



Study on the Infrastructure of the “Plateau Water and Grass Gallery” in Aba Prefecture Based on Nuclear Density Analysis

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Abstract. Aba is renowned for its rich and unique tourism resources such as water, grass and snow-capped mountains. In recent years, Aba has been developing its tourism industry at a high rate with the creation of a national all-area tourism demonstration area as the main line, but the lack of infrastructure has long restricted the high-quality development of its cultural tourism. With the creation of Ruorge National Park approved, Aba urgently needs a more precise positioning in order to build a national model area for tourism and an international ecological and cultural tourism destination. This paper proposes a tourism plan of “Plateau Water and Grass Gallery” and identifies and analyses the five types of POI data and traffic network data clusters related to tourism in Aba Prefecture through ArcGIS. The research concludes that the level of infrastructure does not match; the distribution of scenic spots is concentrated; and the development of the region is unbalanced. Accordingly, countermeasures are proposed in three aspects: complementing transportation, improving supporting facilities and upgrading scenic spots, in order to promote the construction of the water and grass gallery and the high-quality development of the whole area of tourism.

Keywords: Tourist facilities · Plateau Water and Grass Gallery · Aba Prefecture · Whole-area Tourism · Nuclear density analysis

1 Introduction

General Secretary Xi Jinping pointed out in the report of the 20th CPC National Congress that “promoting green development, promoting the harmonious coexistence of man and nature, respecting nature, conforming to nature and protecting nature are the inherent requirements of building a modern socialist country in an all-round way [1].” Aba Prefecture has been actively practicing the concept of “green water and green mountains are golden mountains”, promoting the ecological protection and management of the upper reaches of the Yangtze River and the Yellow River, and insisting on the development of regional tourism as a concrete action to implement Xi Jinping ecological civilization thought, and the tourism industry is developing at a high speed due to the attractiveness of its rich and unique tourism resources.

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However, inadequate tourism infrastructure such as transportation has seriously restricted the high-quality development of cultural tourism in Aba, with Zeng Quanhong et al. (2018) pointing out that Aba's regional tourism faces problems such as "insufficient transportation, poor toilet hygiene, low quality gas stations, and unbalanced catering and accommodation" [2]; Ren Liying et al. (2020) argue that the lagging transportation road network and natural disasters are the primary barriers to the in-depth development of tourism and economic and social take-off in Aba [3]; Liu Ping (2021) found that Aba's cultural tourism still suffers from "weak comprehensive hotel reception capacity, low density of transportation network, poor tourism transportation connectivity and safety" [4]; Luo Zhanfu et al. (2022) found that by (2022) found that the tourism resources of Aba County, which has high aesthetic value in terms of natural landscape, are difficult to develop due to weak infrastructure and slow socio-economic development [5].

The 2023 work report of the Aba Prefecture People's Government states that "we should lead the whole area of tourism with brand orientation, promote the deep integration of "transportation + tourism", and accelerate the construction of the Great Jiuzhai and other tourist scenic corridor system." The construction of the "plateau water and grass gallery" proposed in this paper is essentially about creating a new brand of cultural tourism in Aba, improving the ecological environment, developing the economy and society, and boosting the core of its cultural tourism industry. At present, how to improve the infrastructure is a major challenge for the construction of the "Plateau Water and Grass Gallery". This paper uses ArcGIS10.8 kernel density analysis to identify the tourism infrastructure related to the whole area tourism, namely the traffic road network, petrol stations, accommodation, catering, scenic spots and toilets, and to analyse the problems faced in their upgrading, with the aim of providing support and reference for the subsequent sustainable construction of the "Plateau Water and Grass Gallery" and the high-quality development of cultural tourism. The aim is to provide support and reference for the subsequent sustainable development of the "Plateau Water and Grass Gallery" and the high-quality development of cultural tourism.

