

Article

Chromaticity Analysis on Ethnic Minority Color Landscape Culture in Tibetan Area: A Semantic Differential Approach

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Abstract: The color–area ratio in ethnic minority areas is one way to perceive cultural elements visually. The openness of spaces, sense of rhythm, and richness of color affect people’s emotions and induce different psychological perceptions. Despite many ethnic minority areas being more colorful than the main traits of Han, there is no systematic quantitative study for the color elements in ethnic minority areas’ landscapes, not to mention the research on the color–area ratio, main and auxiliary colors and embellishments, and layouts. Therefore, this paper studies the color–area ratio of Xiangcheng County in the Tibetan area of Ganzi Prefecture in Sichuan Province. Colors are extracted and quantitatively analyzed from six different aspects using the semantic differential (SD) method and color quantitative analysis method. In this way, low-scored (B group) and high-scored (A group) color landscape samples were extracted from the landscape image library and quantitatively analyzed by ColorImpact V4.1.2. The results show that the ethnic minority group’s color layout is characterized by richer colors and stronger contrasts than the Han group. This paper contributes to academic scholarship regarding color culture in ethnic minority areas. It also provides theoretical support for preserving ethnic minority groups’ cultural heritage and practical insights into color planning for urban and landscape designs.

Keywords: semantic differential; color quantification; colorimetry; chromaticity; color–area ratio; public aesthetics; Tibetan areas



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1. Introduction

1.1. The Cultural and Environmental Context of Colorscape

Color is a significant component of urban landscapes. It contains vital information of their history, culture, and perception of aesthetics [1]. It plays an essential role in visual landscapes and affects the emotional perceptions of the nation’s landscapes [2]. National culture and social background influence people’s psychology, aesthetics, and colour characteristics [3,4]. Satio (1996) suggested that cultural, regional, and environmental aspects might influence color preference and formation [5]. Thus, various color landscapes are observed in different ethnic regions with different political systems, cultures, and customs [6]. The characteristics of a color landscape are also affected by the living or/and the natural environment, which influences people’s aesthetic concepts in many ways, such as in local folk customs, and living habits [4].

1.2. The Dilemma of the Color Landscape Development

Today, urban color landscape design has become essential to differentiate or symbolize a city’s characteristics or atmosphere [7]. With the rapid development of urbanization and large-scale urban construction activities, urban color landscapes face a series of problems [8]. First, the traditional color landscape in some cities has been strongly impacted by natural geographic situation, climate, local building materials, ethnic culture and religious

consciousness, social and economic development, and other humanistic environmental factors [9]. Second, the problem of color pollution is prominent in cityscapes, adversely affecting people physically and psychologically, through the use of, for example, bright, solid-color buildings, billboards and lighting clusters [10]. Karim, Paymane, and Alireza (2020) suggested a unifying cityscape in Tehran. Third, colors are similar between cities and the cultural identity of many places is lost [10]. Many modern buildings have similar colors [11], diluting a local culture's characteristics.

1.3. Color Landscape of Ethnic Minority Area in China

Since the 20th century, China's landscape design grounded in its local traditions, culture, and geographic conditions [12]. Traditional ethnic minority landscapes are the carriers of the ancient civilization's artistic style, technological level, and historical information in China in different ethnic minority regions, due to three natural elements (i.e., geography, environment and climate) and three artificial elements (i.e., economy, social culture and customs) ethnic minority's landscapes have distinguished color aesthetic concepts [13]. For China's ethnic minority areas, the color types are richer than other Han regions and have rich cultural and regional connotations. The special color-area ratio in Tibetan areas is reflected in costumes, architecture, and environments, expressing certain local conventions and cultural characteristics. Therefore, the Tibetan color-area ratio is a vital factor in the external space [14] and an important part of the characteristic landscape.

1.4. Research Purpose, Questions, Value, Innovation and Structure

1.4.1. Research Purpose

To preserve the culture and regional characteristics, these color landscapes need to be analyzed in ethnic minority areas in China. The study researches the landscape of Xiangcheng County in Tibetan areas and discusses the technical strategies of color planning in ethnic minority areas. The sample selection, aesthetic evaluation, color quantification processing, and landscape factor inspection are explored from different landscape views using the Semantic Differential (SD) method and color quantitative analysis method. SD allows non-specialists to evaluate the aesthetics of landscape [15]. Then it conducts the quantitative analysis of the colors of the selected excellent and poor samples to obtain the main and auxiliary colors, embellish color layout, and offer suggestions for the color landscape design.

1.4.2. Research Questions

RQ1. *What are the colour layout about ethnic minority color-area ratio features groups of the built environment in the Tibetan area?*

RQ2. *What is the relative importance of color richness, brightness, attraction, sense of rhythm, and spatial openness in the perception of color landscape aesthetics?*

1.4.3. Theoretical and Practical Value

This study integrates theories from landscape design, psychology, cultural studies, and more, offering a new perspective for interdisciplinary research. Employing a methodological approach to studying the color landscapes of minority areas, it provides theoretical support for preserving and transmitting cultural heritage. A systematic color-area ratio quantification model was constructed in this research. Through the model, objective color perception can offer useful information for urban design. The color environment shares historical and cultural information and showcases the city's cultural and artistic characteristics [16]. The research outcomes can be directly applied to urban culture and art research.

The practical significance of the article is that it provides a theoretical to quantify color in a way that translates the laymen's perceptual color understanding into an actionable, data-driven color landscape plan. It provides landscape designers and architects with

the idea of new color–area ratio designs in the Tibetan region. As conservation of these uniquely colored landscapes has the potential to attract more tourists, the results of this research may be used to boost the region’s tourism and subsequent economic development. Furthermore, it can increase public awareness of environmental stewardship by protecting and highlighting the importance of ethnic minority groups’ special landscape colors.

By integrating theoretical with practical concerns, this research demonstrates rigor and cutting-edge qualities in the academic field, as well as importance in practical applications. Its outcomes not only offer useful insights to designers and planners but also provide a significant theoretical and practical foundation for the protection of minority landscape cultural heritage. Moreover, by involving public participation and quantifying emotional cognition, this study pioneers a new direction in landscape design, creating new possibilities for the display of urban culture and art, as well as for creating a healthy color environment conducive to mental and physical well-being.

1.4.4. Innovation

The study focuses on the color landscapes of China’s minority regions, a relatively rare focus in the field of landscape research. The innovative research method that combines traditional color quantitative analysis methods with the semantic differential technique provides a novel methodological approach to color landscape research. Moreover, this research not only focuses on the quantitative analysis of color but also values qualitative human perceptions and emotional responses, making the study more comprehensive.

1.4.5. Research Structure

The rest of this paper is structured as follows: Section 2 presents the conceptual background of color landscape; Section 3 describes the research areas and methods; Section 4 presents data collection and analysis, as well as color–area ratio factor analysis; Section 5 shows the quantitative process of color–area ratio; Section 6 is the discussion; Section 7 is the conclusion; Section 8 presents future research directions.

