

Article

Key Factors Influencing Chinese Consumers' Demand for Naturally Dyed Garments: Data Analysis through KJ Method and KANO Model

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Abstract: The growing global emphasis on environmental issues has driven companies to exert greater efforts on making their products more sustainable. Natural dyeing, an eco-friendly dyeing method used in the textile and apparel industry, is safer for both the environment and human health, aligning with the needs of sustainable design development. This paper examines the key factors affecting Chinese consumers' satisfaction with naturally dyed garments, aiming to provide research-based strategies for the design and development of such garments. In this study, we utilized the KJ method for the detailed categorization of the functionalities of naturally dyed garments, establishing five dimensions and thirty demand indicators. Based on this, the KANO model, coupled with the Better–Worse coefficient and the quadrant analysis method, was used to classify different demand items, ranking their satisfaction and importance. The results indicate that the wearing experience and environmental characteristics of products are key determinants influencing Chinese consumers' demand for naturally dyed clothing. The top five factors significantly impacting product satisfaction, in descending order of importance, are comfort, environmentally friendly dyeing techniques, safety, degradability, and durability. Therefore, to ensure consumer satisfaction with naturally dyed clothing, these factors should be prioritized when establishing a support system that caters to consumer needs. Our findings can help companies to better understand consumers' actual need for naturally dyed garments, enabling the more targeted development and optimization of such garments, enhancing product competitiveness, and promoting the green transformation and sustainable development of enterprises. Simultaneously, this study also contributes novel theoretical approaches and ideas for future research on consumer demand.

Keywords: naturally dyed garments; KJ analysis method; KANO model; consumer demand; data analysis



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1. Introduction

As the world rethinks modern industrial civilization and develops sustainable strategic thought, a new design trend is emerging quietly: green design, also known as ecological design or sustainable design [1]. The textile and apparel industry is one of the major sources of environmental pollution in the industrial sector [2]. According to a report titled “Sustainability and Circularity in the Textile Value Chain—A Global Roadmap” published by the United Nations Environment Programme in 2023, it is evident that this industry accounts for an annual global greenhouse gas emissions range of 2–8%, resulting in approximately 9% of microplastic pollution infiltrating our oceans [3]. This exacerbates climate change, biodiversity loss, and widespread environmental contamination on a global scale. Moreover, the textile industry astonishingly consumes approximately 215 trillion liters of water each year, perpetuating unsustainable consumption and production patterns that lead to a substantial waste of valuable global resources [4]. Due to the universal use and high consumption characteristics of clothing products, the application of materials and

technologies in their production process is critical for the protection of Earth's resources and the long-term development of humanity. Sustainable clothing design represents a new trend and demand in the apparel industry, aiming to improve this industry's pollution issues, thereby achieving sustainable development in terms of the environment, resources, society, and culture.

In December 2019, the European Commission released the European Green Deal, a comprehensive green-development-related strategic document containing specific action goals and policy measures relating to various aspects. In terms of preventing and managing pollution, the agreement mandates the creation of a zero-pollution, harmless environment and encourages the development of safe and sustainable products, thereby replacing hazardous chemicals with destructive environmental impacts [5]. In the textile industry, the sustainable design of clothing requires the sustainability of materials. The use of eco-friendly materials can not only alleviate the pollution problems caused by clothing production but also allow for the more rational use of existing resources, aligning with the global trend and requirements for green development.

In the process of garment processing, fabric dyeing is a crucial step, with dyes being classified into natural and synthetic types. Following the introduction of synthetic dyes in the mid-19th century, the use of natural dyes significantly declined [6]. Many synthetic dyes, due to their low cost, suitability for mass production, and excellent garment-coloring effects, have been widely used in the textile industry [7]. While synthetic dyes offer many advantages, their production and use have a substantial impact on aquatic environments, including the release of hydrogen sulfide gas, the deposition of aluminum-sulfate complexes in soil, and the presence of high salt concentrations in wastewater discharge, all of which severely affect aquatic environments [8]. Moreover, the biocompatibility of chemically synthesized dyes is poor, making them difficult to decompose and their pollution long-lasting [9]. According to previous research statistics, there are still over 10,000 types of synthetic dyes available for commercial use worldwide today, with an annual production volume of nearly 800,000 tons. Approximately 140,000 tons are discharged as wastewater into the environment each year. The introduction of toxic chemicals into aquatic reservoirs has the potential to disrupt entire ecosystems and cause detrimental effects [10]. For instance, in Cambodia, the garment industry is accountable for approximately 60% of water pollution and 34% of chemical pollution [11]. Meanwhile, environmental pollution causes irreversible harm to human life and health. The United Nations report released in 2022 pointed out that "environmental pollution" and the "use of hazardous chemicals" are leading causes of human death [12]. Research shows that one-sixth of the world's deaths involve diseases caused by pollution, a proportion three times greater than deaths from AIDS, malaria, and tuberculosis combined and fifteen times greater than deaths from all wars, murders, and other forms of violence [13]. Given the detrimental impact of textile dyeing on the environment and society, restrictions on synthetic dyes have been increasingly implemented since the beginning of the 21st century. Natural dyeing is currently experiencing a resurgence in interest and holds significant potential as a promising technology [14]. In comparison to synthetic dyes, natural dyes are widely regarded as being safer for both environmental sustainability and human health due to their reduced generation of harmful wastewater during the dyeing process [15]. Natural dyes are organic compounds derived from natural sources, such as plants (e.g., indigo and saffron), insects (e.g., cochineal beetles and lac scale insects), other animals (e.g., certain species of mollusks or shellfish), and unprocessed minerals (e.g., ferrous sulfate, ochre, and clay) [16]. Different sources yield different colors, and some naturally structured dyes not only provide unique hues but also offer functional properties like antibacterial, UV protection, mothproof, and antioxidative qualities [17]. With increasing awareness of environmental issues and engagement in the pursuit of healthy lifestyles, the demand for natural dyes and naturally dyed fabrics is growing. The design and development of naturally dyed products have become hotspots and research directions for textile industry professionals and enterprises.

According to the global consulting firm Accenture, since the COVID-19 pandemic, 61% of consumers have started buying eco-friendly products. Even after the pandemic, 89% of consumers said they would maintain these consumption patterns [18]. Research by McKinsey & Company shows that 90% of Generation Z consumers believe companies have a responsibility to address environmental and social issues [19]. As more consumers focus on the environment, their purchasing decisions are influencing companies to shift towards sustainable development [20]. This consumer focus on environmental issues is prompting textile manufacturers to invest in green practices, respecting high environmental standards in production methods [21]. In response to China's textile industry, the Chinese government has formulated a series of policies, collaborating with enterprises to promote the green and low-carbon development of China's textile industry [22]. Reports show that many well-known Chinese apparel companies have set clear sustainable development goals, actively practicing green transformations in production methods [23]. Consumer preferences and decisions profoundly impact the market, society, and environment [24]. To further promote the development of the naturally dyed garment industry, it is essential to conduct in-depth research on consumer needs. Especially when the market price of green products is higher than ordinary products [25], timely and effective research on consumer needs can provide a basis for enterprises in terms of formulating product development strategies, enabling more targeted design and optimization of naturally dyed garments, enhancing product market competitiveness, and effectively promoting the sustainable development of enterprises and the textile industry.

The KANO model is frequently employed to differentiate categories of needs that result in consumer satisfaction or dissatisfaction [26], with the aim of elucidating the relationship between consumers and products [27]. To date, numerous scholars have applied the KANO model to identify product demand attributes and make design-positioning decisions [28]. However, its application in the field of environmentally friendly dyeing and weaving remains relatively scarce, particularly concerning research on natural dyed clothing within the Chinese consumer market. This study can provide effective data analysis and recommendations regarding Chinese consumers' demand for natural dyed clothing, enabling natural dyeing garment companies to comprehend consumers' intricate behaviors and product demands in order to achieve heightened customer satisfaction. Based on market-oriented demand, this understanding can drive product innovation and effective promotion while expanding market shares and profitability, thereby facilitating green transformation and sustainable development. In terms of its theoretical contributions, this study integrates the KANO model with the KJ analysis method and the Better–Worse coefficient research approach, offering a novel solution with which to accurately determine the importance of requirements that traditional KANO models fail to achieve. The precise and effective exploration of consumer demand is a prerequisite and foundation for conducting consumer demand analysis. The KJ analysis method can consolidate scattered and disorganized opinions, ultimately focusing on key issues to obtain a comprehensive list of consumer demands for natural dyed clothing [29]. Building upon this, we conducted an analysis using the KANO model. While the traditional KANO model can qualitatively classify types of consumer demand for natural dyed clothing [30], it falls short in effectively measuring the priority levels of these demands. Therefore, this study employs the Better–Worse coefficient method to quantitatively evaluate the weights of each requirement item in order to more accurately identify Chinese consumers' classification and prioritization of demand items for natural dyed clothing. Additionally, this research provides new theoretical methods and references for related product design and development.

The specific objectives of this study are as follows: (1) to explore the demand list of Chinese consumers for naturally dyed clothing in the context of the Chinese consumer market; (2) to identify and classify the demand indicators for naturally dyed clothing using the KANO model and investigate key factors influencing Chinese consumers' demand for such clothing; and (3) to provide a research basis for strategy formulation in the design

and development process of naturally dyed clothing. In order to enhance the clarity of the existing research, we propose the following research questions (RQs):

RQ1. What are the demands of Chinese consumers regarding natural dyed clothing?

RQ2. How can the demands of Chinese consumers for natural dyed clothing be effectively categorized?

RQ3. How should the demands of Chinese consumers for natural dyed clothing be prioritized?

To achieve these objectives, this paper is structured as follows: Section 2 provides an overview of the research status in the field of natural dyeing and sustainable consumption in the fashion industry. Section 3 outlines the research methods, processes, data sources, and software employed in this study. Section 4 presents the results obtained from classifying and prioritizing demands for natural dyed clothing using the KANO model and Better–Worse coefficient analysis. Section 5 analyzes these findings and offers relevant recommendations for developing strategies related to natural dyed clothing. Finally, Section 6 concludes with a discussion on both the theoretical and practical significance of this study while highlighting its limitations and suggesting potential directions for future research.