2 Study Overview

2.1 Introduction of the Concept

The "Plateau Water and Grass Gallery" refers to an all-area tourism demonstration area located on the western plateau of Sichuan and within the entire territory of Aba Prefecture, where tourist attractions with the theme of water and grass are linked together, combining motion and static, forming a long painting of snow-capped mountains, grass and water under the blue sky, presenting an "all-area, all-time, three-dimensional and diversified The "Qingming Shanghetu", a natural and humanistic "Qingming Shanghetu" of the plateau, takes the opportunity of Aba Prefecture to accelerate the construction of the Aba Ecological Demonstration Zone in northwest Sichuan, to build a national ecological civilization demonstration area, a national demonstration area for all-area tourism and an international ecological and cultural tourism destination, and to create the Ruo'ergai National Park to cultivate a new cultural tourism landmark in Sichuan and a new national all-area tourism. The creation of Ruo'ergai National Park is an opportunity to cultivate a new cultural tourism landmark and a new national tourism card.

The construction process of the “Plateau Water and Grass Gallery” will be supported by tourism trunk lines and branch lines, with individual famous tourist attractions as points, stringing points as lines, from lines to surfaces, from the original traditional single tourism line sightseeing tourism, to multi-regional linkage, multi-line series development of the transformation of the whole area of tourism, the formation of mutual articulation, common strength of the spatial layout. Comprehensively build an ecological green tourism pattern, form a low-carbon green tourism core competitiveness, and continuously promote the construction of ecological barriers. Efforts will be made to enhance the unblocking role of the tourism infrastructure network, such as transportation and accommodation, to promote the innovative development of all-area tourism and continuously drive the people to rely on cultural tourism to get rich.

2.2 Regional Overview

As shown in Fig. 1, Aba Tibetan and Qiang Autonomous Prefecture (Abbreviated as “Aba Prefecture”) is an autonomous prefecture under the jurisdiction of Sichuan Province, located on the southeastern edge of the Qinghai-Tibetan Plateau and in the northwestern part of Sichuan Province, with 12 counties and one county-level city under its administration, covering a total area of 84,242 square kilometers. Aba is located in the upper reaches of the Yangtze and Yellow rivers, and is an important water source, recharge area and ecological function area of important national wetlands. The overall contour of the state’s surface is typical of the plateau, and the imposing natural landscape with its high terrain, towering snow-capped mountains, lively waters and sprawling meadows, together with the highly distinctive Tibetan and Qiang customs and humanities, form a rich and unique tourism resource, laying a solid foundation for the development of all-area tourism.

Tourism is the pillar industry of Aba Prefecture, the state currently has a total of 3 national 5A-level tourism scenic spots, 4A-level scenic spots 26, the total number

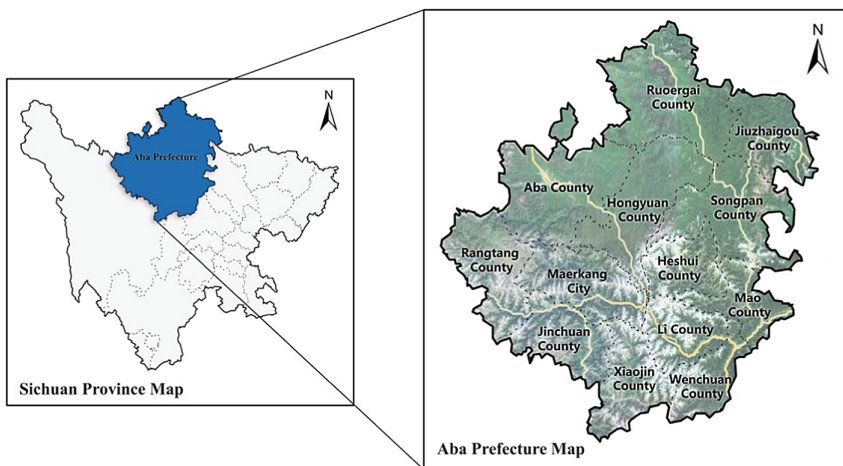


Fig. 1. Schematic diagram of the location of the study area

Table 1. Summary of tourism in Aba in the last three years

| Year | Number of visitors Received(million) | A-class scenic spot admission fee collection(RMB billion) | Total Tourism Revenue(RMB billion) |
|------|--------------------------------------|---|------------------------------------|
| 2019 | 3157.1 | 4.74 | 227.58 |
| 2020 | 3604.01 | 3.74 | 301.14 |
| 2021 | 4058.71 | 5.21 | 342.95 |