2. Literature Review

2.1. Color Landscape

2.1.1. Definition of Color Landscape

Color landscape synthesizes artificial decoration, such as buildings, roads, squares, and pavements, and natural colors like mountains, forests, plants, sky, and rivers [17–19]. The composition of a color landscape mainly includes distant and near views [6]. The color landscape affects people’s emotions. Coupled with unique locality and nationality, the color landscape is an important part of the local landscape [20]. Color design is the focus of modern landscape design, and color can impact people’s vision and psychology [16,21]. Some researchers pointed out that the regional and personalized urban landscape can be expressed through controlled color planning and design in the surroundings [22]. The color number, ratio, and layout differences can form varied color–area ratios and convey different emotional tones [14,15]. Human beings obtain 80% of their information through vision, while color is the most sensitive and direct visual information symbol, affecting people’s psychological perceptions [23]. Existing studies rarely quantify landscape colors through image analysis [24]. Wang and Hu (2014) analyzed the components of community landscape colors, the specialty of design, factors influencing community landscape color, and the application of color in residential community landscape design [25]. Lengen (2015) studied the effect of colors, shapes, and boundaries of landscapes on perceptions, emotions based on space and place, and connected light aspects such as color hue, saturation, and brightness, all of which play an essential role in the perception of therapeutic landscape [6]. Cuixia (2018) analyzed the main contents and principles of color design in the landscape, providing a reference for landscape architecture designers [16].

2.1.2. Elements of Color Landscape

(1) Hue (H), Saturation (S) and Brightness (B)

Using color quantitative index HSB data analysis of hue, saturation, and brightness for analyzing landscape color environment has special research significance [4]. It is believed that hue, brightness, saturation of color, and color–area ratio of constituent color can influence color harmony and users’ perception of color design [14]. (1) Hue (H) is used to distinguish different types of colors and determine the characteristics of a color landscape, and is the most easily captured by people’s vision; (2) Saturation (S) is the freshness of the color perception, reflecting the vividness of the city’s colors in the external space, and the purity of a city’s color can fully demonstrate ambiguity and express emotion; (3) Brightness (B) refers to the perceived degree of lightness and darkness of colors, and is key objective in urban color visual design [4,26]. This article uses the HBS as an essential factor to extract color information from photographs for the next step, analysis.

(2) Color–area ratio and layout

This study adopts the color–area ratio, a color design element in product color design [14], to study landscape color. The color ratio refers to the proportional relationship between each part’s length and area in the color combination design [14]. It is produced with the changes in form, position, and space, and plays a decisive role in the overall style and beauty of the color design scheme [27]. Due to the different color ratios, it is possible to create diverse landscape appearances despite using the same color. The proportion of the area occupied by the color greatly influences the effect of color layout in the landscape. Man and Wei (2019) pointed out that a color layout form should match the users’ emotions for product design [15]. All in all, color layout is the spatial arrangement and distribution of colors within a composition, focusing on how colors are positioned relative to each other to achieve visual balance and harmony. In contrast, color ratio pertains to the quantitative relationship between different colors in a composition, emphasizing the proportion of one color to another to create desired visual effects or to convey specific emotions and meanings.

(3) Main color, auxiliary color, and decorative color

The three constituent colors are main color, auxiliary color, and decorative color, occupying about 70%, 25%, and 5% of the surface area of the product, respectively, which is widely adopted in the color design of color–area ratios [14]. The dominant color features determine landscapes’ presentation and visual experience [24]. Urban tones are the overall effect constructed by the three colors and their combined relationships [28], as follows: (1) the primary color is a color that best reflects its cultural and landscape characteristics, which accounts for more than 70% of the ratio, and it has a certain degree of stability and sense of inheritance; (2) the colors that account for more than 20% and less than 70% can be summarized as the city’s auxiliary colors, which play a role in color transition and coordination, and are determined by the color co-frequency rule in color design; and (3) the colors that account for less than 5% can be summarized as urban decorative tones, playing a role in highlighting themes.

2.1.3. Psychological Perception Elements of Color Landscape

Jonauskaite, Tremea and et al. (2020) made full use of the emotional characteristics of color for color therapy and human psychology, and rationally arranging the surrounding environment, which can effectively improve the impact of drug treatments [29]. In today’s era of economic globalization, Man and Wei (2019) believed that when similar products’ functions, structure, and production technology have no significant gap, their design and aesthetics must rely on the differentiation of form and color to differentiate them in the market [15]. If a research product wants to gain a foothold in the international market, it is necessary to understand the national culture of the country that the product is sold in and

master its color psychology [30]. Color can express emotions intuitively, conveniently, and can directly affect people's psychology and emotions.

In addition to the importance of color to the urban landscape, color recognition is also critical. Frank Mahnke, Chairman of the International Association of Color Consultants, pointed out that seeing colors is not a simple visual process but a complex experience process [31]. It can be expressed as a physiological reaction, subconsciousness, association, cultural influence, fashion influence, and self-experience (Figure 1). From the bottom to the top of Figure 1, is the order in which color directly affects emotions and physical states (a physiological reaction); subtly affects psychology (subconsciousness); triggers specific things or emotional associations (association). Different cultures have different interpretations of colors (cultural influence). These are affected by fashion trends (fashion influence), and reflect personal preferences, personality and identity (self-experience). From the elementary to advance pyramid series, we can grasp the context that affects people's color and psychology, from physiology to psychology via the process of cultural influence. Regarding the colors: (1) white often symbolizes purity and sanctity and is commonly seen in religious buildings and ceremonies. Studying the use of white can offer deeper insights into Tibetan religious beliefs and cultural values; (2) Red brown, a color frequently found in Tibetan architecture and artifacts, is typically associated with the earth and stability, aids in understanding Tibetan lifestyles and artistic expression. (3) Yellow in Tibetan culture is associated with authority and nobility, especially in Buddhism. Studying the distribution of yellow can reveal aspects of religious and social structures. (4) Black and grey are often linked with winter, resilience, and survival challenges. Researching these colors can help others to understand how Tibetans express their relationship with the natural environment through color, etc. [15,30].

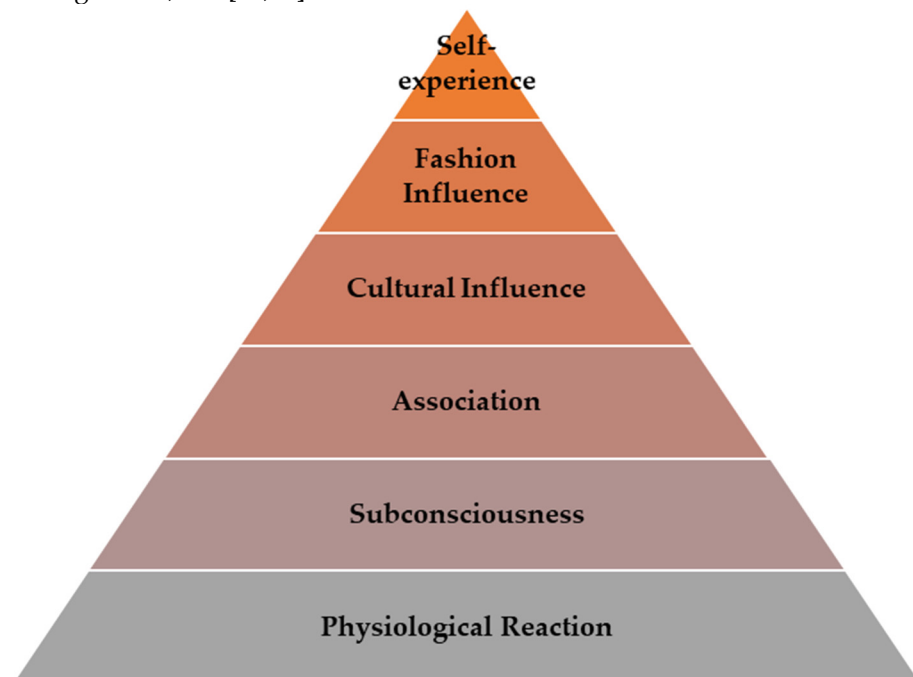


Figure 1. The process of color experience.