2. Literature Review

2.1. Characteristics of Natural Dyeing

The use of environmentally friendly materials plays a significant role in the sustainable development of the textile and apparel industry, where natural dyes, as substitutes for synthetic dyes, are increasingly gaining attention, and related research is also growing. The dyeing process of natural dyes mainly includes the cultivation of raw materials, extraction of pigments from materials, fabric pretreatment, and choosing different dyeing processes [31]. The dyeing process is shown in Figure 1. Natural dyes can be divided into three groups based on their sources: (1) vegetable/plant sources; (2) insect/animal sources; (3) mineral sources [32]. Among them, plants are the primary source, including fruits, flowers, wild grasses, and leaves. Plant maturity is seasonal, and it is best to collect them when ripe and then promptly dry or bake them. The pretreatment of dye raw materials includes screening, purification, and grinding [33]. Screening and purification aim to remove impurities, like mud, iron chunks, stones, and spoiled materials. Iron impurities significantly affect the color of dyes—even a small amount can blacken the dye. Stones and mud increase the ash content and reduce purity. Spoiled materials with damaged pigments darken the color and greatly decrease purity and must be removed separately. The purpose of grinding is to provide uniformly sized crushed material for extraction, to extract pigments more rapidly and completely, thus improving yield and ensuring product quality. After the raw materials are processed, the next step is the extraction of natural dyes. Common methods include aqueous extraction, solvent extraction, acid and alkaline extraction, enzymatic extraction and fermentation, ultrasonic and microwave extraction, and supercritical fluid extraction [34]. The overall preparation process of dyes is shown in Figure 2. Before dyeing, textiles undergo pretreatment, such as washing, bleaching, mercerizing, and desizing, to remove surface dirt and impurities [35,36], ensuring uniform dyeing effects and stable quality. Then, different dyeing methods are used according to the characteristics of the dyes [37,38], followed by cooling, washing, and other finishing processes to produce ecological textile products dyed naturally. The main processes used in the dyeing process are listed in Table 1. In addition to their green environmental characteristics, some plant dyes contain natural organic compounds, such as tannins, flavonoids, anthraquinone, etc., which, while dyeing the fabric, also impart health and protective functions to the fabric, such as antibacterial, antioxidant, UV protection, etc. [17].

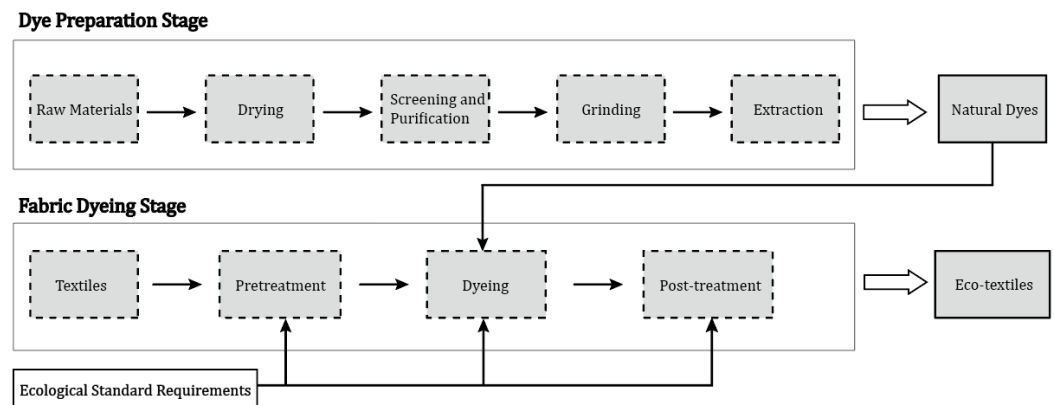


Figure 1. Natural Dyeing Process.

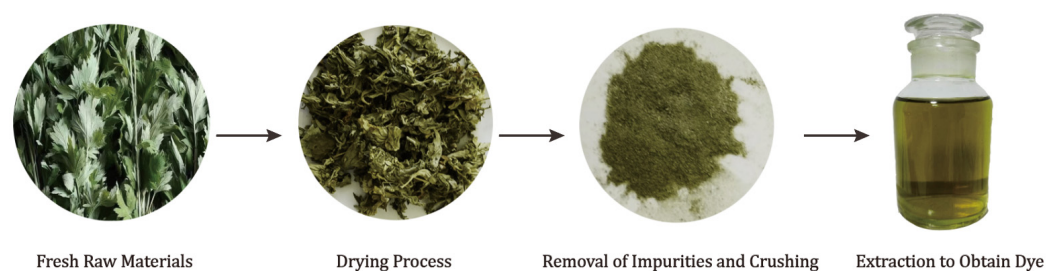


Figure 2. Preparation Process of Dyes.

Table 1. Main Techniques in Natural Dyeing Process.

Dye Extraction Methods					
Aqueous Extraction	Solvent Extraction	Acid and Alkaline Extraction	Enzymatic Extraction and Fermentation	Ultrasonic and Microwave Extraction	Supercritical Fluid Extraction
Pretreatment Methods for Textiles before Dyeing					
Scouring		Bleaching	Mercerizing		Desizing
Dyeing Methods					
Direct Dyeing Method		Mordant Dyeing Method		Reduction Dyeing Method	

Currently, research on natural dyeing primarily focuses on the performance of natural dyes and the development of related technologies. In terms of the performance of natural dyes, the research review by Sajda S. Affat summarized the literature on the classification, advantages and disadvantages, and toxicity of dyes. It showed that most synthetic dyes are non-biodegradable, accumulating in land and rivers and causing ecological issues, hence the effort to replace harmful synthetic dyes with natural ones [32]. In Recep Karadag's research, a detailed inventory of natural dye resources, natural pigment compounds, mordants, auxiliary substances, and the fastness index of dyes used in textiles was documented, establishing standards for natural dyes in textile dyeing products (NODS) [39]. Atav, Rıza, and Osman Namırtı compared 30 different plant dyes in their study, exploring which dye plants are suitable for dyeing PET fibers [40]. Arpana Kamboj indicated that natural dyes contain a large number of phytochemicals, providing unique functional finishes to textiles. The research reviewed scientific efforts made in recent years to obtain antibacterial activity in the field of natural dyes, introducing the main colors of phytochemicals, their antibacterial and antifungal activities, modes of action, application methods, bacterial resistance evaluation, challenges faced, and market potential [41]. Shailendra Yadav and others compiled the colors extractable from different sources and introduced new applications of

natural dyes and pigments, such as in antibacterial finishing textiles, UV shielding textiles, deodorizing finishing, moth repellent textiles and artifacts, and food colorants [42]. Jin Fang, Chen Meng, and Guangzhi Zhang verified the feasibility of simultaneously dyeing and functional finishing (antibacterial and UV protection) fabrics with Batata leaf extract without using inorganic salts and metal mordants, for the clean production of environmentally friendly value-added products. The results could provide possibilities for the application of agricultural waste in textile ecological dyeing and finishing, as well as the value-added management of green waste [43]. Somayeh Baseri used tamarind hulls as a biological dyeing material for natural dyeing of cotton yarns, developing biodegradable medical textiles with added value. The results showed that tamarind hulls, as an eco-friendly mordant, could form insoluble complexes on the surface of cotton yarns, increasing the dye adsorption and thereby improving the lightfastness and washfastness of cotton yarns [44]. Yamini Dhanania, Deepali Singhee, and Ashis K. Samanta used *Quercus infectoria* as a biological mordant and aqueous extract of *Acacia nilotica* bark for dyeing cotton fabrics, standardizing the whole process by assessing color strength and other color parameters (including wash, rub, and lightfastness) and ultimately verifying the good UV protection effect of the *Quercus infectoria* pre-mordanted and *Acacia nilotica* dyed cotton fabrics [45].

In the field of research on the development of natural dyeing technologies, Aminoddin Haji and Maryam Naebe indicated that natural dye dyeing, despite its increasing attention due to non-toxic and environmentally friendly properties, has limitations, such as low yield and color fastness, limiting its potential in industrial-scale applications. Plasma treatment has been proven to be an eco-friendly method to enhance the dye absorption rate of textiles dyed with natural dyes. The study reviewed the impact of plasma treatment on the surface modification of most common natural fibers (wool, cotton, silk) and synthetic fibers (polyester, nylon, acrylic) and its subsequent effect on natural dye dyeing. The results demonstrate that combining plasma treatment with natural dyeing is a green and eco-friendly sustainable dyeing method for textiles [15]. Livia Lara and others aimed to explore the relationship between variables involving traditional dyeing processes and environmental issues. The study proposed the application of materials and emerging technologies, especially in the pre-treatment and dyeing stages. In terms of pre-treatment, biochemical (enzymatic) and physical treatments (UV radiation, plasma, ozone technology) were discussed. In dyeing processes, eco-materials (natural dyes) and emerging technologies (such as plasma, supercritical CO₂, AirDye[®], ultrasound, microwave, nano-dyes, and electrochemistry) were involved [46]. Pizzicato B, Pacifico S, Cayuela D, and others discussed the main characteristics of natural dyes and their differences from synthetic dyes and outlined the latest research in the field of natural dyes, including extraction techniques, substrate preparation, mordanting methods, and dyeing processes [47]. Wided Fersi and others noted that microwave-assisted extraction (MAE) technology has become a popular method for extracting natural dyes from plants. The authors used a household microwave method to extract dyes from cones, and the obtained colored extract was used to dye woolen fabrics [48]. Aminoddin Haji and Maryam Rahimi, to introduce new sources of natural dyes and develop a sustainable dyeing process, optimized the dyeing of wool with *Berberis* leaves DC using the response surface method. The results indicated that increasing dye concentration and dye bath temperature could enhance the color intensity of the dyes [49]. Recep Karadag, Banu Yesim Buyukakinci, and Emine Torgan conducted dyeing studies on organic cotton fabrics with *Quercus ithaburansis* Decaisne and *Quercus ithaburansis* Decaisne + *Rhamnus petiolaris* Boiss using microwave radiation and conventional dyeing methods. They were used in equal proportions, and the dyed fabrics were analyzed using different analytical and process methods. RP-HPLC-PAD method was used to analyze the coloring compounds in the dyeing solution (before and after the dye bath) and dyed fabrics, showing that the microwave radiation dyeing method has great superiority compared to traditional dyeing methods [50]. Muruganandham Moorthy and others used ultrasound technology to extract yellow dye from *Cassia alata* flower petals

and evaluated the antibacterial activity of the extracted yellow dye against skin bacteria. The results demonstrated that the application of ultrasound technology greatly improved the extraction efficiency of colorants from *Cassia alata* flower petals [51].