Source: Official website of the People’s Government of Aba Tibetan and Qiang Autonomous Prefecture

of A-level scenic spots in the province’s top three. In recent years, Aba Prefecture has continued to optimise its cultural tourism industry around the creation of a national demonstration area for all-area tourism. As shown in Table 1, the number of visitors received and the total tourism revenue in Aba have climbed year after year in the past three years, and have continued to drive healthy economic and social development through tourism development.

2.3 Data Sources

As shown in Table 2, the study crawled POI (Point of Interest) data of selected tourism facilities in Aba Prefecture from Baidu Map via python, including five categories: accommodation, catering, scenic spots, toilets and petrol stations. The road network data is vector data of the 13 counties (cities) in Aba Prefecture, derived from OSM (Open Street Map). By combining the POI data with the road network data, it can effectively reflect the distribution, density and accessibility of tourism public facilities in the region, and provide support for the coordinated development of regional tourism.

Table 2. POI data fact sheet

| Data category | Number | Contents |
|---------------|--------|--|
| Accommodation | 1295 | Hotels, resorts, farmhouses, etc. |
| Catering | 1141 | Chinese food, snacks and fast food, beverage shops, etc. |
| Gas stations | 108 | — |
| Scenic areas | 131 | Cultural monuments, scenic spots, etc. |

3 Study Analysis

3.1 Study Methodology

The first law of geography is that the closer things are to each other the more closely they are related, and the closer the location to the core element the greater the density expansion value obtained [6]. To study the distribution of infrastructure, we considered

the geographical coordinates of each facility as a core element, and used ArcGIS10.8 software and Kernel Density Estimation (KDE) to explore the correlation between the core elements in the region, so as to judge the gathering and distribution of tourism infrastructure in the region. The results were verified by the network text analysis method and field survey method. The operator formula is shown in (1), where K is the weight function of the kernel, h is the bandwidth, i.e. the width of the surface extended in space with x as the origin, and the value of h will affect the smoothness of the graph; $x-x_i$ is the distance between the density valuation point x and x_i .

$$f_n(x) = \frac{1}{nh} \sum_{i=1}^n k\left(\frac{x-x_i}{h}\right) \quad (1)$$

3.2 Analysis of Results

3.2.1 Road Network Situation

Tourism traffic is an important pointing indicator for the development of regional tourism, and the density of the traffic network directly affects the number of tourists and the level of industry in the region [7]. As far as tourists entering Aba are concerned, road is the main option of transportation, so the level of road access has a great influence on the development of local cultural tourism. By the end of 2022, Aba had 15,460,000 km of roads, including 2,194.736 km of Chinese roads, 1,830.769 km of provincial roads, 2,670.491 roads in counties and 4,319.958 km of township roads, which is advanced in absolute terms. At the same time, Aba has a reasonable distribution of petrol stations, which can also provide effective replenishment for transportation. In order to explore the relative density of the road network in the state, this paper overlays the roads above the township roads and the petrol stations within the road network in Aba to the layer through ArcGIS10.8 software, and conducts a nuclear density analysis.

As shown in Fig. 2 and Fig. 3, the results show that the overall distribution of the transport network in the state is even, showing a typical form of two horizontal and three vertical, which can better link the west and the east and run through the north and south, providing communication conditions for the core nodes of the “Plateau Water and Grass Gallery” such as Jiuzhaigou, Mouni Gou and Bibang Gou. The core nodes of the petrol stations are also well fitted to the dense road network, which can greatly meet the traffic demand. At the same time, Aba, Mao and Wenchuan counties are densely populated with roads, showing a trend towards a network of multiple parallel roads, providing favourable factors for connecting to Qinghai Province in the west and Chengdu in the south. Jiuzhaigou and Songpan counties also have a somewhat dense road network, although there is still a shortage of minor roads and branch roads and an unbalanced distribution of routes in the state, which seriously affects the collaborative development between the regions. Among them, Ruoerge and Hongyuan counties have insufficient road penetration and poor internal accessibility, while the dense distribution and excellent quality of water and grass resources in the region require internal vessels for linkage.