2.1.4. Color Quantitative Analysis Method

The color landscape can be categorized in cities and blocks, down to the building materials' details, and there is rich color information. The recording and research of this color information generally fall into qualitative and quantitative categories. Lenggen (2015) studied the effect of colors, shapes and boundaries of landscapes on emotion perception by in-depth qualitative interviews [6]. The progressive development of contemporary digital technology in software and hardware has assisted landscape research in transforming from qualitative descriptions of color to quantitative instrumental data [4]. Tan (2021) proposed

an automatic extraction method for color features from landscape images based on image processing through experiments [24]. Shen, Yao and Li (2021) quantitatively evaluated the color harmony and suitability degree of the plant community and external environment according to the Moon–Spencer (M-S) color harmony theory [2]. Cheng and Tan (2018) used the quantitative analysis of the color of the Ming Dynasty City Wall in Nanjing as a case study [4]. The study of Zhu, Zhang, Lan and et al. (2020) used Xunpu Village in southern Fujian as an example with which to conduct a quantitative analysis of color features and a qualitative evaluation of public perception [20]. Zhang, Chen et al. (2020) assessed the aesthetic quality of autumn landscape forest using scenic beauty estimation and analyzed the effects of color characteristics on ornamental value of autumn landscape forests based on color composition and color spatial pattern according to human visual characteristics [32]. There are many methods to describe color quantitatively and qualitatively, such as the hue, value, and chroma (HVC) model of the Munsell color system; the red, green and blue (RGB) model of the ratio of the 3-element color light; the hue, saturation, brightness (HSB) model using human eyes as the detector; the cyan, magenta, yellow, key (CMYK) model based on the mixture ratio of inks; and the Commission Internationale de l'Éclairage (CIE) color system described by pure mathematical models, etc., [4].

How to reasonably quantify and create rich color landscapes to achieve the best visual perception of the color landscape at different visual scales to meet the aesthetic needs of the public better based on culture and regional context has become a challenging issue of the landscape color design and application in ethnic minority areas. There are no studies on color landscape/color-area ratios in an ethnic minority in China. Therefore, the aim of this paper was analyze HSB, color area ratio, primary and secondary colors, and embellishment color landscape modes in ethnic minority areas. The study focuses on the color landscapes of minority regions in China, particularly the landscapes of Xiangcheng County in the Tibetan region.

2.2. SD Method

Semantic differential (SD) analysis was used to evaluate the characteristics of landscape aesthetics [33]. The SD, also known as the feeling record method, was proposed to measure psychological feelings in psychophysics [34]. The SD method uses the subject's psychological perception of language scale as the basis for evaluation and constructs quantitative data through the subject's psychological and physical perception factors [35]. In the SD method, it is necessary to design an evaluation that can objectively describe things and expand pairs of adjectives and antonyms. Some researchers studied color design by obtaining the user's color image perception based on semantic difference (SD) analysis [15]. The evaluation of landscape aesthetic quality is a crucial step in managing color landscapes [32]. In China, color is essential to distinguished ethnic minority landscapes, such as the Tibetan area of Ganzi Prefecture in Sichuan Province. Utilizing the semantic differential (SD) method, this study incorporates public aesthetic judgment into academic research, offering a new democratic path in landscape studies. Based on the color composition, color space pattern, and the SD method, it assessed the aesthetic quality. It analyzed the impact of color on the landscape values of ethnic minority areas.

The article uses the SD method to analyze the characteristics of landscape aesthetics in public spaces. It then extracts the high-quality and low-quality samples to be quantified by HSB, color ratio, and color layouts. The results of the high-quality groups can be used as typical samples for color landscape.

3. Research Area and Methods

3.1. Research Location

Xiangcheng County is in the Ganzi Tibetan Autonomous Prefecture in the West of Sichuan Province. It is located on the southwestern edge of the Qinghai–Tibet Plateau, in the north-central section of the Hengduan Mountains, spanning the 99°22'~100°04' east longitude and 28°34'~29°39' north latitude. It borders Daocheng to the east, Litang to the

north, Batang and Derong counties to the west, and Shangri-La City, Yunnan to the south. The name is derived from the local terrain. The Chinese translation of the Tibetan word “Kashen” means the ‘Buddhist beads in hand’. Xiangcheng County has a history of more than 2100 years. It is a national historical and cultural city and a famous tourist city. It is rich in historical and cultural relics. The magnificent mountain scenery and the Liujiang River form the most colorful urban landscape in Xiangcheng County [36].

3.2. Color Culture of the Study Areas

According to the people’s government of Xiangcheng (<http://www.xcx.gov.cn>, accessed on 5 May 2023), the local cultural context is related to the colors in Xiangcheng. The “Three Wonders in Xiangcheng County” are the Fengzhuang, Baizangfang and Sangpiling Temples. First, Fengzhuang is a traditional dress worn by Xiangcheng Tibetan women. The rich color is its main feature, showing the unique ethnic culture of Xiangcheng, with colors such as red, yellow, green, black, and gold on the left and right breasts, representing the good life, land, prophets, livestock, and wealth. Second, as one of the significant architectural landscapes, the Baizangfang is the most popular type of architecture in Xiangcheng. It is characterized by white exterior walls, flat roofs, and wooden window frames, a design that accommodates the unique climatic conditions of the high-altitude region. In terms of color application, the primary use of white for the external walls contrasts with the blue and red of window frames and decorations. This color scheme reflects the aesthetic preferences inherent in Tibetan culture. The Baizangfang’s white color is prominent in the natural environment. This vibrant hue has now become an integral part of the landscape, serving as a vital decoration. Its sacred and pure colors harmoniously blend to create a unique Tibetan scenery that is enriched with ethnic culture, adding depth and beauty to the surroundings. Third, Sangpiling Temple is one of the largest Gelug temples in Eastern Tibet and has a lofty status in Xiangcheng. The religious beliefs of the Tibetans affect the architectural colors. Ascending in a majestic sequence, the colors adorning the main building facade are arranged from top to bottom: golden, red, white, and black. Each hue symbolizes a profound meaning, representing loftiness, holiness, and unwavering faith. These sacred colors are held in utmost reverence by both monks and fervent believers, embodying their deep respect and profound devotion. Diverging from the conventional composition of residential buildings, the facade of this structure distinguishes itself with a trio of colors: red, white, and black. These colors artfully combine to form a three-part facade, imbuing the building with a unique visual appeal. Notably, the expansive white walls command attention, drawing the eye with their prominence. The infusion of a warm brown-red hue serves to invigorate the spirits of worshippers, fostering an atmosphere conducive to reverence. The colors of the “Three Wonders in Xiangcheng County” mirror the distinctive Tibetan landscape, convey profound national beliefs, and offer spiritual nourishment.

3.3. Sample Collection and Research Method

The research methods employed in this study center around the chromaticity measurement of images [37]. These methods enable precise and calibrated assessment of the visual attributes of samples. This research uses meticulous data analysis to extract the color spectrum that aligns with the traditional hues found in landscapes associated with ethnic minority groups. Researchers make field observations, photographs, and video recordings of landscape elements such as buildings, mountains, water bodies, vegetation, etc., extract image and image color information (removal of color deviations caused by weather, light, cameras, and other related factors), establish a color database for observation points, and analyze and summarize database information. Then, the current color database can be summarized to objectively reflect Xiangcheng County.

The landscapes in the research were classified into landscape aerial view, residential buildings, religious buildings, streets, farmland, and local materials [38–40]. Moreover, the landscape was segmented into three categories according to the distance of sight: distant view, middle view, and nearby view [41,42]. The distant view type is mainly an aerial view;

the middle view type includes residential and temple buildings, streets, and farmlands; and the nearby view type mainly includes the local material details of landscape architecture (Table 1).