2.2. Analysis of Sustainable Fashion Consumption Based on the Literature

The concept of sustainable development, initially proposed by experts and scholars concerned about environmental and resource issues, was formally introduced by the United Nations in 1987. It is defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”, and this fundamental idea has since been embraced in various fields [52]. Sustainable fashion design, derived from sustainable development, refers to the design of fashion garments using biodegradable, eco-friendly materials to meet individual needs without negatively impacting the environment and socio-economy, with the resulting garments possessing a longer lifecycle [53]. In 2007, WGSN (World Global Sourcing Network) editor Helen Job, based on studies on economics, consumer goods, technology, and architecture, predicted that sustainable fashion would become a societal focus [54]. In 2019, the United Nations established the “UN Alliance for Sustainable Fashion”, aimed at promoting projects and policies to change the fashion process, reduce negative impacts on the environment and society, and transform fashion into a force for improving the world’s ecosystems and achieving Sustainable Development Goals (SDGs) [55].

Currently, an increasing number of studies focus on sustainable fashion design, mainly discussing sustainable design strategies and sustainable consumption behaviors. In their study on sustainable consumption behavior, Aindrila Biswas and Mousumi Roy [56] investigated the impact of consumer values on sustainable consumption practices across various consumer segments, elucidating the underlying motivations behind consumers’ adoption of such practices. Among consumers who prioritize eco-friendly products, peer opinions and social approval exert the strongest influence on their sustainable consumption behavior. Therefore, promoting and advocating for sustainable consumer values can effectively drive sustainable consumption behavior. Muhammad Abrar [57] and others conducted a study on consumer behavior in developing countries, such as Pakistan, regarding the purchase of green organic textiles. The findings revealed that factors such as health consciousness, consumer knowledge, environmental concern, and personal norms positively influence consumer attitudes. These research findings contribute to businesses’ comprehension of consumer behavior towards organic textiles, emphasizing the necessity of effective marketing strategies during product selling that highlight environmental friendliness, safety, and esthetics to meet consumers’ demands. Chuang Li and others [58] conducted a study based on sentiment analysis and text mining of online reviews for green products sold on the Chinese e-commerce platform JD.com. The cited study examines factors associated with both positive and negative emotions expressed by consumers. The findings indicate that, firstly, there has been a significant increase in Chinese consumers’ attention to and positive sentiments towards green attributes over the past three years. Secondly, as environmental awareness continues to rise, price is no longer the primary determinant of consumer behavior in China. Evaluations of green products now encompass multiple attributes, such as price, functionality, quality, environmental friendliness, energy efficiency, etc., with different product consumers prioritizing different attributes. Thirdly, increasing promotional efforts for green products through the appropriate labeling of their eco-friendly features on packaging or other means can assist consumers in better identifying these products and enhance their motivation to make purchases. Young Kim and Sungeun Suh conducted qualitative case analyses based on literature reviews and in-depth interviews with experts, clarifying the core values and specific standards of sustainable fashion to better communicate with consumers, help them understand sustainable fashion, and invigorate the market in the process [59]. Given the escalating global apprehension regarding environmental concerns, an urgent imperative for sustainable alternatives within the fashion industry is arising. However, this is contingent upon consumers’ acceptance

and awareness of the advantageous attributes inherently held by sustainable products. The aforementioned research scrutinizes and assesses pertinent industries and products regarding sustainable clothing from a consumer-centric standpoint, thereby enhancing product development and associated services to augment consumers' inclination towards selecting more sustainable options.

Studies on consumer behavior regarding textile natural dyeing products are relatively scarce. Xing Xue and Li Li investigated the different consumer behaviors regarding natural dyeing products in China and Japan from a cultural difference perspective [60]. The results showed that attitudes, social norms, and perceived behavioral control (PBC) influence fashion consumption willingness and behavior towards natural dyeing. Comparing China and Japan, attitudes have a stronger impact on intentions in China, while PBC has a greater impact in Japan. Using indigo dyeing as an example, while Japanese consumers prioritize a fashionable lifestyle, in China, indigo-dyed clothing is deeply rooted in ethnic customs. Therefore, when targeting the Chinese consumer market, it is crucial to first further develop the traditional cultural characteristics of natural dyed garments. Secondly, it is important to promote the establishment of diverse natural dyeing brands across different price ranges—i.e., high-end, mid-range, and low-end—in order to establish differentiated positioning for natural dyeing as a fashionable consumer material resource. This approach will enable broader coverage of various consumer groups. Eunjou Yi and Renzo Shamey conducted cross-cultural studies on color emotions and preferences for persimmon-dyed cotton fabrics, indicating that consumers from different cultural backgrounds have varying preferences and demands for the colors of naturally dyed products. Therefore, the design and development of products should consider cultural background factors [61]. In the study by Wen-Cheng Wang and others, different factors, such as color, pattern size, and pattern type, were analyzed for their impact on consumer preference for natural indigo dyeing and stonewashed Tung blossom denim. The results indicated that the main effect of pattern size was significant, with the subjects showing the strongest preference for large patterns and the weakest for extra-small patterns [62]. Letsiwe Mabuza and others explored and described consumers' understanding of clothing color and environmental impact and their willingness to choose sustainable products. The results suggest that for natural dyes to be commercially viable, the efficacy of the dyes needs further development to match the level of synthetic dyes instead of merely relying on consumer support for the environment. Simultaneously, traditional apparel attributes, such as affordability, availability, and fashion style, are also crucial [63]. These studies have investigated the determinants of consumer behavior towards natural dye products, encompassing cultural background, design style, and material performance perspectives. This research significantly contributes to comprehending consumers' consumption intentions and purchasing preferences.

These studies have greatly contributed to our understanding of consumer sustainable consumption behavior, but so far, there is currently a research gap in understanding the specific consumer demand for naturally dyed clothing within the Chinese market. According to statistics from the China Textile Industry Federation, from January to July 2023, there were 13,600 clothing industry enterprises in China with a main business income over CNY 20 million, achieving a business income of CNY 660.06 billion [64], indicating a huge clothing consumer market. At the same time, numerous apparel enterprises actively practice green production, expanding and optimizing product structures around functional use and natural health, and a new ecological industry featuring clean production and green development is accelerating its formation [22]. Effective, timely, and objective identification of consumer needs can facilitate the formulation and implementation of scientific and precise differentiated product strategies in the design and development of naturally dyed garments. Therefore, in today's consumer scenario, accurately grasping current consumer demands, innovating products based on market demand orientation, and effectively promoting them can help naturally dyed apparel enterprises and artisans expand their market shares and profitability, thus achieving better development. The KANO model is an effective tool for analyzing the relationship between product performance and

consumer satisfaction. Therefore, this study, based on the KANO model, explores Chinese consumers' demand for naturally dyed garments, hoping to provide references for the future development of related enterprises.

3. Method

In this study, we adopted a combination of qualitative and quantitative research methods. Firstly, we utilized the KJ analysis method for qualitative research to determine the consumer needs inventory for naturally dyed garments. Secondly, quantitative research was conducted using the KANO model, based on the results of the KJ analysis, to study the impacts of naturally dyed garments and their characteristics on consumers. Finally, based on the Better–Worse coefficient of KANO analysis, consumer needs for naturally dyed garments were optimized and categorized. The importance rankings of each need for naturally dyed garments were calculated based on the sensitivity (importance) index coefficient using the Better–Worse coefficient formula. The research process is shown in Figure 3.

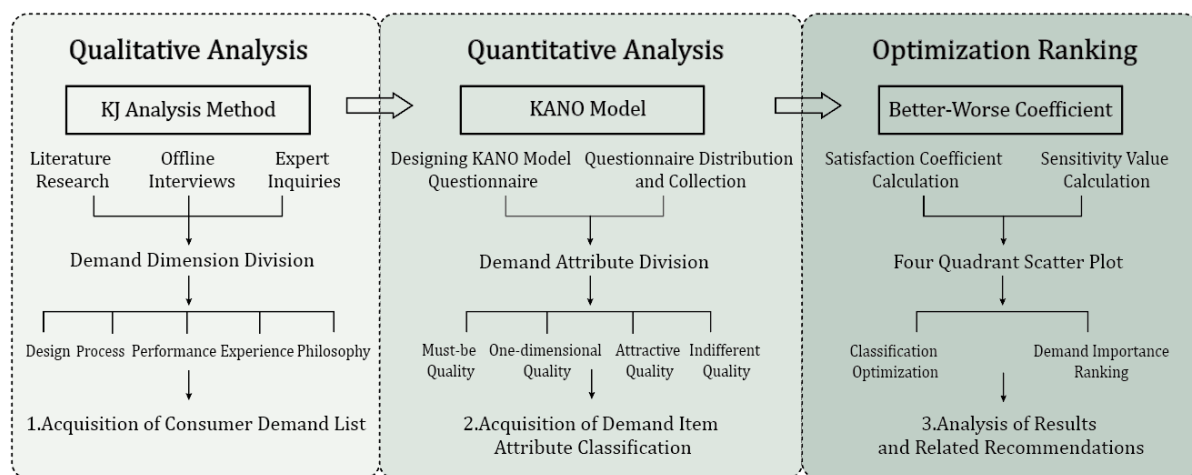


Figure 3. Research Process.

3.1. Using KJ Method to Identify Demand Indicators

To understand consumer needs for naturally dyed garments, this study employed the KJ method, combining a literature review, offline interviews, and the Delphi method for research.

3.1.1. Theoretical Model of the KJ Method

The KJ method, also known as the affinity diagram method, is a consensus-building approach that helps organize complex ideas and information. Invented by Japanese anthropologist Jiro Kawakita, this method categorizes disparate views or conditions based on their interrelationships, clarifying their connections [65]. The implementation steps are as follows: First, identify the research theme for the demand investigation of naturally dyed garments. Next, based on the research findings, create three-level demand cards, and use affinity clustering to form secondary and primary demand cards. Finally, compile a demand list in consultation with experts [66], as shown in Figure 4. The KJ method is often used in product design for its effectiveness and scientific nature, suitable for deeply exploring target consumers' needs and applying the findings to product design, ensuring that the produced products genuinely meet the target consumers' demands [67].

