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## Landscape pattern analysis of urban green space based on the new green space classification standard Take Danzhou City, Hainan Province as an example

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# Landscape pattern analysis of urban green space based on the new green space classification standard Take Danzhou City, Hainan Province as an example

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**Abstract.** This study takes the urban center of Nada, Danzhou City, and Hainan Province as the research object and uses GIS technology and the principle of landscape ecology to analyze the urban green space and landscape pattern of public green space of the central city. The results show that the land scape structure of the central city is unreasonable, the public green space is seriously lacking and the distribution is not balanced. The proportion of regional green space is high and the available space is large; the landscape diversity index is low and the degree of fragmentation is high.

## 1. Introduction

Urban green space is of great significance to providing basic life support, maintaining good social relations, and improving the well-being of residents [1, 2]. The urban green space landscape is composed of landscape mosaics, namely plaques, corridors and matrices from the perspective of land scape ecology [3]. Urban Green Space Classification Standard is the basic standard for the landscape architecture industry and an authoritative technical standard for urban green space system planning, preparation, and statistics [4]. The new edition of Standard for Urban Land Classification and Planning Development land launched in 2017 has broken the urban rural dual segmentation model centered on the urban standard, optimized the relationship among city, country side, human and nature from an ecological perspective and become a mandatory reference standard for the formulation of industry standards of urban greenspace planning [5].

Due to the long-term effects of many factors such as human activities and urban development. The urban green space landscape pattern is varying in degree. In the context of urban rural integration overall planning, it has become an urgent issue how to optimize the spatial structure of urban green space to maximize its social service functions and ecological benefits. Due to its strong real-time performance, high precision and visualization, 3S technology is widely used in the research on urban green space landscape pattern. Many scholars have made outstanding achievements in the research on green space landscape patterns in megapolises and provincial capitals [6-9]. But the exploration of green-land landscape patterns in small and medium-sized cities under the new urban green space planning standards is still rare. Based on the new version of Urban Green Space Classification Standard Green Standard, this paper uses remote sensing technology to conduct a multi-scale research on the urban green space and public green space landscape pattern in the urban area of Dan Zhou City to provide feasible



suggestions for the optimization of green space pattern, the enhancement of green space ecological benefit and the planning and design of green space in the central urban area of Danzhou City.

## 2. General situation of the research area

Danzhou City, Hainan Province, is located in the western part of Hainan Province. It is the second largest city in Hainan Province. In 2017, it was awarded the title of National Garden City. The space structure of the cities in the stage of punctiform development and the Nada is the largest group. Therefore, the research scope is from Luobian village in the east to North Gate River in the west, Wanfu West road in the south, and Zhanqian East road. In the north. The total area is 5354 hectares. It has a tropical humid monsoon climate and hasn't seen frost and snow all year round. The annual average temperature is 23.5°C. And the average annual rainfall is 1815 mm.

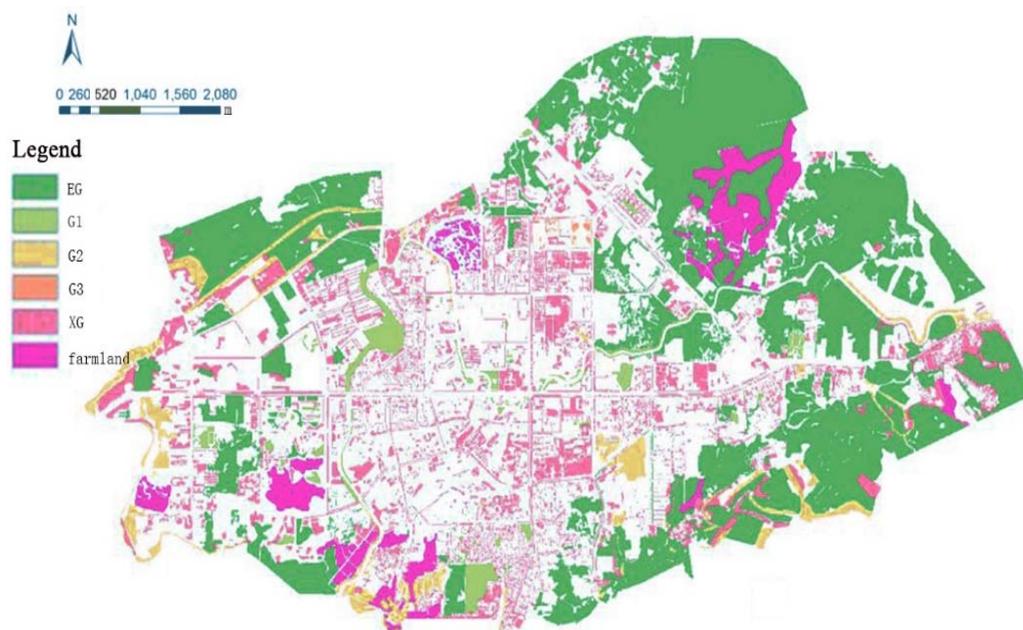
## 3. Data source and method

### 3.1. Data source

Aerial photography of Danzhou City (2017), the overall urban planning of Danzhou City (2010-2030). The landscaping statistics and urban planning materials of Danzhou City in recent years.