Table 1. Sample classification and selection basis.

Landscape View	Color Landscape Elements	Basis and Key Points for Sample Selection in Xiangcheng	Sources
Distant view	Aerial View	<p>Large-area color landscape data are selected from commanding heights in the core area of Xiangcheng by a bird's-eye view to collect: S1 and S2.</p> <ul style="list-style-type: none"> The aerial view shows the terrain and natural colors, such as the farmland's green contrasting with the Baizangfang's white. It can reflect the connection between Tibetan culture and the natural environment. From a high altitude, one can see how buildings and farmland blend harmoniously with the natural landscape. 	A bird's-eye view can provide a color layout of the main study area [43–45]. It can also observe the overall harmony and contrast of colors in natural and man-made environments—for example, the color boundaries between urban and natural areas [46].
Middle view	Architecture	<p>The local representative residential buildings and temples are selected, almost designed and constructed by local people: S3, S4, S5.</p> <ul style="list-style-type: none"> Baizangfang is a unique residential architectural form of the Garze Tibetan people. Its white exterior walls and wooden frame reflect Tibetan living habits and aesthetics. Religious buildings such as the Sangpiling Temple use traditional red and golden colors. Temples' architectural style and decorative details are important for studying Tibetan cultural identity and religious beliefs. 	Architecture is an integral part of the urban/rural landscape, and architectural color becomes the protagonist of urban/rural color [47,48]. It sometimes even determines the color construction of the entire city/countryside [49].
	Street	<p>This study selected streets with core landscape nodes: S6, S7, and S8.</p> <ul style="list-style-type: none"> Bright colored shops and religious symbols, such as prayer flags and colorful flags, are common on streets in Xiangcheng, reflecting Tibetan religious and daily life. The use of color on the street is an expression of visual aesthetics and a reflection of community cohesion and cultural heritage. 	Streets are landscape corridors and important activity spaces in cities, and their color analysis helps to understand the vitality and functionality of cities and rural areas [50,51]. This analysis includes pavement materials, street trees, street buildings, and other elements [52].
	Farmland	<p>This study selected angles that can reflect the overall farmland layout and detailed characteristics of the crop landscape: S9, S10, and S11.</p> <ul style="list-style-type: none"> Farmland color shows a harmonious integration with the natural environment. For example, the color of crops forms a visual coordination with the surrounding sky, mountains and other natural landscapes. Farmland layouts often follow traditional terrain utilization, demonstrating the relationship between topography and water sources. 	The changing colors of farmlands reflect the changing seasons and the type of agricultural activity [53].

Table 1. Cont.

Landscape View	Color Landscape Elements	Basis and Key Points for Sample Selection in Xiangcheng	Sources
Nearby view	Local Materials	<p>Materials such as landscape retaining walls, building walls, painted wooden beams, and carved door lintels are selected: S12, S13, and S14.</p> <ul style="list-style-type: none">• The natural materials used in Tibetan architecture and landscapes, such as stone, wood, etc., their natural colors and processed colors demonstrate Tibetan environmental adaptability and aesthetics.• These materials maintain their natural color and texture.	The natural and processed colors of materials (such as stone, wood, metal, etc.) used in architecture and landscape design directly affect the color effect of the overall landscape [54,55].

Note: The above sample collection basis and key points come from the People’s Government of Xiangcheng (<http://www.xcx.gov.cn>, accessed on 15 April 2024).

From 6 different landscape perspectives, a total of 14 color–area ratio samples were selected from landscape research area and numbered S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13, and S14, respectively (Table 2). The selection process was conducted by interviewing three landscape design specialists who research color landscape design and cultural heritage protection. The sample comprised 58 pictures, among which 14 samples were selected.

Table 2. Selected samples.















Type	No.	Sample Photographs	Type	No.	Sample Photographs
Aerial View	S1		Street	S8	
	S2		Farmland	S9	
Residential architecture	S3			S10	

Table 2. Cont.

Type	No.	Sample Photographs	Type	No.	Sample Photographs
Residential architecture	S4			S11	
Religious architecture	S5		Local Materials	S12	
Street	S6			S13	
	S7			S14	

Note: The research samples were collected via key landscape nodes in the main local tourist routes, and the landscape samples were collected based on the basis listed in Table 1.

4. Color–Area Ratio Factor Analysis

4.1. SD Factor Analysis

4.1.1. Selection of SD Evaluation Factors

Fourteen landscape samples (S1 to S14) were used for the analysis. Respondents scored each of these from -2 to 2 . The results were then tabulated and calculated to obtain their average values. Those average values were plotted into an SD graphic and analyzed by factor analysis. This factor analysis was used to reduce landscape characteristic variables. This analysis found six factor (X_1 to X_6) variables, presented in Table 3, including the set of color landscape aesthetic characteristics [56]. This research project collected adjective pairs when designing the evaluation scale and constructing the questionnaire, understanding the SD method's specific meaning, and referring to the SD method in landscape color, artistic color, architecture, and gardens. The word pairs used above, combined with SPSS for principal component analysis, finally adopted six groups of adjective pairs; that is, six common factors from X_1 to X_6 were screened out (Table 3). The six common factors formed two groups: (1) the physical perception of human vision—spatial openness, sense of rhythm, color richness; and (2) psychological perception—attractiveness, shading and aesthetic degree.

Table 3. SD factor adjective pairs.

No.	SD Evaluation Factor	SD Evaluation Adjective Pair
X ₁	Spatial openness	Open-----Closed
X ₂	Sense of rhythm	Strong-----Weak
X ₃	Color richness	Colorful-----Monotonous
X ₄	Attraction	Attractive-----Unattractive
X ₅	Color brightness	Bright-----Dark
X ₆	Aesthetic degree	Aesthetic-----Not aesthetic

Xiangcheng’s landscape and urban color–area ratio samples in the original state decide the SD evaluation factors. These factors comprise spatial openness (X₁), sense of rhythm (X₂), and color richness (X₃); psychological perception includes attraction (X₄), color brightness (X₅), and aesthetic degree (X₆). A total of six pairs of adjectives were constructed according to the Tibetan characteristics of Xiangcheng’s landscapes, (1) “Open” and “Closed” were used to describe spatial openness (X₁); (2) “Strong” and “Weak” were used to describe the sense of rhythm (X₂); (3) “Colorful” and “Monotonous” were used to describe color richness (X₃); (4) “Attractive” and “Unattractive” were used to describe psychological perceptions, including attraction (X₄); (5) “Bright” and “Dark” were used to describe color brightness (X₅); (6) and “Aesthetic” and “Not aesthetic” were used to describe aesthetic degree (X₆). (Table 3).

4.1.2. Evaluation Scale and Questionnaire Design

The evaluation scale was based on the “bi-polar” principle to facilitate quantitative statistical analysis. Generally, the evaluation scale of adjective pairs is divided into 5–7 levels to conduct quantitative statistics [57,58]. To increase the accuracy and convenience of the evaluation, this paper set the evaluation scale at five levels to carry out the questionnaire design and quantitative statistics [14]. The 5-level evaluation scale was set to symmetrical: 2, 1, 0, −1, −2, as shown in Table 4. Among all 18 questions, 14 used the five-level scale to score 14 figure samples from S1 to S14, as shown in Tables 2 and 4.

Table 4. Evaluation scale and questionnaire design.