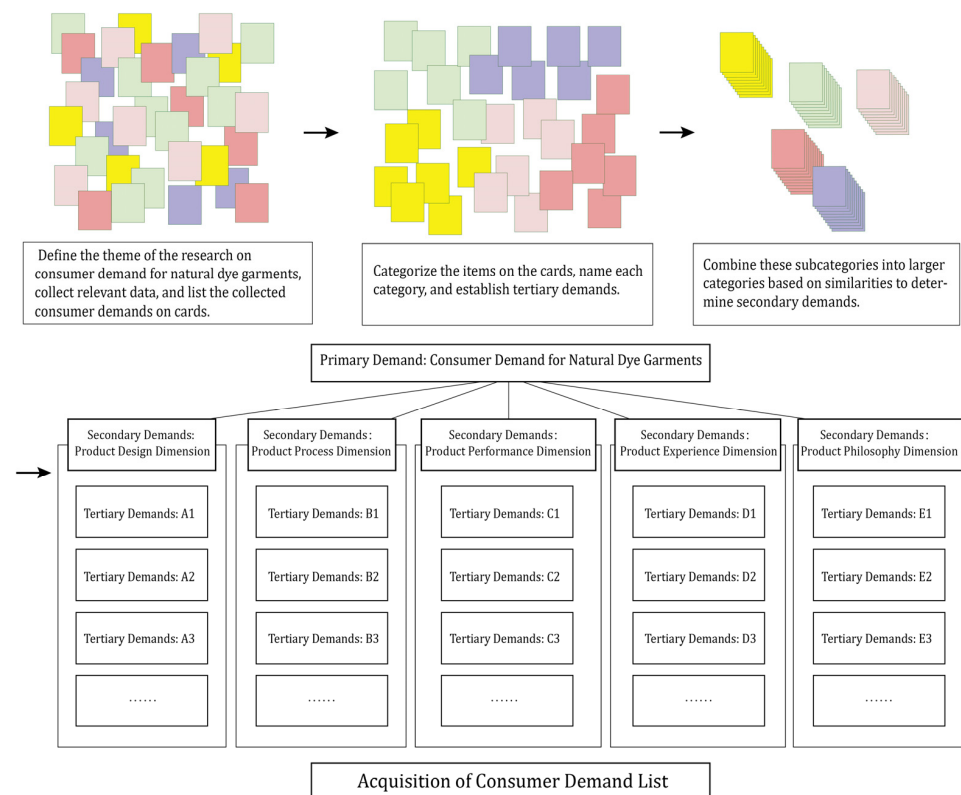


Figure 4. Flowchart of the KJ Analysis Method.

3.1.2. Gathering Demand Information Using the KJ Method

Comprehensive literature searches were conducted in both Chinese and English databases. The Chinese literature was sourced from the CNKI database, including the Peking University Core Index Database, the Chinese Science Citation Database (CSCD), and the Chinese Social Sciences Citation Index (CSSCI). The primary English database used was Web of Science (WOS), a widely recognized and authoritative citation index database that includes SCIE, SSCI, A&HCI, and other sub-collections, supplemented by searches in ScienceDirect (Elsevier) and PubMed databases. The search keywords were “Natural dyeing”, “Plant dyeing”, “Natural dyed clothing”, “Sustainable Fashion”, “Green Design”, and “Ecological Design”, combining keywords and free-word searches, tracing relevant articles in references, and focusing on articles published between January 2012 and July 2023.

A brainstorming session was conducted based on the gathered materials. Using divergent thinking, 486 demand information samples related to naturally dyed garments were obtained. These were then categorized and merged based on similarity or closeness of function, forming a new set of 102 demand information samples.

The offline interviews targeted fashion retail stores and custom design studios in Shanghai, China. Random and snowball sampling methods were used to select 12 interviewees who had some understanding of or had purchased naturally dyed garments. The interview outline was developed after a literature review, as shown in Table 2.

Table 2. Interview Outline.

Number	Question
1	Why are you willing to choose “natural dye” garments?
2	What issues and needs do you have regarding purchasing “natural dye” garments?
3	What do you think are the reasons behind these needs?
4	How do you address these needs?
5	What additional support and assistance do you hope to receive?

Semi-structured interviews were conducted at a natural dyeing clothing design studio in Shanghai in July 2023. This studio's dyes were all derived from carefully selected and mixed plants. The dyeing process is complex, requiring knowledge and skill. This studio has a professional dyeing team skilled in providing high-quality dyeing services. The interviews were conducted in a quiet, undisturbed meeting room. Each interview lasted 20–30 min and was recorded in its entirety.

In this study, we simultaneously conducted data analysis and collection. After the interviews, recordings were transcribed and supplemented with field notes, cross-checked, and verified with interviewees the next day. For data extraction, we used Colaizzi's seven-step method [68], which involved reading transcripts, extracting meaningful statements, coding recurring views, forming sub-themes, condensing sub-themes into main themes, defining themes based on interview objectives and theoretical concepts, and verification with research subjects. Finally, 86 demand information samples were compiled.

After synthesizing all the gathered data, the consumer demand information for naturally dyed garments was categorized into hierarchical levels, forming "third-level demand indicators". These were further classified into "second-level demand indicators" and then into "first-level demand indicators", creating a preliminary list of consumer demands for naturally dyed garments.

Following the initial demand list, the Delphi method was used to consult experts via back-to-back communication [69]. Twelve experts participated in two rounds of inquiry in August 2023, including two textile university professors, both serving as doctoral supervisors, possessing extensive academic backgrounds and having attained many achievements. Additionally, the inquiry included two textile material researchers, two textile designers, two fashion designers, and four doctoral students in textile design. These esteemed experts possess substantial practical experience and play indispensable roles in addressing real-world challenges. They are eminent figures within their respective industries, renowned for their profound theoretical knowledge and exceptional practical expertise, thereby rendering their opinions highly valuable as significant references. The experts' details are shown in Table 3. The inquiry was conducted via WeChat and email, with responses collected every 1–2 weeks. After the first round, the questionnaire was revised based on statistical results and expert opinions, and a second round was conducted. The inquiry was terminated once expert opinions converged. The Delphi method effectively leverages experts' experience and knowledge, allowing independent judgment by each expert and opinions to gradually converge through several feedback rounds.

Table 3. Basic Information of Experts Consulted.

Item	Indicator	Frequency	Percentage (%)
Gender	Male	4	33.33
	Female	8	66.67
Age	30–39	6	50.00
	40–49	4	33.33
	50–59	2	16.67
Education Level	Bachelor's Degree	2	16.67
	Master's Degree	3	25.00
	Doctorate	7	58.33
Occupation	Textile Field University Professor	2	16.67
	Textile Material Researcher	2	16.67
	Textile Designer	2	16.67
	Fashion Designer	2	16.67
	Textile Field Doctorate	4	33.33

After reaching a consensus among experts, the cards were finally organized to derive a demand information list for naturally dyed garments. Naturally dyed garments should possess the characteristics of general apparel products, but they often display ethnic el-

ements since many natural dyes and techniques are industrialized based on traditional ethnic crafts. Moreover, naturally dyed garments have environmental and health features not found for general apparel. Therefore, the product demands were summarized into five dimensions, namely, product design, production, performance, experience, and concept, forming a list of 30 demand items for naturally dyed garments, featuring items such as “Fashionability” and “Biodegradability” (Table 4).

Table 4. Demand List for Natural Dye Garments.

Dimension	Code	Requirements	Description
Product Design	A1	Fashionability	Attractive design that aligns with current fashion trends.
	A2	Personalization	Distinct from the majority of market apparel in style, highlighting individual temperament.
	A3	Natural Color Coordination	Soft and elegant colors, imbued with natural hues.
	A4	Ethnic Features	Utilization of traditional ethnic dyeing methods and patterns, reflecting ethnic characteristics.
	A5	High-Quality Fabrics	Selection of pure natural fiber fabrics, emphasizing high-quality feel of the garment.
	A6	Classic Styles	Comfortable and generous design style, classic and durable, and timeless.
	A7	Easy to Match	Easy to mix and match with other clothing items.
	A8	Packaging Design	Fashionable and beautiful packaging design, meeting social gifting needs.
	A9	Clear Labeling	Clear natural dyeing labels on packaging, specifying the dyeing materials used.
Product Process	B1	Biodegradable	Materials are naturally sourced and biodegradable, processing them does not create pollution, and harmless to the environment.
	B2	Sustainable	Dyeing materials are not rare or exotic; they are recyclable and sustainable.
	B3	Eco-friendly Dyeing Techniques	Dye preparation involves minimal or no chemical reactions, reducing environmental impact.
	B4	Traditional Crafts	Incorporation of traditional Chinese dyeing techniques, preserving ethnic characteristics and cultural heritage.
Product Performance	C1	Comfort	Comfortable for close-to-body wear.
	C2	Durability	High color fastness, resistant to fading from washing and sun exposure.
	C3	Safety	Safe for long-term wear without causing harm or health issues.
	C4	Easy Maintenance	Easy to wash and maintain.
	C5	Functional Health Benefits	Health benefits such as antimicrobial properties.
Product Experience	D1	Cost-Effectiveness	High cost-effectiveness.
	D2	Purchasing Methods	Convenient purchasing options, multiple channels available.
	D3	Product Promotion	Extensive product advertising.
	D4	Styling Advice	Styling advice or guidance provided.
	D5	After-sales Service	After-sales care and maintenance services.
	D6	Clothing Recycling	Recycling services for unused old clothes.
	D7	Personal Customization	Personalized design services based on consumer needs.
Product Philosophy	E1	Esthetic Needs	Conveys personal fashion taste and esthetic preference.
	E2	Social Needs	Suitable for social occasions, also ideal as a gift.
	E3	Lifestyle Philosophy	Represents a healthy lifestyle and a relaxed, comfortable, ideal living state.
	E4	Cultural Significance	Features ethnic elements, embodying traditional cultural meanings.
	E5	Social Responsibility	Demonstrates a sense of social responsibility for environmental protection.

3.2. KANO Model Questionnaire Design and Distribution

3.2.1. Theoretical Model of the KANO Model

The KANO model, proposed by Japanese management scientist Noriaki Kano, is based on the in-depth study and development of the two-dimensional nonlinear relationship

among user quality, attributes, performance, and overall satisfaction. It is a theory and tool for categorizing and prioritizing user needs [70]. The KANO model, widely applied in many fields, is commonly used for consumer demand research and product design. It classifies product/service quality characteristics into five categories: Must-be Quality, One-dimensional Quality, Attractive Quality, Indifferent Quality, and Reverse Quality [71]. A diagram of the KANO model is shown in Figure 5.