### 3.2. Research methods

#### 3.2.1. Data preprocessing



**Figure 1.** Green Space Distribution Map of Nada Central District of Danzhou City

Based on the aerial imagery, the field investigation and the relevant literature, the paper uses ARCGIS to draw all kinds of green space patches, extracts all kinds of green space information by attribute assignment and establishes the green space information database of Nada City. According to the Urban Green Space Classification Standard (CJJ/T85-2017), the types of green space are park green space (G1), protective green space (G3), square green space (G2), affiliated green space (XG), regional green space (EG) and farmland. The green underground is divided into four categories: comprehensive park (G11), community park (G12), special park (G13), and garden (G14).

*3.2.2. Analysis of landscape pattern.* In the FRAGSTATS, the paper calculates the relevant landscape pattern index. According to the research of Wang Haifeng [10], Zhang Yanan [11], Zhao Hongxia [12] etc., this paper selects relevant landscape pattern index, outputs indexes which can reflect the landscape space accurately and comprehensively. They are Total plaque area (CA), number of plaques (NP), plaque density (PD), mean plaque area (MPS), average plaque dimension (MPFD), Separation Index (Fi), I and scape Metrics (SHDI), Fragrance Uniformity Index (SHEI), Dominance (D), Landscape Fragmentation Index(C).

#### 4. Result and analysis

##### 4.1. Analysis of the composition of green space landscape

**Table 1.** Landscape Composition of Nada Central District of Danzhou City

| Greenbelt Types | Green area/m <sup>2</sup> | Number of plaques | Area composition/% | Land area/hm <sup>2</sup> |
|-----------------|---------------------------|-------------------|--------------------|---------------------------|
| G1              | 99.94                     | 111               | 3.53               |                           |
| G2              | 172.70                    | 139               | 6.11               |                           |
| G3              | 4.99                      | 36                | 0.18               |                           |
| XG              | 641.19                    | 3177              | 22.67              |                           |
| EG              | 1701.64                   | 243               | 60.16              |                           |
| Cultivate Land  | 207.83                    | 49                | 7.35               |                           |
| Total           | 2828.29                   | 3755              | 100                | 5354                      |

According to the data in Table 1, the land area in Danzhou City is 5,354 hm<sup>2</sup> and the green area is 2828.29hm<sup>2</sup>. The number of affiliated greenbelt patches in the urban area is the largest and the area is much larger than other greenbelts. It indicates that the greening level of the affiliated greenbelts is good, but the landscape connectivity is insufficient. Because the residential area is more fragmented. There is no organic connection between the various groups. According to Figure 1. Although some parts of the city built a complex and well-constructed road system, the main roads have not formed more perfect system. The pattern of green space is not fully formed. The area of regional green space is 60.16%. It is mainly concentrated in the periphery of the urban area. It shows that during the urbanization development of Nada city, the green areas around the city are mostly natural vegetation. The plant distribution is disorderly and the ecological benefits are low. Relevant department should make good use of these areas to improve the ecological environment. Cultivated land is interlaced with regional green space. The proportion of public green space area is 3.53%, it indicates that the public green space of Danzhou is extremely scarce. The proportion of protective green space is not high, because it is distributed in strips around urban areas.

##### 4.2. Plaque type level analysis

**Table 2.** Landscape Type Horizontal Landscape Index of Nada Central District of Danzhou Cities

| Greenbelt Types | PD     | MPFD | MPS   | Fi   |
|-----------------|--------|------|-------|------|
| G1              | 3.79   | 1.08 | 0.90  | 0.25 |
| G2              | 4.93   | 1.09 | 1.23  | 0.38 |
| G3              | 1.28   | 1.07 | 0.14  | 0.22 |
| XG              | 112.67 | 1.06 | 0.20  | 0.30 |
| EG              | 8.62   | 1.08 | 40.15 | 2.82 |
| Cultivated Land | 1.74   | 1.10 | 4.20  | 0.77 |

Note: *PD*: plaque density, *MPFD*: average plaque fractal dimension, *MPS*: average plaque area, *Fi*: Separation index.

The larger the value of the plaque density PD, the higher the degree of greening fragmentation. It can be seen from Table 2 that the burial density of the auxiliary green space type in the study area is the largest, because the main body of the large urban area is composed of residential area s, administrative office land, and commercial land. The average plaque fractal dimension reflects the complexity of the plaque shape. The MPFD values of all Greenfield types are below 1.20, it reflects the greater interference of the greenbelt landscape in the metropolitan area. Among them, although the affiliated green space is closely related to surrounding buildings, most of them are regular design.