No.	Right Adjective Pair	Very Poor −2	Poor −1	Average 0	Good 1	Very Good 2	Left Adjective Pair
1	Open						Closed
2	Strong						Weak
3	Colorful						Monotonous
4	Attractive						Unattractive
5	Bright						Dark
6	Aesthetic						Not aesthetic

4.1.3. Subject Selection and Questionnaire Survey

To improve the accuracy of the research results, this research conducted questionnaire surveys on gender, occupation, age, scope, and number of subjects. Using purposeful sampling methods, this survey study included 274 professionals in the landscape design industry and non-professionals in the non-landscape sector, accounting for 30% and 70% of the total subjects, respectively. Table 5 reveals that there were more women than men and most were between 18 and 29 years old (73.36%). The survey sample mainly were from students major in landscape and related subjects (23.72%) and students of other majors (35.04%) with Bachelor’s degrees (72.63%).

Table 5. Data analysis of Samples.

Item	Classification	Number of People	Percentage
Gender	Male	97	35.40%
	Female	177	64.60%
Age	12–17 Years Old	4	1.46%
	18–29 Years Old	201	73.36%
	30–45 Years Old	40	14.60%
	45–59 Years Old	25	9.12%
	Over 60 Years Old	4	1.46%
Degree	Primary School	1	0.36%
	Junior Middle School	7	2.55%
	Junior High School	16	5.84%
	Bachelor	199	72.63%
	Master	45	16.42%
	Ph.D.	6	2.19%
Work	Landscape And Related Fields Work	29	10.58%
	Other Areas Of Work	44	16.06%
	Students Majoring In Landscape And Related Majors	65	23.72%
	Students Of Other Majors	96	35.04%
	Unemployment	4	1.46%
	Retiree	6	2.19%
	Others	30	10.95%

4.1.4. Average Analysis

The questionnaire was analyzed, and the scale evaluation data of each sample from S1 to S4 were extracted using the SPSS 22.0 software. The data of the six evaluation factors of spatial openness (X_1), sense of rhythm (X_2), color richness (X_3), attraction (X_4), color brightness (X_5), and aesthetic degree (X_6) were averaged and weighted via SPSS 22.0 to obtain a sample statistics table (Table 6). The sample of S5 (weighted value 1.098) represents the characteristic religious buildings in rural areas, and the sample of S13 (weighted value 0.425) represents the details of landscape materials. Among the various evaluation indicators, spatial openness (X_1) is the highest (S10, 1.29); the lowest is (S14, 0.09); the sense of rhythm (X_2) is the highest (S4, 1.13), the lowest is (S1, 0.20); the highest color richness value is S5 (1.21), the lowest is (S1, 0.02); the most attractive is (S14, 1.1.0), the lowest is (S1, 0.22); the color brightness (X_5) is the highest is (S14, 1.17), the lowest is (S10, 0.54); the highest aesthetic is (S13, 1.17), and the lowest is (S8, 0.33). It can be concluded that: among all the samples, S10 makes the public feel the most open and spatial; S4 gives the most comfortable rhythm of landscape; S5 consists of the most kinds of colors; S14 is the most attractive among them; S14 makes the public experience brightest landscape; and S13 is the most aesthetic landscape. The final comparison of the weighted scores from high to low is: S5 > S3 > S14 > S6 > S9 > S12 > S4 > S7 > S11 > S10 > S2 > S8 > S1 > S13. Therefore, the results show that the evaluator's sense of identity with the landscape samples gradually weakens from S5 to S13.

Table 6. SD method analysis results of Xiangcheng's color-area ratio.

		X_1	X_2	X_3	X_4	X_5	X_6	Weighted Value
		Spatial Openness	Sense of Rhythm	Color Richness	Attraction	Color Brightness	Aesthetic Degree	
Sample Statistics	S ₁	1.13	0.20	0.02	0.22	0.68	0.39	0.449
	S ₂	1.09	0.30	0.12	0.27	0.70	0.39	0.490
	S ₃	0.85	0.95	1.20	1.08	1.21	1.17	1.092
	S ₄	0.87	1.13	0.66	0.44	0.85	0.67	0.766
	S ₅	1.04	1.06	1.21	1.05	1.07	1.02	1.098

Table 6. Cont.

		X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	Weighted Value
		Spatial Openness	Sense of Rhythm	Color Richness	Attraction	Color Brightness	Aesthetic Degree	
Sample Statistics	S ₆	0.66	0.75	1.32	0.92	0.98	0.94	0.985
	S ₇	0.83	0.49	0.74	0.72	0.87	0.78	0.761
	S ₈	0.70	0.45	0.23	0.35	0.76	0.33	0.474
	S ₉	1.27	0.76	0.66	0.73	1.02	0.76	0.881
	S ₁₀	1.29	0.42	0.32	0.57	0.54	0.65	0.626
	S ₁₁	0.94	0.64	0.57	0.52	0.78	0.58	0.689
	S ₁₂	0.78	0.62	0.72	0.67	1.00	0.75	0.776
	S ₁₃	0.55	0.37	0.25	0.29	0.65	0.44	0.425
	S ₁₄	0.09	1.01	1.43	1.10	1.17	1.13	1.005
Average		0.86	0.65	0.68	0.64	0.88	0.71	0.715

4.2. Data and Analysis

4.2.1. Kaiser–Meyer–Olkin (KMO) and Bartlett’s Test

Kaiser–Meyer–Olkin (KMO), Bartlett’s sphericity test, and factor analysis for dimensionality reduction ensures that the evaluation factors have high correlation and low overlap [15]. The questionnaire data were imported into the SPSS22.0 to perform KMO and Bartlett sphere detection using factor analysis (Table 7). The KMO value was $0.781 > 0.5$, and the significance of Bartlett’s sphericity test (Sig) was $0.000 < 0.05$, indicating good validity of the questionnaire setting and strong SD factor correlation. Therefore, factor analysis for dimensionality reduction could be performed to analyze data.

Table 7. KMO and Bartlett’s test.

KMO Sampling Suitability Quantity		0.781
Bartlett Sphericity Test	Approximate chi-square	228.289
	Degree of freedom (DF)	15
	Significance (sig)	0.000

4.2.2. SD Factor Analysis

The total variance explanation was obtained by the factor analysis for dimensionality reduction using SPSS 22.0 software, showing that just one factor can be chosen as the common factor, and the common factor can evaluate 76.9% of the internal relationship of color–area ratio quantification (Table 8). Therefore, when the number of landscape factors is small, and the independence of a few factors is high, these factors can also reflect the validity of quantification of the original data of color–area ratio factors in ethnic minority areas.

Table 8. Total variance explanation.

	Initial Eigenvalue			Extract the Sum of Squares of the Load		
	Total	Variance%	Total %	Total	Variance%	Total %
1	4.616	76.934	76.934	4.616	76.934	76.934
2	0.847	14.122	91.056			
3	0.318	5.304	96.359			
4	0.170	2.830	99.189			
5	0.031	0.521	99.710			
6	0.017	0.290	100.000			

The correlation matrix of color–area ratio evaluation factors (Table 9) can intuitively reflect the correlation between various color–area ratio factors and show that human vision and landscape interaction will change psychological perception. Therefore, colors are related to a person’s psychological feelings. While color gives people a sense of beauty, it also affects people’s psychological activities in many ways. Color psychological feelings can be generated from direct visual stimuli or obtained through simple associations and symbols. In short, it unconsciously influences people’s emotions, thoughts, and behaviors [6]. The X_1 in the SD factor is low, with a low load. Therefore, X_1 has a relatively weak relationship with X_2 , X_3 , X_4 , X_5 , and X_6 , showing that the effect of spatial openness on the evaluation of color visual perception and psychological perception is weak.