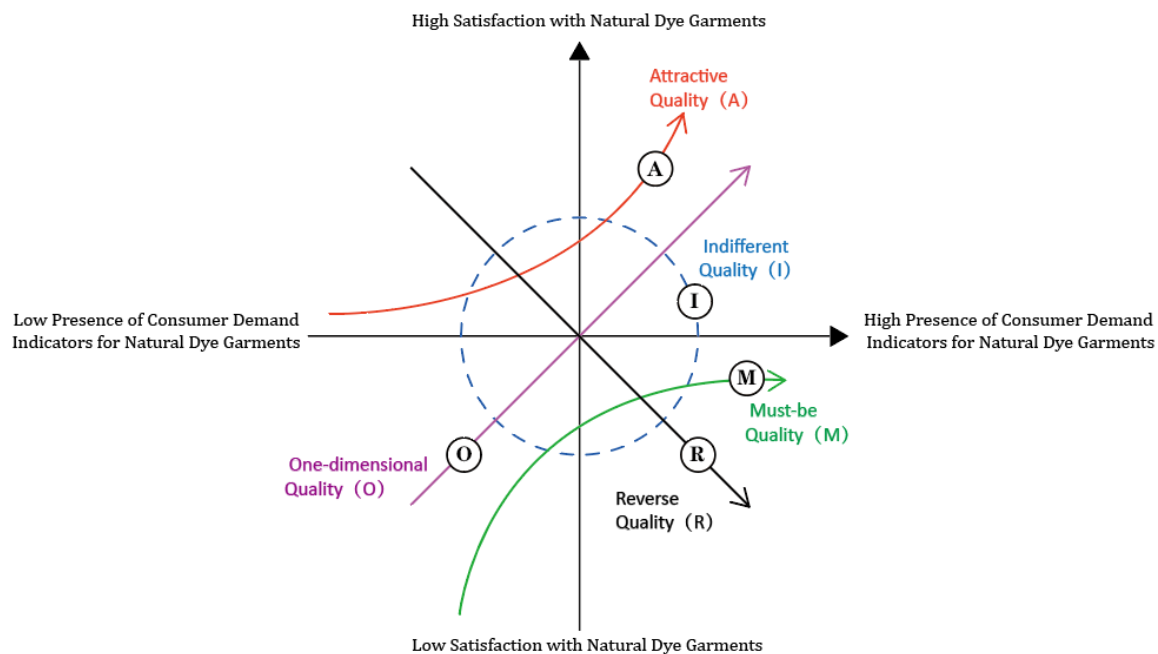


Figure 5. KANO Model Diagram.

The application of the KANO model enables a comprehensive understanding of Chinese consumers' demands and expectations regarding natural dyed clothing. Through structured questionnaire surveys, we can assess consumer satisfaction levels and determine the relative importance of different product functionalities. These evaluation results allow companies to comprehend diverse consumer needs and subsequently optimize and enhance product features accordingly.

The KANO model process involves collecting consumer demands, designing a survey questionnaire based on these demands, and asking target consumers to evaluate the presence or absence of each demand, using answer options like "Like", "Must-be", "Neutral", "Tolerate", and "Dislike". Then, according to the KANO model evaluation standards (Table 5), demand attributes are classified. The most frequent attribute choice is considered the final category [72].

Table 5. Comparison Table of KANO Model Evaluation Results Classification.

Consumer Attitude towards Needs		Reverse Issue: Product Does Not Meet Consumer Needs				
		Like	Must-be	Neutral	Tolerate	Dislike
Positive Issue: Product Meets Consumer Needs	Like	Q *	A	A	A	O
	Must-be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Tolerate	R	I	I	I	M
	Dislike	R	R	R	R	Q

* A: Attractive Quality, O: One-dimensional Quality, M: Must-be Quality, I: Indifferent Quality, R: Reverse Quality, Q: Suspicious Quality.

3.2.2. Questionnaire Design and Distribution

Based on the demand list obtained through the KJ analysis method, the KANO model questionnaire was designed. The questionnaire consists of two parts: the first part gathers basic personal information of the respondents, such as gender, age, educational level, monthly average income, and the number of times they have purchased naturally dyed garments. The second part comprises 30 dual-directional questions about consumer demands during the purchase and use of naturally dyed garments. Positive questions ask about feelings towards garments with specific features; negative questions ask about the absence of these features. After understanding the questions, respondents express their satisfaction level for each demand being met or not. The questionnaire uses a vertical inquiry method, answering first for the presence of an attribute, then for its absence, and so on. To encourage participation, respondents receive material rewards upon completion of the questionnaire. Online respondents can participate in a red packet lottery, while offline respondents receive a fine craft gift. To ensure questionnaire validity, criteria for exclusion include responses under 2 min, missing data exceeding 10%, and pattern responses. Questionnaires failing these criteria are discarded. The KANO model questionnaire features five levels of options for both positive and negative questions, using a Likert scale with options: “Like”, “Must-be”, “Neutral”, “Tolerate”, “Dislike”. The sample questionnaire is shown in Table 6, with explanations provided to ensure respondents understand the intensity of feelings for each option. The questionnaire aims to capture the respondents’ true attitudes.

Table 6. Sample Questionnaire.

Dimension	Function	Question	Like	Must-Be	Neutral	Tolerate	Dislike
Product Performance	C5. Functional health care: It has certain health care functions for human body, such as “antibacterial function”.	With this function	☐	☐	☐	☐	☐
		Without this function	☐	☐	☐	☐	☐

In this study, the KANO model questionnaire was distributed using a combination of online and offline methods, targeting consumers and potential consumers of naturally dyed garments. The online survey was conducted on WJX.cn, leveraging cash red packet lotteries and disseminating through social media tools like WeChat. The offline survey involved visiting three major shopping malls in Shanghai, where naturally dyed garments were sold, to randomly survey consumers and sales staff at brand counters. Additionally, a visit was made to a natural dyeing clothing design studio in Shanghai to survey consumers who had custom-made garments dyed there. In the offline survey phase, each respondent was thanked and presented with a small gift after the survey. The questionnaire distribution was completed between 10 and 31 September 2023, with 400 online and 95 offline questionnaires, totaling 495. After discarding 108 invalid questionnaires based on exclusion criteria, 387 valid questionnaires were obtained, yielding a response rate of 78%.

Characteristics of KANO questionnaire respondents are as follows (Table 7). Of the 387 valid responses, 64.6% were female and 35.4% were male, indicating a significantly higher participation by women. The largest age group was 31–40 years, accounting for 31.78%, followed by 26–30 years at 27.13%, with the least being under 18 years at only 2.84%. The majority of respondents were between 18 and 50 years old, accounting for nearly 80%. Regarding educational level, 43.67% had a bachelor’s degree, followed by 24.81% with an associate degree. Only 4.13% had a middle school education or below. Monthly average income statistics showed that the majority earned between CNY 3001 and 9000, with the largest group earning CNY 6001–9000 at 35.92%. Those earning below CNY 3000 were only 8.79%, while those earning over CNY 9000 were 20.16%. In terms of purchasing experience with naturally dyed garments, 33.07% had never bought such products, 41.6% had bought them 1–3 times, and 25.32% more than three times.

Table 7. Demographic Characteristics of the Sample.

Item	Indicator	Frequency	Percentage (%)
Gender	Male	137	35.4
	Female	250	64.6
Age	<18	11	2.84
	18–25	61	15.76
	26–30	105	27.13
	31–40	123	31.78
	41–50	41	10.59
	51–60	33	8.53
	>60	13	3.36
Education Level	Junior High School and Below	16	4.13
	High School / Technical School	47	12.14
	Junior College	96	24.81
	Bachelor’s Degree	169	43.67
	Graduate Degree and Above	59	15.25
Average Monthly Income(RMB)	<3000	34	8.79
	3001–6000	136	35.14
	6001–9000	139	35.92
	>9000	78	20.16
Experience in Purchasing Natural Dye Garments	Never Purchased	128	33.07
	Purchased 1–3 Times	161	41.6
	More than 3 Times	98	25.32

3.2.3. Reliability and Validity Test

The SPSSAU (online SPSS analysis software) was used to test the reliability and validity of the KANO questionnaire for naturally dyed garment demands [73]. Reliability was represented by Cronbach’s alpha coefficient, ranging from 0 to 1, with higher values indicating greater internal consistency of the questionnaire. Many studies mention that a coefficient of 0.7 or above indicates effective reliability, with some considering 0.6 or above acceptable [74]. As per Table 8, the overall Cronbach’s alpha coefficient for the 387 valid questionnaires was 0.855, with 0.964 for positive questions and 0.969 for negative questions, all above 0.8. This indicates strong correlations among various items of the questionnaire, making it a valid measurement tool. The large sample size also lends credibility to these results, providing a reference for subsequent research. Validity testing aims to check the truthfulness and accuracy of the questionnaire. Generally, a KMO value above 0.9 indicates good validity; 0.8–0.9 is suitable; 0.7 to 0.8 is acceptable [75]. The validity results of this questionnaire, as shown in Table 9, had a KMO value of 0.968, well above 0.8, and a significant Bartlett’s test of sphericity, indicating the data were suitable for factor analysis.

Table 8. Reliability Test.

Item	Cronbach’s α Value
All questions	0.855
Positive questions	0.964
Negative questions	0.969

Table 9. Validity Test.

KMO and Bartlett’s Test		
KMO Value		0.968
Bartlett’s Test of Sphericity	Approximate Chi-Square	16,071.455
	df	1770
	Sig.	0.000

3.2.4. Satisfaction Coefficient

The traditional KANO model can qualitatively classify consumer demand items for naturally dyed garments but cannot effectively measure the weight of demand items [76]. In order to accurately identify the categories and significance of demand items, optimization is imperative for enhancing the traditional KANO model. Matzler and Hinterhuber [77] introduced a consumer satisfaction coefficient to aid in discerning demand types based on the conventional KANO model, utilizing the Better–Worse coefficient method to quantitatively assess the weights of each requirement. The outcomes can serve as a valuable reference for determining key elements of consumer demands and prioritizing improvements [78]. The calculation formula is presented as follows:

$$\text{Better} = (A + O)/(A + O + M + I) \quad (1)$$

$$\text{Worse} = (O + M)/(A + O + M + I) \times (-1) \quad (2)$$

where Better is the satisfaction coefficient; Worse is the dissatisfaction coefficient; and A, O, M, and I represent the frequency counts of the Attractive, One-dimensional, Must-be, and Indifferent quality attributes, respectively.

The satisfaction coefficient reflects how the addition or removal of a demand item affects satisfaction. The Better coefficient represents the proportion of Attractive (A) and One-dimensional (O) demands within the overall demands, with higher values indicating the clear significance of such demands. The Worse coefficient is expressed as the proportion of One-dimensional (O) and Must-be (M) demands, with higher absolute values indicating a significant impact on overall satisfaction and being key to achieving customer satisfaction [79].