The area with smallest average plaque area in the study area is the square land, because the square green space has less greening and is greatly affected by human activities. The distribution of regional green space and protective green space provides space for public green space planning and urban expansion. The regional green space separation index is much larger than other types of green space. The regional green space is located in the suburbs, so it is the most scattered. The cultivated land is not concentrated, so it is more discrete. The protective green space is mainly located around the city, but it doesn't completely enclose the city. The number of park green space and square green spaces is. Therefore, the classification index of these three types of green land is low.

#### 4.2.1. Analysis of landscape level

**Table 3.** Landscape Index of Greenbelt Landscape Level in Nada Central District of Danzhou City

| Greenbelt Types | Shannon Diversity Ined (SHDI) | Shannon Evenness Iendex (SHEI) | Dominance (D) | Landscape Fragme Tation Index (C) |
|-----------------|-------------------------------|--------------------------------|---------------|-----------------------------------|
| G1              |                               |                                |               | 1.11                              |
| G2              |                               |                                |               | 0.80                              |
| G3              |                               |                                |               | 7.21                              |
| XG              |                               |                                |               | 4.95                              |
| EG              |                               |                                |               | 0.14                              |
| Cultivated Land |                               |                                |               | 0.24                              |
| Total           | 1.13                          | 0.63                           | 0.37          | 1.35                              |

According to the data in Table 3. The highest landscape frag mentation index in the study area is the square green space. Because the number of squares is very small, the patches in each square are scattered, the patches are few. The second is the affiliated green space, which is 4.95. Because the affiliated green space is often embedded in building groups and roads. In the western part of the city, the green patches are mostly forms of Green stitching". So landscape fragmentation is high. In the study area, the park green space is generally larger. Because of the small plaque area of Palm Island Park and Sports Park. It causes a high turnover index of park green. Space, the fragmentation is serious. Regional green space and protective green space are more concentrated, and the plaque area is large, so the degree of fragmentation is low. The overall frag mentation index is 1.35, it indicates that the landscape of Nada is fragmented.

The diversity index can reflect the heterogeneity of the landscape. The larger the value of the fragrance diversity index, the richer the type of the patch. The index is 1. 13, which indicates that the green landscape type is more complete and the plaque area of each type is more balanced; the dominance index is 0.37 because of large regional green area; the uniformity index is 0.63, it indicates that the proportion of green area is relatively low. In summary, the regional green spaces can be considered to use in the future.

## 5. Discussion and conclusion

The results of research about the central of Nada urban area, Danzhou City are summarized. As follows:

(1) The urban green space landscape structure of Nada urban area is unreasonable, the green land is severely fragmented and the natural vegetation coverage area is large. In the green landscape, the regional green space and the affiliated green space are the dominant green space types. They account for 60.05% and 22.81% of the total landscape area respectively. The park green space and the square land in the public green space account for 3.55% and 0.18% respectively. It shows that there is a lack of public land in the central city and the area of unused land in the city is large. The landscape structure of the affiliated. Green space and public green space is relatively fragmented, the degree of separation of public green space is large, and the road system is not fully established.

(2) The landscape pattern of public green space in the central city of Nada is unreasonable, the landscape diversity index is not high and the spatial distribution of various types of public green spaces not balanced. The average patch area of public green space is small, so the degree of landscape fragmentation is high. The number and area of public green space in areas with large building density are obviously insufficient. There is a big gap between the current distribution of green space and planning, and the completion of urban construction is not high.

Based on the above analysis, several suggestions are given:

1) Increase the coverage of public green space to achieve a balanced distribution. The southern of residential areas are densely populated, but the number of public green spaces is obviously insufficient. It is necessary to increase the number of parks and expand the existing park area within the urban area. It is recommended to adjust the land balance and change the original natural vegetation and reserve public green space to support urban expansion in northern city.

2) Reduce the degree of landscape fragmentation. In addition to the regional green space, all kinds of green spaces have high fragmentation degree. It is suggested that residential district green area should be connected into strips. Besides, improve the greening rate of the roads is also important. The green space should be concentrated on the square land. The protective green space is arranged in a strip shape; the green space should be connected into a piece in the park green space; the cultivated land should be uniformly planned. A small amount of cultivated land within the urban area should be concentrated out of the urban land.

3) Strengthen the connection between various types of green spaces and form a central urban area layout pattern of one ring, one belt and multiple gardens". At present, the green areas in the central urban area are mostly green spots. The structure of various green areas is complex, there is no unified planning. It doesn't form an ecological network. According to the image. There is no organic connection between public green spaces .it doesn't form an ecological layout pattern. The Songtao Main Canal is divided into four sections by the road, so it is recommended to use the Songtao Main Canal to connect the entire urban area with four park green spaces. The rest of the main canal uses a variety of ecological revetments to form a main ecological corridor of the city. Enhance the ecological benefits of public green space within the urban area. The protective green space around the urban area should be connected into a ring to enhance the health protection function.

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