Table 9. Factor correlation matrix.

	Spatial Openness	Sense of Rhythm	Color Richness	Attraction	Color Brightness	Aesthetic Degree
X_1	1.000	−0.289	−0.472	−0.312	−0.390	−0.316
X_2	−0.289	1.000	0.815	0.736	0.772	0.779
X_3	−0.472	0.815	1.000	0.953	0.873	0.951
X_4	−0.312	0.736	0.953	1.000	0.863	0.976
X_5	−0.390	0.772	0.873	0.863	1.000	0.863
X_6	−0.316	0.779	0.951	0.976	0.863	1.000

4.2.3. Establishment of Evaluation Model

According to the above analysis, a common factor was extracted from the cumulative contribution rate of the variance of each color–area ratio evaluation factor, and the proportion of the total variance contribution rate of the common factor was used as the weight for a weighted summary:

- (1) Standardized value of landscape evaluation factor: $F1 = \sqrt{Xi * 76.934}$
- (2) Comprehensive landscape evaluation factor $F = 76.934 \times F1 / 76.934$

Table 10 shows that the SD evaluation factors, including space openness, sense of rhythm, color richness, attraction, color brightness, and aesthetic degree, can significantly impact the color–area ratio evaluation in Xiangcheng. Among the six SD factors, color richness has the highest score and has the most significant impact on color evaluation. Secondly, spatial openness has the lowest impact factor on color evaluation. These factors reflect a unique Tibetan cultural style and the unique colour artistic value of the colour–area ratio in Xiangcheng. Compared with the sense of rhythm, color richness, attractiveness, brightness, and aesthetics, the evaluation score of spatial openness is low, and the gap is large. The results show that spatial openness did not receive much attention when evaluating the landscape. In addition, the evaluators are more concerned about color richness than spatial openness. Thus, color plays a vital role in landscape design; color richness is the most important influencing factor to impact color landscape based on public aesthetics evaluation. According to the results, it is necessary to analyze the color characteristics quantitatively.

Table 10. Factor score coefficient and ranking.

X_i	X (Factor Score)	F (Overall Score)	Ranking
(X_1)	0.100	0.2300	6
(X_2)	0.186	0.596	5
(X_3)	0.213	0.713	1
(X_4)	0.207	0.607	3
(X_5)	0.209	0.609	2
(X_6)	0.201	0.601	4

5. Color Quantitative Analysis

The color–area ratio quantification method uses Photoshop, ColorImpact, etc., to objectively analyze HSB color and RGB values in the landscape, which differs from subjective judgment through the perception of human vision [59]. Data obtained from the color quantification samples were screened and classified to obtain typical samples. Color–area ratio quantitative data, such as hue (H), saturation (S), brightness (B), etc., were analyzed to obtain the quantitative standard of the color–area ratio in Xiangcheng.

5.1. Color–Area Ratio

Three samples were imported into Photoshop to pixelize them. The sample pixel file, as the value according to the pixel square 100 unit, was rasterized, and the digitized image was extracted. Finally, the digitized image was imported into ColorImpact V4.1.2. The distribution range of each color was highlighted, and the proportions of its color areas were quantified (Table 11).

Table 11. The distribution range of each color HSB.

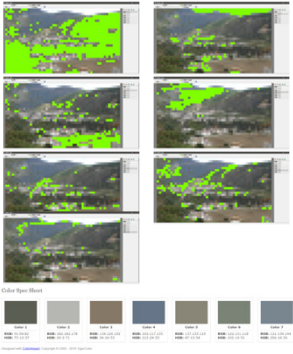
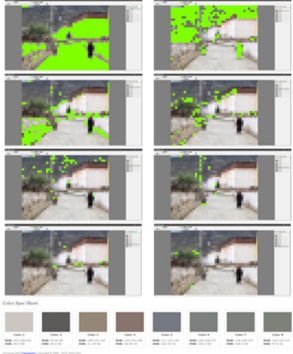
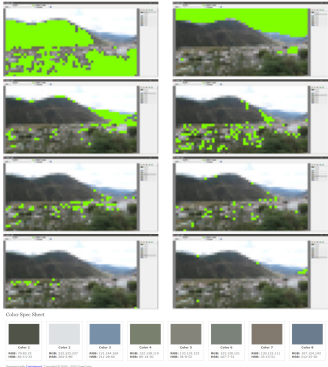
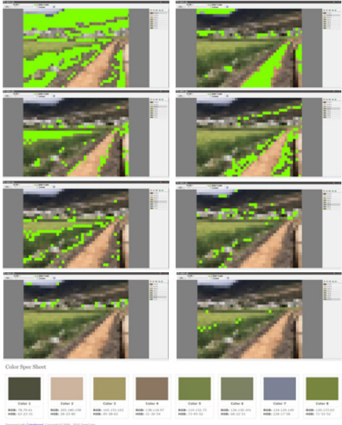
Type	No.	Samples	Type	No.	Samples
Aerial View	S1		Street	S8	
	S2		Farmland	S9	

Table 11. Cont.

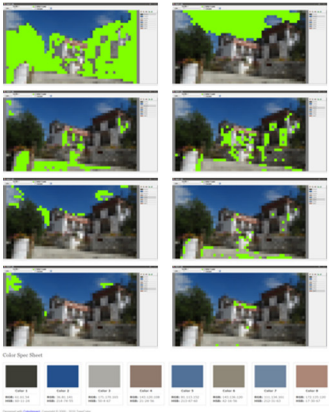
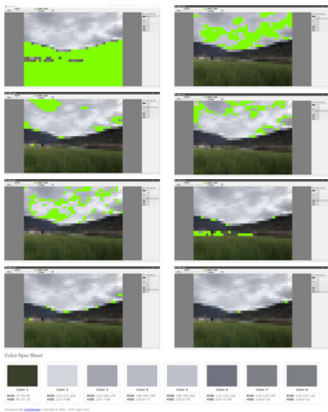
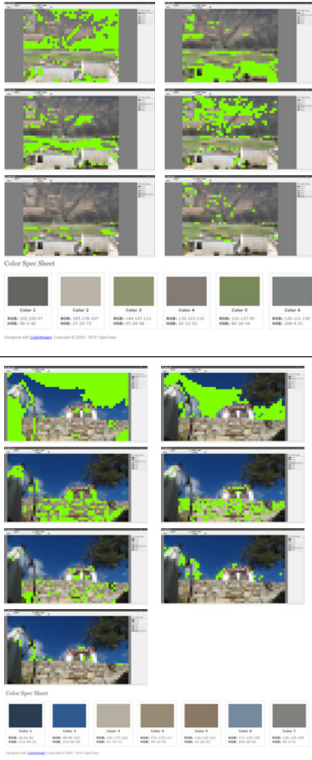
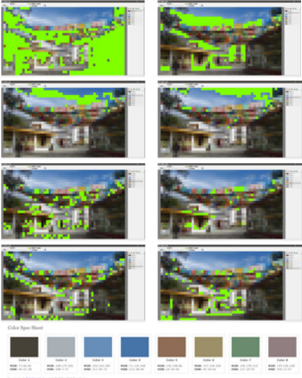
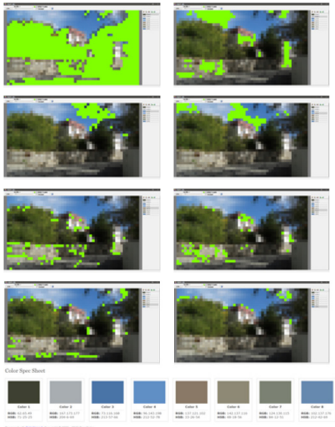
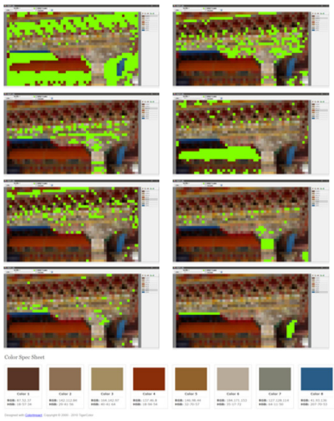
Type	No.	Samples	Type	No.	Samples
Residential architectures	S3		Farmland	S10	
Religious Architectures	S5		Materials	S12	
Street	S6			S13	

Table 11. Cont.