4. Analysis and Results

4.1. Results of Traditional KANO Analysis

Table 10 shows that the main category of demands in this study is One-dimensional Quality (O), with 20 items. If these attributes are present, consumers will be satisfied; if not, they will be dissatisfied. These demands should be prioritized for enhancement and improvement. Next are Attractive Quality (A) demands, totaling 10 items. If these attributes are present, they can pleasantly surprise consumers; if they are absent, they will not cause dissatisfaction. Clearly, products or services with Attractive Quality factors are more appealing to consumers and more likely to create a competitive advantage in similar situations. However, classifying naturally dyed garment demands solely based on the traditional KANO model presents certain difficulties. The traditional KANO model also struggles with quantitative evaluation and prioritization of specific demand items, showing its limitations. Therefore, further exploration combining an improved KANO model is needed.

Table 10. Attribute Statistics of Traditional KANO Model.

Dimension	Code	A (%)	O (%)	M (%)	I (%)	R (%)	Q (%)	Classification
Product Design	A1	26.98	34.90	20.63	15.95	0.61	0.93	O
	A2	29.19	27.25	19.21	21.15	1.79	2.05	A
	A3	24.77	30.14	22.92	18.84	1.48	1.85	O
	A4	31.50	28.48	17.66	19.53	1.20	1.63	A
	A5	26.93	34.23	19.30	15.18	1.74	2.60	O
	A6	26.29	32.52	20.79	16.81	1.49	2.10	O
	A7	28.82	32.75	18.12	15.96	1.81	2.54	O
	A8	31.44	29.21	17.35	18.68	1.48	1.85	A
	A9	25.62	32.29	21.62	17.15	1.44	1.90	O

Table 10. Cont.

Dimension	Code	A (%)	O (%)	M (%)	I (%)	R (%)	Q (%)	Classification
Product Process	B1	26.78	35.48	19.18	14.47	1.63	2.47	O
	B2	22.17	33.18	24.92	16.65	1.28	1.79	O
	B3	28.38	36.58	18.58	14.41	0.72	1.34	O
	B4	29.69	31.64	18.23	17.11	1.35	1.98	O
Product Performance	C1	16.76	36.06	28.89	13.43	1.97	2.89	O
	C2	24.37	35.76	20.55	14.71	1.42	2.17	O
	C3	18.23	36.04	28.32	14.33	1.42	1.80	O
	C4	23.70	34.40	22.99	15.84	1.26	1.82	O
	C5	32.26	29.49	16.56	18.11	1.56	2.03	A
Product Experience	D1	29.94	32.22	17.75	16.49	1.52	2.07	O
	D2	25.06	34.95	21.20	15.20	1.40	2.20	O
	D3	31.16	27.61	18.04	20.36	1.30	1.52	A
	D4	30.79	28.90	18.65	19.87	0.77	1.03	A
	D5	29.80	32.95	17.54	15.86	1.59	2.26	O
	D6	33.46	31.74	15.56	16.40	1.13	1.69	A
	D7	24.84	25.64	22.69	21.99	2.37	2.48	O
Product Philosophy	E1	27.52	29.61	20.63	19.17	1.40	1.67	O
	E2	30.50	30.18	17.39	17.58	1.75	2.60	A
	E3	29.05	28.44	19.37	19.79	1.41	1.93	A
	E4	31.30	32.48	16.37	15.78	1.72	2.38	O
	E5	29.51	28.14	18.43	19.33	2.09	2.51	A

4.2. Results of KANO Analysis Based on Better–Worse Coefficients

4.2.1. Demand Satisfaction

To accurately gauge the impact of naturally dyed garment demand attributes on consumer satisfaction and dissatisfaction, the Better and Worse coefficients for each demand item were calculated based on the KANO attribute classification results, as shown in Table 11. Combining the Better–Worse coefficients and using the Better value and the absolute value of the Worse index as the horizontal and vertical coordinates (with their averages serving as the critical lines) [80], a four-quadrant scatter plot of demand satisfaction for naturally dyed garments was drawn. This data-processing method compensates for the shortcomings of the traditional KANO method, which solely relies on the highest frequency to determine the attribute classification of each indicator [75].

Table 11. Satisfaction and Sensitivity Coefficients for Demand Items.

Dimension	Code	Better Coefficient	Worse Coefficient	Sensitivity ω	Ranking	Basic Classification	Optimization Classification
Product Design	A1	0.6285	−0.5640	0.8445	8	O	O
	A2	0.5831	−0.4800	0.7552	29	A	I
	A3	0.5680	−0.5489	0.7899	22	O	M
	A4	0.6173	−0.4748	0.7788	24	A	A
	A5	0.6395	−0.5597	0.8498	7	O	O
	A6	0.6100	−0.5530	0.8234	16	O	M
	A7	0.6437	−0.5318	0.8350	12	O	A
	A8	0.6273	−0.4816	0.7909	21	A	A
	A9	0.5990	−0.5576	0.8184	17	O	M
Product Process	B1	0.6492	−0.5699	0.8639	4	O	O
	B2	0.5711	−0.5995	0.8280	14	O	M
	B3	0.6632	−0.5631	0.8700	2	O	O
	B4	0.6344	−0.5159	0.8177	18	O	A

Table 11. Cont.

Dimension	Code	Better Coefficient	Worse Coefficient	Sensitivity ω	Ranking	Basic Classification	Optimization Classification
Product Performance	C1	0.5552	−0.6827	0.8800	1	O	M
	C2	0.6304	−0.5903	0.8636	5	O	O
	C3	0.5600	−0.6641	0.8687	3	O	M
	C4	0.5994	−0.5921	0.8425	9	O	M
	C5	0.6404	−0.4776	0.7989	20	A	A
Product Experience	D1	0.6448	−0.5184	0.8273	15	O	A
	D2	0.6224	−0.5824	0.8524	6	O	O
	D3	0.6048	−0.4698	0.7658	28	A	I
	D4	0.6078	−0.4842	0.7771	25	A	I
	D5	0.6526	−0.5251	0.8376	10	O	A
	D6	0.6711	−0.4868	0.8291	13	A	A
	D7	0.5308	−0.5079	0.7347	30	O	I
Product Philosophy	E1	0.5894	−0.5183	0.7849	23	O	I
	E2	0.6344	−0.4973	0.8061	19	A	A
	E3	0.5948	−0.4947	0.7736	27	A	I
	E4	0.6649	−0.5092	0.8375	11	O	A
	E5	0.6042	−0.4881	0.7767	26	A	I

The results in Figure 6 indicate that most of the 30 indicators are close to the center of the horizontal and vertical coordinates. The first quadrant represents One-dimensional Quality demands, including six demand indicators: Fashionability (A1), High-Quality Fabrics (A5), Biodegradability (B1), Eco-friendly Dyeing Technology (B3), Durability (C2), and Purchase Method (D2). High Better values and absolute Worse values in this quadrant suggest that providing these features not only enhances consumer satisfaction but also prevents dissatisfaction. Thus, demands in this quadrant are crucial factors to be prioritized in the design and development of naturally dyed garments.

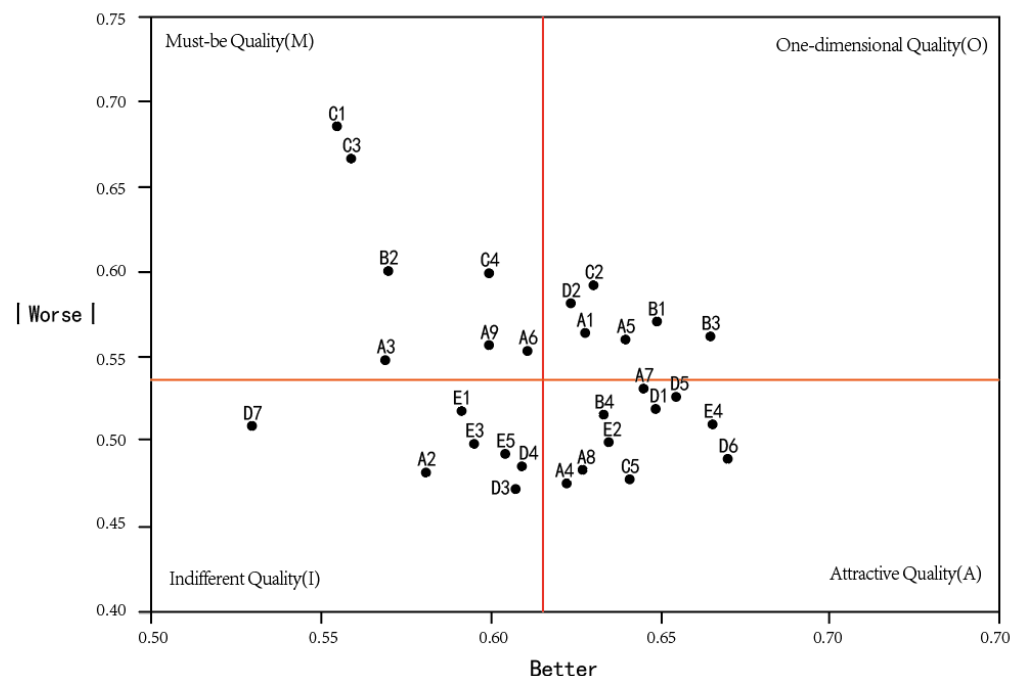


Figure 6. Four-Quadrant Scatter Plot of Satisfaction for Natural Dye Garments.

The second quadrant contains Must-be Quality demands, including seven indicators, such as Natural Color Coordination (A3), Classic Style (A6), and Clear Labeling (A9). The lower Better values indicate that providing these services does not significantly improve satisfaction. The higher absolute Worse values imply increasing dissatisfaction if these

features are not provided. Despite not increasing satisfaction, their absence can cause dissatisfaction, so they deserve attention.

The third quadrant encompasses Indifferent Quality demands, including seven indicators like Personalization (A2) and Product Promotion (D3). Both Better and Worse absolute values are below average, indicating that these features have minimal impact on satisfaction but might transform into higher-level demands with future service improvements.

The fourth quadrant includes Attractive Quality demands, with ten indicators, including Ethnic Characteristics (A4) and Value for Money (D1). High Better values suggest that providing these features can enhance satisfaction without increasing dissatisfaction if absent. These indicators are unexpected bonus points for product demand satisfaction. According to the importance hierarchy derived from long-term practice based on the KANO model theory, the prioritization of features is generally ordered as follows: Must-be (M) > One-dimensional (O) > Attractive (A) > Indifferent (I) [81]. Therefore, for product development and design, a competitive product must contain all Must-be attributes, perform better than competitors in terms of One-dimensional attributes, and include differentiated Attractive attributes.