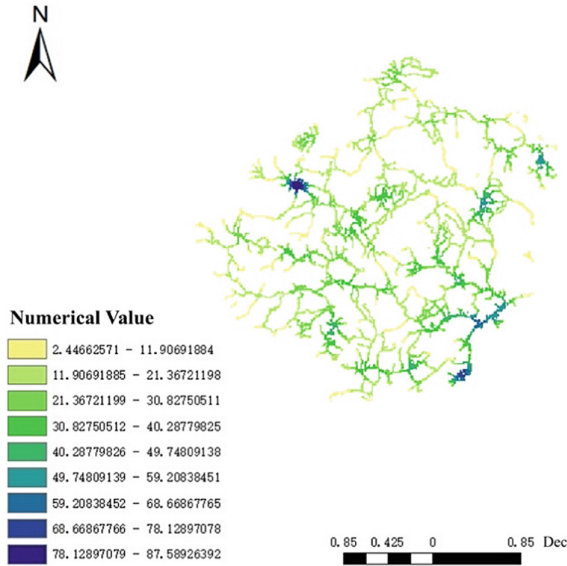


Fig. 2. Aba transport nuclear density

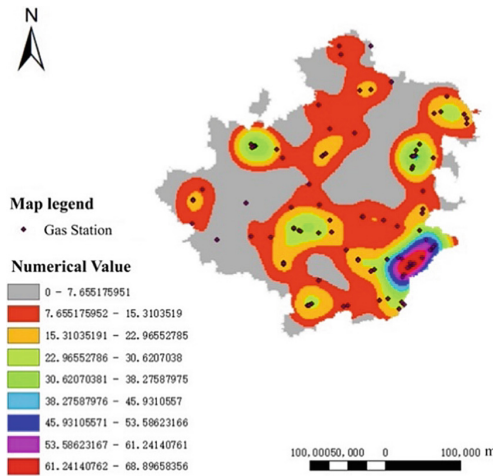


Fig. 3. Aba gas station nuclear density

3.2.2 Accommodation and Catering Situation

Accommodation and catering is an important factor in the carrying capacity of the regional tourism industry, and is also an important part of the construction of the tourism infrastructure of the “Plateau Water and Grass Gallery”. As shown in Fig. 4 and Fig. 5, the results of this analysis show that the areas of high density of accommodation and catering are generally consistent, with Jiuzhaigou being a rich area and Mao County,

Wenchuan County and Li County also having concentrated distribution, a pattern that is generally consistent with tourism development. In addition, the lack of accommodation support in Malcolm suggests that most tourists in the area commute on the same day, which is not conducive to longer stays and increased industry income. In addition, the design of the Shui Cao Gallery tourism route is mostly circular, so increasing the supply of accommodation and food around the main transport routes such as the national highways G317, G213, G347 and G248 has also become a necessity.