Type	No.	Samples	Type	No.	Samples
Street	S7		Materials	S14	

5.2. Analysis of Main and Auxiliary Colors and Embellishments

According to the evaluation value obtained by the SD method, the top five samples with high aesthetic degrees (S5, S3, S14, S6, and S9) were classified as group A, and the last five samples with low aesthetic degrees (S10, S2, S8, S1, and S13) were classified as group B. Color quantitative analysis was performed on the two groups of samples using ColorImpact based on the color HSB information from Table 11. All sample color modes were set as 32 colors to ensure the unity of the quantitative analysis and color balance.

A comparison of Tables 12 and 13 shows that group A’s main and auxiliary colors are prominent. Group A is mainly composed of white, reddish brown, yellow, black, and natural colors such as mountain green and sky blue as the main, and auxiliary colors with yellow, red, green, black, and blue in the same color tones as embellishments that represent the theme of the color landscape. Therefore, the whole picture is rich in color without affecting the expression of the overall tone. In contrast, the color distribution in Group B is more balanced between the main and auxiliary colors. The main color in Group B does not stand out as a dominant single hue, resulting in a more subtle and uniform color composition. Additionally, the embellishment colors used in Group B are more monotonous and less varied when compared to the diverse palette employed in Group A.

Table 12. Color quantitative analysis of the samples in group A.









No.	Samples	Main and Auxiliary Colors	Embellishments
S ₅			
S ₃			
S ₁₄			No

Table 12. Cont.


















No.	Samples	Main and Auxiliary Colors	Embellishments
S ₆			
S ₉			No

Table 13. Color quantitative analysis of samples in group B.

No.	Samples	Main and Auxiliary Colors	Embellishments
S ₁₀			No
S ₂			No
S ₈			
S ₁			No
S ₁₃			

5.3. Color Layout

According to the color layout analysis of the samples in groups A and B, the influence of the color layout on the aesthetic evaluation was obtained (Tables 14 and 15). The color layout of group A has the characteristics of rich colors, strong contrast, and coordinated pictures, reflecting the characteristics of Xiangcheng's color-area ratio. The color layout of group B is monotonous, and the contrast is not apparent. Although the color tone in

group B is uniform, the color richness is weak and cannot reflect the characteristics of Xiangcheng's color–area ratio. Therefore, color richness and coordination in the picture are essential for the color layout, which can affect the aesthetic degree.

Table 14. Group A color layout.








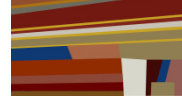












No.	S ₅	S ₃	S ₁₄	S ₆	S ₉
Samples					
Color layout					
Single analysis	48% Gray, 10% white, and 22% green make up the main area of the picture, occupying a balanced proportion, and the picture is coordinated. The 18% reddish brown and 2% yellow of the building reflect the characteristics of ethnic temples.	34% Blue and 18% white occupy the main area of the picture, and the facade of the building is decorated in many colors and rich in colors, reflecting the ethnic color.	The colors are rich, reflecting the ethnic characteristics of rural areas.	The prayer flags' colour is the most direct embodiment of the ethnic color, and the picture is coordinated.	The colors of the fields, paths, and mountains, and buildings are in strong contrast.
Overall analysis	The pictures in the color layout of group A have rich colors, strong contrast, and coordinated pictures, which can reflect the color characteristics of Xiangcheng's landscape.				

Table 15. Group B color layout.

No.	S ₁₀	S ₂	S ₈	S ₁	S ₁₃
Samples					
Color layout					
Single analysis	The picture is coordinated, but the color is monotonous, without the unique color of Xiangcheng, and cannot reflect the ethnic characteristics.	The green in the foreground occludes the white of the building, causing the space to be fragmented and the color monotonous.	White takes up a large proportion, and the color is monotonous.	The environmental color ratio is too large, and the main color is not prominent.	Blue and white are in contrast, the contrast is strong, but the color is monotonous and cannot reflect ethnic characteristics.
Overall analysis	The color layout of group B is monotonous, and the contrast is not apparent. Although the color tone is uniform, it does not reflect Xiangcheng's characteristics.				

6. Discussion

6.1. *Colorscape's Quantitative Model Should Be Coordinated and Unified with the Environment*

The quantitative expression of Xiangcheng's landscape color is a research process based on a comprehensive interpretation of the objective laws of the color characteristics of static viewing environments. The use of analysis software to objectively and rationally analyze the HSB measurement thresholds of the color effects of spatial elements. It is different from the subjective judgment of color that relies on human eye function and perceptual cognition. The color average quantitative data obtained in the study are typical representative data extracted after classifying and filtering the data. From the qualitative and quantitative research process and methods of the color effects of Ming city walls [4], it can be seen that the selection of sample sheets and quadrats in this study can fully represent the color composition characteristics of Xiangcheng and the presentation of color visual effects under ideal outdoor viewing conditions. Xiangcheng's color data, obtained through quantitative data analysis of hue, saturation, and brightness (HSB), can be used as the basis for color planning and in the design of rural and urban landscapes.

Furthermore, the results of the study indicated that colors should be coordinated and unified with the environment. Local materials and plants should be fully utilized as much as possible to coordinate the landscape and the original environment of the area. The interrelationship between color–area ratios also determines the effect of the color–area ratio. Using and processing the law of unity and change between colors correctly can create a rich color change effect in a significant positive relationship.

6.2. *The Quantitative Influences of Landscape Color Evaluation Factors*

The quantitative influences of various landscape color evaluation factors on the landscape color in Tibetan areas are as follows: color richness (X3) > color brightness (X5) > attraction (X4) > aesthetic degree (X6) > sense of rhythm (X2) > spatial openness (X1). Among these factors, color richness and color brightness, which rank as the top two, are more intuitive for color expression and stimulate vision more easily. Therefore, the more attention paid to the color richness and color brightness by people, the more popular the landscape, indicating that the richness and brightness of colors are vital in color–area ratio design. The factors of color brightness, attraction, and aesthetic degree, which are partial to the psychological perception of landscape color descriptions, have received less attention than color richness. However, these factors are also important for design expressions in landscape color moods. The sense of rhythm ranks fifth among these six factors. Color spatial openness has received the lowest attention, indicating no absolute relationship between the color–area ratio design and spatial openness. Therefore, the intuitive visual expression of color, psychological emotion, and artistic conception is indispensable in color–area ratio planning and design.

6.3. *The Different Color Landscapes with Specific Color Layouts*

The component characteristics of the color landscape are rich in color without affecting the expression of the overall tone in Xiangcheng. At the same time, the color landscape design in Xiangcheng is mainly composed of white, reddish brown, yellow, black, and natural colors, such as mountain green and sky blue, as the main and auxiliary colors with yellow, red, green, black, and blue in the same color tones as embellishments. Most of the embellishments are colors with cultural contexts in Xiangcheng. The color landscape in the color layout should have rich colors, strong contrast, and a coordinated color ratio that can reflect the color characteristics of Xiangcheng's landscape. The results from Section 5.3, Tables 14 and 15, show different color landscapes with specific quantitative color layouts.