4.2.2. Importance of Demands

The choices and satisfaction levels of consumers regarding product demand items are two crucial aspects in the decision-making process of businesses. To better meet consumer needs and provide intuitive data references for product development and decision makers, the importance of each demand satisfaction coefficient was calculated and ranked. Using the sensitivity (importance) index coefficient and the Better–Worse coefficient formula, the sensitivity values and importance rankings of each demand item for naturally dyed garments were calculated. The formula is as follows:

$$\omega = \sqrt{\text{Better}^2 + |\text{Worse}|^2} \quad (3)$$

where a sensitivity coefficient “ ω ” closer to 1 indicates higher consumer sensitivity and importance [81]. The overall ranking of the sensitivity coefficient “ ω ” is shown in Table 11, with higher “ ω ” values indicating higher sensitivity and impact on consumers, while lower “ ω ” values indicate lower sensitivity and impact, which can be temporarily disregarded.

The importance ranking of demands for naturally dyed garments is shown in Table 12. Must-be Quality (M) demands are the most important, with the sensitivity coefficients ranking as follows: Comfort (C1), Safety (C3), Easy Care (C4), Sustainability (B2), Classic Style (A6), Clear Labeling (A9), and Natural Color Coordination (A3). The next most important are One-dimensional Quality (O) demands, for which the sequence is arranged in accordance with the corresponding sensitivity coefficient: Eco-friendly Dyeing Technology (B3), Biodegradable (B1), Durability (C2), Purchase Method (D2), High-Quality Fabric (A5), and Fashionability (A1); this finding indicates that providing these features can significantly enhance consumer satisfaction. The Attractive Quality (A) demands include many indicators: After-sales Service (D5), Cultural Connotation (E4), Easy to Match (A7), Clothing Recycling (D6), Value for Money (D1), Traditional Craftsmanship (B4), Social Needs (E2), Functional Health Benefits (C5), Packaging Design (A8), and Ethnic Features (A4). Lastly, Indifferent Quality (I) demands include Esthetic Needs (E1), Styling Suggestions (D4), Social Responsibility (E5), Lifestyle Philosophy (E3), Product Promotion (D3), Personalization (A2), and Customization (D7), with Customization (D7) having the lowest sensitivity, indicating that it is currently a non-essential feature for consumers.

Table 12. Ranking of Importance of Demands for Natural Dye Garments.

Ranking Method	Demand Importance Ranking
Must-be (M)	C1 > C3 > C4 > B2 > A6 > A9 > A3
One-dimensional (O)	B3 > B1 > C2 > D2 > A5 > A1
Attractive (A)	D5 > E4 > A7 > D6 > D1 > B4 > E2 > C5 > A8 > A4
Indifferent (I)	E1 > D4 > E5 > E3 > D3 > A2 > D7
Product Design	A5 > A1 > A7 > A6 > A9 > A8 > A3 > A4 > A2
Product Process	B3 > B1 > B2 > B4
Product Performance	C1 > C3 > C2 > C4 > C5
Product Experience	D2 > D5 > D6 > D1 > D4 > D3 > D7
Product Philosophy	E4 > E2 > E1 > E5 > E3

From the ranking results regarding the product dimensions, in terms of product design needs, high-quality fabric (A5) has the highest sensitivity coefficient, followed by fashionability (A1), both of which are in the first quadrant (O) of the four-quadrant chart, indicating that they are key factors in establishing consumer satisfaction. Other relatively high-sensitivity coefficients include easy to match (A7), classic style (A6), and clear labeling (A9). Easy to match (A7) is categorized as an attractive requirement, suggesting that having this feature can pleasantly surprise consumers. However, its absence will not have a negative impact, providing that it significantly increases customer satisfaction. Classic style (A6) and clear labeling (A9) are both considered basic needs, indicating consumers view timeless, durable styles and clear, intuitive natural dye labeling as essential, so these aspects should be ensured in product design. Finally, personalization (A2) has the lowest sensitivity in product design needs and is classified as an indifferent need (I), suggesting consumers are not particularly concerned about unique design styles. The significantly higher sensitivity coefficient for classic style (A6) compared to personalization (A2) also indicates a preference for classic, versatile designs. Therefore, there should be a bias towards such styles in product design choices.

For product craft needs, Eco-friendly Dyeing Technology (B3) has the highest sensitivity coefficient, followed by Biodegradable (B1), both of which are situated in the One-dimensional quadrant (O), indicating a high demand for environmentally friendly dyeing technology and natural materials. Sustainability (B2) also ranks high, being a Must-be Quality, reflecting consumers' concern for recyclable materials and the importance of sustainability. Traditional Craftsmanship (B4), ranking 18th and constituting an Attractive Quality, shows that traditional cultural features are not key for naturally dyed garments, but they can serve as bonus points.

In terms of product performance needs, Comfort (C1) and Safety (C3) are top priorities, both being Must-be Qualities, indicating that their absence would significantly reduce consumer satisfaction. Durability (C2) and Easy Care (C4) also have high sensitivity, with Durability (C2) constituting a One-dimensional Quality, emphasizing the need to enhance color fastness in product development. Functional Health Benefits (C5) has the lowest sensitivity, and it is an Attractive Quality, suggesting that health benefits are not currently a pressing demand but can add value.

For product experience needs, Purchase Method (D2) has the highest sensitivity coefficient, and it is a One-dimensional Quality, indicating that providing convenient purchase methods is key for consumer satisfaction. Other high-sensitivity demands include After-sales Service (D5), Clothing Recycling (D6), and Value for Money (D1), all of which are Attractive Qualities, indicating that offering maintenance and recycling services can significantly satisfy and surprise consumers.

In product concept needs, Cultural Connotation (E4) has the highest sensitivity, and it is an Attractive Quality, showing consumer interest in products that reflect traditional culture. Social Needs (E2) also has high sensitivity, and it is an Attractive Quality, suggesting that consumers wish for naturally dyed garments suitable for social occasions or gifting, but this is not urgent. Esthetic Needs (E1), Social Responsibility (E5), and Lifestyle Philosophy

(E3) have lower sensitivities, and they are Indifferent Qualities, indicating less concern for expressing personal style, social responsibility, or healthy lifestyle attitudes.

5. Discussion

To survive in global competition, companies must accurately and consistently identify consumer needs and satisfy them [27]. Conducting research on naturally dyed garments with a focus on consumer needs is instrumental in providing targeted optimization directions and research foundations for strategy formulation in design development, marketing promotion, and after-sales services. In this approach, the aim is to enhance consumer satisfaction with naturally dyed garments, thereby expanding their influence and ultimately promoting the implementation of green development strategies in China's textile industry. This study employed the KJ analysis method and the KANO model, investigating consumer demand for naturally dyed garments across five dimensions: product design, craftsmanship, performance, experience, and concept. The survey results categorized and ranked the demand indicators based on consumer satisfaction, identifying the degrees of consumers' need for different demand items and the key factors for satisfaction enhancement. This reduces subjective influences on product development, standardizing and scientizing the development process. The results provide designers with references and decision makers with a basis for their decisions.

This study's focus on product demand classification has led to the extraction of specific characteristics of consumer needs for naturally dyed garments, resulting in the establishment of a demand indicator list that aligns with consumer expectations. It identified 30 demand indicators related to naturally dyed garments, categorized into product design (nine indicators), craftsmanship (four indicators), performance (five indicators), experience (seven indicators), and concept (five indicators). The findings indicate that Attractive Quality demands constitute the largest proportion of these 30 indicators. This shows that, currently, consumers have high expectations for various features of naturally dyed garments. As these expectations are continuously met, consumer satisfaction is likely to increase, making these aspects critical indicators in the demand list for naturally dyed garments. In essence, understanding and catering to these identified consumer demands can guide the development and optimization of naturally dyed garments, ensuring that they meet the current market needs and preferences. This approach not only enhances consumer satisfaction but also contributes to the broader adoption and appreciation of naturally dyed garments, aligning with sustainable and eco-friendly fashion trends.

Starting from satisfaction and importance and combining the dimensions of satisfaction, in this study, we constructed a satisfaction support system for naturally dyed garments. By applying the Better–Worse coefficient formula, the sensitivity values and importance rankings of each demand item were calculated. The top five demands in terms of importance are Comfort (C1), Eco-friendly Dyeing Technology (B3), Safety (C3), Biodegradability (B1), and Durability (C2). These indicators, which have the highest sensitivity coefficients among all 30 demand indicators, are the main concerns of consumers and should thus be the focus of and a priority in product R&D. The aforementioned five indicators demonstrate that the primary factors influencing the demand of Chinese consumers for natural dyed clothing during its emergence stage are a product's wearing experience and environmental protection characteristics. Primarily, consumers prioritize a superior sense of comfort when it comes to natural dyed clothing, with this demand surpassing their desire for visually appealing designs. Secondly, Chinese consumers are becoming increasingly conscious of environmental issues and seek to minimize negative impacts on the environment while enjoying high-quality products. Simultaneously, there is a relatively high demand among consumers for the environmental sustainability attributes of natural dyed clothing. This indicates that Chinese consumers exhibit a strong inclination towards embracing eco-friendly alternatives and are associated with favorable market prospects for enterprises engaged in designing and developing relevant sustainable products, thereby facilitating an environmentally conscious transformation of production methods. In addi-

tion, these indicators belong to the dimensions of product performance and craftsmanship, suggesting that to maintain consumer satisfaction with naturally dyed garments, these two dimensions should be focused on first. For instance, in the product performance dimension, companies should strictly control product quality to produce comfortable, safe, and durable products. Comfort should include both the tactile comfort of the fabric and the comfort of the design, such as the fit of clothing and comfort during movement. Safety should meet relevant standards, and testing reports should be provided to reassure consumers. Regarding durability, the focus should be on improving color fastness and other related technical developments to increase product lifespan. Regarding craftsmanship, attention should be paid to eco-friendly technology development and highlighting the environmentally friendly features of naturally dyed garments in marketing strategies. For the demands ranked 6–10, namely, Purchase Method (D2), High-Quality Fabric (A5), Fashionability (A1), Easy Care (C4), and After-sales Service (D5), these indicators belong to the dimensions of product experience, design, and performance. These demands indicate that consumers seek more convenience throughout a product's lifecycle, from purchase to use and after-sales. Therefore, companies should pay close attention to these demands, focusing on product performance R&D, expanding sales channels, and providing comprehensive after-sales services. For example, wrinkle-resistant, easy-care fabrics are highly favored by consumers, so R&D departments should prioritize these types of functional fabrics. In terms of sales, continuously expanding sales channels, particularly focusing on the consumption habits of contemporary consumers, and vigorously developing online sales platforms are important. Promotion and publicity via new media will provide consumers with more options and channels for purchasing naturally dyed garments. In regard to after-sales service, a clear return and exchange policy is essential, along with repair and maintenance services and convenient laundry services for special-care items. Providing professional services can save consumers time and enhance their experience. Lastly, High-Quality Fabric (A5) and Fashionability (A1) are design-related demands, indicating consumer interest in high-quality, fashionable products. Therefore, during the design process, attention should be paid to current trends while selecting pure natural fiber materials to emphasize the high quality of garments.

