traditional blue dye?
(1) Indigo (Indigofera tinctoria)
(2) Lithospermum (Lithospermum erythrorhizon)
(3) Madder (Rubia tinctorum)

10. In traditional Chinese plant dyeing, which color is considered the most difficult to obtain?
(1) Blue
(2) Red
(3) Yellow

Part 3: Difficult questions of Chinese plant dyeing

11. In traditional plant dyeing processes, what is commonly used as a mordant?
(1) Acetic acid
(2) Mineral salts
(3) Animal fats

12. In which aspect does the batik dyeing technique particularly demonstrate its uniqueness?
(1) The vibrancy of colors
(2) The complexity of patterns
(3) Water resistance

13. In the indigo dyeing process, how does the fermentation step primarily affect the final color?
(1) Color saturation
(2) Color stability
(3) Color brightness

14. In traditional Chinese plant dyeing, which plant dye is considered precious due to its complex extraction process?
(1) Lithospermum (Lithospermum erythrorhizon)
(2) Madder (Rubia tinctorum)
(3) Indigo (Indigofera tinctoria)

15. Which of the following factors has the greatest impact on the final outcome of plant dyeing?
(1) Dye concentration
(2) Dyeing time
(3) The pH value of the water

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Perception of Plant Dye Culture and Willingness to Participate（Evaluation FormConsideration, Evaluation, Suggestions）

1. Gender

(1)Male

(2)Female

(3)Non-binary

2. Your age

(1) Under 18 years old

(2) 18-24 years old

(3) 25-34 years old

(4) 35-44 years old

(5) 45-60 years old

(6) Over 60 years old

3. Income Range（CNY/Year）:

(1) 0 - 50,000Yuan

(2) 50,001 - 100,000Yuan

(3) 100,001 - 400,000Yuan

(4) 400,001 - 1,000,000Yuan

(5) 1000000+Yuan

(6) Prefer not to answer

4. Educational Background

(1) High School or below

(2) Bachelor’s Degree

(3) Master’s Degree

(4) Doctoral Degree

(5) Other

5. The exhibition's atmosphere conveyed unique cultural characteristics and artistic beauty.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

6. The plant dye fashion design sparked my curiosity and desire to explore plant dye culture.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

7. The plant dye fashion exhibition attracted me to participate in and learn more about related activities.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

8. The exhibition enhanced my knowledge of traditional dyeing culture and broadened my perspective.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

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9. The exhibition informed me about traditional dyeing techniques and their application in contemporary design.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

10. demonstrating innovation in dyeing culture.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

11. The exhibition effectively presented the charm of traditional dyeing techniques and culture.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

12. The exhibition displayed respect for and the inheritance of traditional dyeing techniques.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

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13. The plant dye fashion promoted a broader dissemination and understanding of traditional dyeing techniques and culture.

(1) Strongly Disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly Agree

14. The exhibited works, close to nature, reflected the genuine beauty of plant dyeing.

(1) Strongly Disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly Agree

15. The plant dye fashion demonstrated a true use of and respect for raw materials and traditional techniques.

(1) Strongly Disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly Agree

16. The exhibition allowed me to experience the authenticity and purity of dyeing culture.

(1) Strongly Disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly Agree

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17. Viewing the exhibition brought me the enjoyment of beauty and spiritual pleasure through plant dyeing.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

18. The exhibition evoked my respect and emotional resonance towards nature and traditional culture.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

19. The exhibition immersed me in an artistic atmosphere that blends tradition with modernity, experiencing unique cultural stories.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

20. If time and financial conditions permit, I would be willing to participate in a plant dye fashion exhibition.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

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21. I would recommend visiting a plant dye fashion exhibition to friends and family to share this unique cultural experience.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

22. Compared to other traditional plant dye exhibition formats, I am more interested in participating in plant dye fashion exhibitions.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

23. Even if time and financial conditions are limited, I would look for opportunities to learn about and support plant dye fashion culture, such as watching exhibitions online or purchasing plant-dyed products.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

24. I believe participating in plant dye fashion exhibitions is an important way to understand and support sustainable fashion and traditional crafts.
(1) Strongly Disagree
(2) Disagree
(3) Neutral
(4) Agree
(5) Strongly Agree

25. I am willing to participate in plant dye workshops or activities to personally experience and learn the craft of plant dyeing.

(1) Strongly Disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly Agree

26. Understanding the culture and techniques behind plant dye fashion design increases my interest in participating in the exhibition.

(1) Strongly Disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly Agree

27. I support the promotion and inheritance of traditional dyeing techniques through plant dye fashion exhibitions.

(1) Strongly Disagree

(2) Disagree

(3) Neutral

(4) Agree

(5) Strongly Agree

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