(1) For religious architecture design, 48% Gray, 10% white, and 22% green occupy a balanced proportion, and the color landscape is coordinated. At the same time, the 18% reddish brown and 2% yellow of the building reflect the characteristics of ethnic temples. From the perspective of the relationship between cultural heritage and color, these buildings serve as centers of cultural and religious activities. Their colors retain rich

traditional arts and craftsmanship contexts, demonstrating the Tibetan people's spiritual pursuits and cultural values. Analyzing architectural color can provide insight for designers to enhance the beauty of a building and its relationship to its surroundings. Attention is paid to of conserving and restoring buildings to maintain their historical and cultural value. Nonetheless, the application of traditional colors in modern architecture can be further studied;

(2) For residential architecture design, 34% blue and 18% white are needed, and the facade of the building is decorated in many colors, reflecting the ethnic culture. The layout and proportion of the colors of the surrounding environment, such as the Baizangfang and the sky, align with the aesthetic values of nature. It can also reflect the structure and cultural identity of Tibetan society, such as the social status of the family (such as the color and area of Baizangfang, the number of building floors, the form of painting, etc.) and the climatic conditions of the region environment (such as the blue sky, clean and pollution-free surroundings, etc.);

(3) For materials design and applications, the colors are rich, reflecting the ethnic characteristics of rural areas. The richness of colors of the materials not only reflects the characteristics of the natural environment but also embodies the Tibetan culture's emphasis on the harmonious symbiosis of nature. Therefore, the relationship between culture and materials is very important. The color selection and processing (such as painting and carving) techniques of traditional materials reflect Tibetan environmental protection concepts and commitment to sustainable development. The natural colors of wood and stone are often used to construct residences and temples. Analyzing the colors of these materials can help designers use different materials to reveal their unique color properties under the influence of natural light, making them harmonious with their surroundings;

(4) For street design, the color of the prayer flags has the most direct embodiment of ethnic colors, and the picture is coordinated. In addition, street elements also include pavement materials, street trees, street buildings and other components. The color combination of these elements can affect people's emotions and behavioral patterns. For example, bright and colorful streets may attract more tourists and shoppers. Combined with the application of color psychology, street color can enhance the spiritual outlook of the community and happiness of residents, and enhance the cultural confidence and identity of the region. However, a comparative analysis showed that, in one of the streetscape samples appearing in Group B, white takes up a large proportion of the sample; the color is monotonous, and the results show a relatively negative result. The streetscape in this area may be too monochromatic due to the monotony of landscape elements. Future color planning can be optimized concerning the proportion and type of architectural colors;

(5) For farmland design, the colors of the fields, paths, mountains, and buildings are in strong contrast. This reflects the characteristics of strong local color contrast but overall coordination between farmland and the surrounding natural and cultural environments. Additionally, by analyzing the color of farmlands, crop maturity, planting patterns, and their integration with the natural landscape can be observed. From the perspective of color and environmental sustainability, color management on farmlands emphasises ecological sustainability, such as using multiple crop rotations to increase biodiversity. Future research can collect farmland samples in different seasons for analysis. Seasonal changes in farmland color not only improve the beauty of farmlands and promote ecological balance.

(6) On the contrary, from an aerial view, the white color of traditional Tibetan roofs and walls stands out against the green, natural background. White has special significance in Xiangcheng Tibetan culture. There is a special local festival, "White Filling Ceremony". It is an ancient custom in which Tibetans use a local white clay diluted with water and then pour a layer of white clay on the outer walls and courtyard walls of Tibetan houses. However, the green in the sample's foreground blocks the building's white, resulting in fragmented space and monotonous colors. Although the color richness is weak and cannot reflect the characteristics of Xiangcheng's color-area ratio, it can reflect whether the whole color landscape is uniform. Thus, the color layout of the bird's-eye-view sample provides a

unique perspective. It can help analyze the color transition between different areas and be used to study the spatial layout and color application of Tibetan areas to reflect their social structure and cultural values.

6.4. Research Limitations

Studying Tibetan color landscapes is not merely an investigation of colors themselves, but a deep exploration of Tibetan culture, religion, social structure, and interactions with the natural environment. This research provides a comprehensive perspective to understand and appreciate the rich and colorful cultural heritage of Tibetan area. However, this research has certain limitations, as follows: (1) The complex terrain of Tibetan area and the inaccessibility of many areas may limit field investigations and data collection in certain regions [60,61]; (2) Due to language and cultural differences, non-Tibetan researchers may face challenges in fully comprehending the deep meanings of colors in Tibetan culture; (3) Current color analysis technologies and methodologies might not adequately capture and interpret the complex cultural and environmental factors influencing color landscapes; and (4) The selection of a limited sample of investigation, 14 images, and only with 6 factors to do factor analysis and one common factor could be a limitation of this study. When estimating factor loadings, a problem we may face is specifying too few factors (under-decomposition) or too many (over-decomposition), although the latter results in less error [62]. However, specifying too many factors can lead to the creation of constructs that have little theoretical value [62]. One of the fundamental questions for multivariate observations is the true actual number of principal components or factors in the underlying data-generating model. Determining this number of factors is a complicated and long standing problem [63]. Furthermore, the difference in whether conditions were detected by pictures could represent a bias in the study.

7. Conclusions

With the updating of digital technology, color physical properties and visual and psychological perception are described using quantitative and qualitative methods in color landscape in forests, urban and rural areas, etc. [4]. However, the lack of a common and good cognition standard for colorsapes in ethnic minority areas has led to a separation of planning from the local public and cultural environments and to a lack of identity. Quantitatively selecting and using traditional ethnic minority color elements in landscape design in Tibetan areas is a research gap in current landscape research. Therefore, the evaluation and analysis of the color–area ratio, the color quantification process, and the construction of quantification standards are all problems faced by color–area ratio quantitative research in Tibetan areas. This study combined the SD method and the color quantitative analysis method to systematically analyze color–area ratio quantitative research in Tibetan areas. Based on the SD method evaluation, the factor analysis for dimensionality reduction was carried out to test whether the correlation and overlap of the SD evaluation factors were reasonable. The common factors of color–area ratio design were extracted based on qualified inspection, making the quantitative study of the color–area ratio in minority areas objective and reasonable, enhancing the operability of the design. In the survey process, it is also necessary to strengthen collaboration with local researchers and communities, leveraging their deep understanding of local culture to overcome barriers to cultural comprehension.

8. Further Research Directions

(1) Develop advanced color analysis tools and methods to more accurately capture and analyze the subtle variations in Tibetan color landscapes, encourage interdisciplinary team collaborations, integrate perspectives from anthropology, cultural studies, psychology, and more, for a comprehensive understanding of Tibetan color landscapes;

(2) Conduct long-term studies to explore the changes in Tibetan color landscapes over time and the socio-cultural and environmental factors these changes reflect. For example, the samples about distinguished color landscapes may be comparatively studied

in different seasons; or studied in different periods during the day and night to compare colorsapes under natural light and artificial light;

(3) Comparing the color landscapes of Xiangcheng County with other Tibetan regions can reveal cultural and environmental differences among regions. Comparing Tibetan color landscape research with similar studies in other regions or cultures can be used to explore the commonalities and differences in color usage across different cultures. Using the same methodology to study other urban/rural areas outside Tibetan areas could be a future research direction and make the results generalizable for other urban/rural areas.

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