Starting from the types of product demands, the survey results indicate that the Must-be Quality (M) demands for naturally dyed garments are Comfort (C1), Safety (C3), Easy Care (C4), Sustainability (B2), Classic Style (A6), Clear Labeling (A9), and Natural Color Coordination (A3). Improving these aspects presents a challenge, as Must-be Quality demands are often fundamental and expected by consumers by default. Enhancements in these areas do not necessarily lead to greater satisfaction, but if these basic functionalities fail to meet expectations, they can significantly negatively impact consumer satisfaction. Among these attributes, Comfort (C1), Safety (C3), and Easy Care (C4) fall under the product performance dimension. Sustainability (B2) is part of the product functionality dimension, and Classic Style (A6), Clear Labeling (A9), and Natural Color Coordination (A3) are within the product design dimension. These results indicate that consumers' most basic needs for naturally dyed products are concentrated on a product's performance and design. Among these seven indicators, the top three in terms of the sensitivity coefficient are Comfort (C1), Safety (C3), and Easy Care (C4), highlighting that the wear and usage experience of a product are foundational in enhancing consumer satisfaction. Therefore, in subsequent product development, regardless of the addition or optimization of other features, it is crucial to avoid overlooking the safety, comfort, and practical durability of a product. Ensuring that these fundamental needs are met is essential for maintaining and enhancing consumer satisfaction with naturally dyed garments. This approach not only satisfies the immediate needs of consumers but also lays a solid foundation for developing long-lasting and valued products for release to the market.

Eco-friendly dyeing technology (B3), biodegradability (B1), durability (C2), purchasing methods (D2), high-quality fabrics (A5), and fashionability (A1) all fall under the category of One-dimensional Quality (O) demands. These demands have a proportional

relationship with customer satisfaction; the more they are met, the higher the consumer satisfaction. Conversely, unmet expectations lead to increased dissatisfaction, although not as significantly as with basic needs. Among these six indicators, eco-friendly dyeing technology (B3) and biodegradability (B1) rank the highest in terms of sensitivity coefficients, indicating that as environmental awareness increases, consumers pay more attention to the eco-friendliness of products. Therefore, product development can involve greater investment in eco-friendly dyeing technology, minimizing environmental impacts while meeting consumer needs. Additionally, marketing strategies can leverage new media to amplify the promotion of the eco-friendly aspects of naturally dyed garments, thereby significantly enhancing consumer satisfaction and expanding the consumer market. The need for durability (C2), purchasing methods (D2), high-quality fabrics (A5), and fashionability (A1) indicates a high demand for product quality, convenience in relation to purchasing methods, and stylish design. Future developments should focus on strict quality control, the innovation of styles and fabrics, and expanding sales channels to meet these diverse consumer demands.

Attractive Quality demands can offer consumers unexpected delights without creating excessive expectations. Therefore, these demands can significantly enhance consumer satisfaction. However, even when these expectations are not met, consumers do not express marked dissatisfaction. Ordered by sensitivity coefficients, the Attractive Quality demands are as follows: After-sales Service (D5), Cultural Content (E4), Easy to Match (A7), Clothing Recycling (D6), Cost-effectiveness (D1), Traditional Craftsmanship (B4) > Social Needs (E2), Functional Health Properties (C5), Packaging Design (A8), and Ethnic Features (A4). These demands encompass all five dimensions of naturally dyed garments, indicating a diversity in consumer needs. Among these ten Attractive Quality demands, three are related to product experience, namely, After-sales Service (D5), Clothing Recycling (D6), and Cost-effectiveness (D1), all with relatively high sensitivity coefficients. This suggests that enhancing and optimizing consumer-experience-related products and services can improve customer loyalty and effectively increase satisfaction. Furthermore, Cultural Content (E4), Traditional Craftsmanship (B4), and Ethnic Features (A4) are all related to traditional culture. This indicates that deep engagement with traditional cultural features can effectively enhance consumer identification with naturally dyed garments, thereby serving the purpose of increasing consumer satisfaction.

Finally, Indifferent Quality demands are those that do not affect consumer experience, whether provided or not. Esthetic needs (E1), styling suggestions (D4), social responsibility (E5), life philosophy (E3), product promotion (D3), personalization (A2), and custom-made services (D7) all belong to this category. Among these, esthetic needs (E1), social responsibility (E5), and life philosophy (E3) are requirements that are somewhat vague and conceptual, reflecting a product's philosophy rather than its tangible features. Their classification as Indifferent Quality demands suggests that current consumers are more focused on the specific functions of naturally dyed garments, with clearer preferences. Additionally, custom-made services (D7), ranking last in terms of sensitivity, and personalization (A2), ranking second to last, indicate that consumers currently do not place much importance on personalized services or individualistic design styles in naturally dyed garments. They do not seek to express unique fashion concepts through these products. As shown earlier, consumer expectations for differentiation in naturally dyed garments are more focused on eco-friendly attributes. However, these findings are not absolute. According to the KANO model theory, the categorization of attributes is not fixed and may change over time [82]. A demand's attribute might transform over time from left to right (I-A-O-M), meaning an Indifferent Quality might become an Attractive Quality, which, in turn, might become a One-dimensional Quality and eventually a Must-be Quality. Therefore, completely ignoring Indifferent Quality demands is unscientific. Developers of naturally dyed garments should use modern technologies, like the internet and big data, to appropriately track these Indifferent Quality indicators and adjust strategies in a timely manner.

The integration of the KANO model and KJ analysis method effectively uncovers the real demands of consumers. Thus, this study can serve as a foundation for future research on the development of naturally dyed garments and the improvement of service quality. The results suggest that increasing consumer involvement in the design process can enhance product development. This approach provides valuable insights and directions for formulating design strategies, ensuring that products not only meet but exceed consumer expectations in terms of both functionality and aesthetics. By aligning product features with consumer needs, it is possible to create garments that are not only environmentally friendly but that also resonate strongly with the target market.

6. Conclusions

6.1. Research Conclusions

This study intends to enhance the market value of naturally dyed garments by examining consumer needs and satisfaction, thereby providing a foundation for product design and development strategies. Utilizing the KJ Analysis Method, we compiled a demand inventory for naturally dyed garments through a literature review, offline interviews, and expert inquiries, covering five dimensions, namely, product design, craftsmanship, performance, experience, and concept, totaling 30 items. Based on this analysis, a KANO demand questionnaire was developed and verified with respect to its reliability and validity. The KANO model was applied to categorize the quality attributes of consumer demands for naturally dyed garments, and using the Better–Worse coefficients, the classification of these demands was further refined and ranked by importance. This process identified the characteristics of 30 demands and analyzed their impact on Chinese consumers and the key factors affecting satisfaction. The findings indicate a high level of consumer focus on the wearing experience and eco-friendly attributes of products, with safety, comfort, sustainability, and durability being crucial to consumer satisfaction. Additionally, design elements such as fashionability, high-quality materials, and convenience in purchasing, usage, and after-sales processes significantly increase consumer satisfaction. Therefore, in the design process of naturally dyed garments, priority should be given to developing and promoting safety, comfort, and environmental features in terms of product performance and craftsmanship. Moreover, businesses should provide more convenience and services in purchasing channels and after-sales recycling to enhance the overall consumer experience.

6.2. Research Contributions

This research has implications in both practical and theoretical realms. Practically, it combines quantitative and qualitative methods to categorize and rank pre-defined product functions based on consumer satisfaction. This offers data support for formulating strategies in final product design and development. It enables enterprises to refine their focus to needs that are critical and satisfying to consumers, thereby producing marketable naturally dyed garments. This approach not only yields better economic benefits for companies but also fosters their green transition and sustainable development. Theoretically, the integration of the KJ Analysis Method and the KANO Model presents a novel solution to the issue of accurately determining the importance of needs in the KANO Model. This combined research method more effectively resolves the issues related to the ambiguous division of consumer demand attributes and the unclear importance of consumer needs specific to naturally dyed garments. It substantially reduces the gap between actual consumer needs and product development concepts, making the design and development of naturally dyed garments more scientific and rational, thereby enhancing consumer acceptance. By categorizing each need attribute based on the weight of satisfaction and dissatisfaction post-fulfillment and summarizing them in charts, this study provides a direct reflection of the importance of consumer needs. This not only offers insights for enhancing the functions of naturally dyed garments but also presents new theoretical methods and references for the design and development of related products.

6.3. Limitations of This Study

This study has certain limitations. Firstly, the consumer research part of this study was based on China, and extrapolating the results to populations in other global regions with different demographic structures may introduce some biases, thus limiting the applicability of the findings. Additionally, the sample size of this study is limited. Future research should consider factors such as region, culture, consumption, and education level to further segment the consumer groups, expand the scope of the survey, and strengthen comprehensive measurement and analysis. This would provide a more holistic empirical reference for the design and development of naturally dyed garments, satisfying a broader market demand. Thirdly, this study only explores the importance of current consumer needs. With the growing global focus on environmental issues and the continuous advancement of standards and policies in the textile and apparel industry in various countries, consumer needs are in a state of constant change and development. This study falls short of addressing this reality, and it also lacks verification of the practicality and feasibility of these needs.

6.4. Future Research Directions

In terms of future prospects, efforts will be made to further refine the questionnaire items related to consumer needs and to increase targeted research on consumer requirements at different stages, such as product development, marketing, and service quality enhancement, in the production of naturally dyed garments. Such efforts are intended to continually improve the credibility and systematization of the KANO questionnaire for the demand of naturally dyed garments. Overall, the development of naturally dyed garments, as a part of sustainable clothing design, possesses multi-dimensional attributes. It requires keeping pace with the times, combining technological advancements with effective consumer satisfaction to achieve sustainable development in this industry.

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