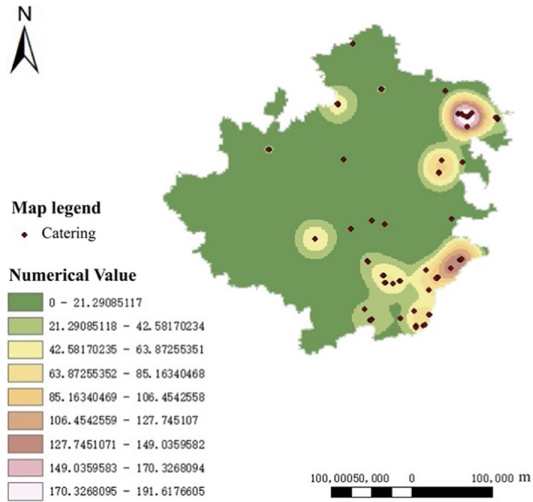


Fig. 4. Aba catering nuclear density

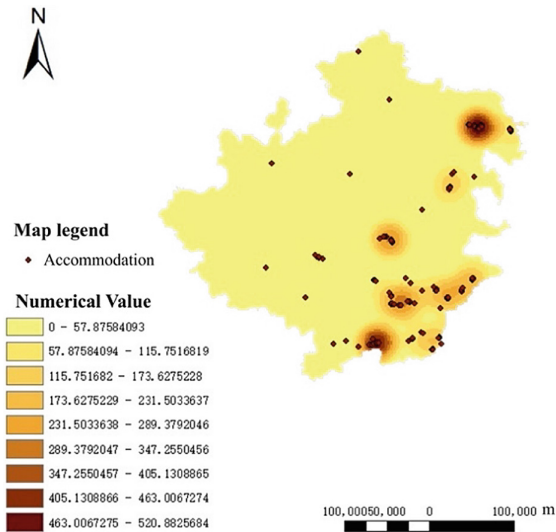


Fig. 5. Aba accommodation nuclear density

3.2.3 Scenic Areas Situation

Aba is a place where Tibetan and Qiang people live together, with rich cultural tourism resources, the state has more than 700 cultural relics, 22 cultural relic protection units in 8 places, and 17 national intangible cultural heritage lists. The state’s water and grass resources are of high grade, large scale and densely distributed, with a good ecological environment. It has three World Natural Heritage Sites (Jiuzhaigou, Huanglong and Sichuan Giant Panda Habitat) and 83 national A-class tourist attractions, covering 13 counties (cities) in the state. Therefore, the construction of a “Plateau Water and Grass Gallery” is extremely feasible.

However, Aba still suffers from insufficient resource exploitation and insufficient linkage of scenic spots. As shown in Fig. 6, the results show that there are more scenic spots in the east and fewer in the west, and fewer in the north and more in the south. Within the state, the north-western part has good water and grass resources and rich religious resources, but the degree of development is low and no resource-based travel area has been formed. While the eastern and southern regions are highly visible and have a concentrated distribution of scenic spots, the overall collaboration is poor due to policy barriers and insufficient road links between counties, which restricts the creation of a “Plateau Water and Grass Gallery”.

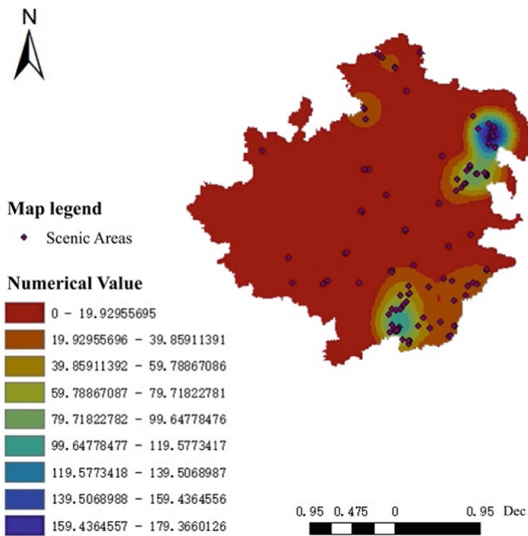


Fig. 6. Aba scenic areas nuclear density

3.2.4 Toilets Situation

In the context of ecological civilization, tourist toilets have become a new element of tourism, and their planning layout can affect tourist satisfaction [8]. As far as toilet layout is concerned, scenic spots with larger modules should be laid out with more

than three toilets, while their location should be in densely populated areas or near the entrance and exit, and they should also have features such as convenience concealment. As shown in Fig. 7, The results of the analysis show that the layout of toilets in Aba can be approximately fitted with the distribution of scenic spots and population, and the number is reasonable in Jiuzhaigou and Huanglong areas, which can basically carry the maximum number of visitors. There is also concentrated construction in Malkang, Wenchuan, Lixian and Xiaojin counties. The “Plateau Water and Grass Gallery” has the problem of fragile ecological environment and long cycle of poor natural recovery energy, so efforts to build eco-friendly intelligent public toilets and other green supporting facilities have become a new issue under the new situation.

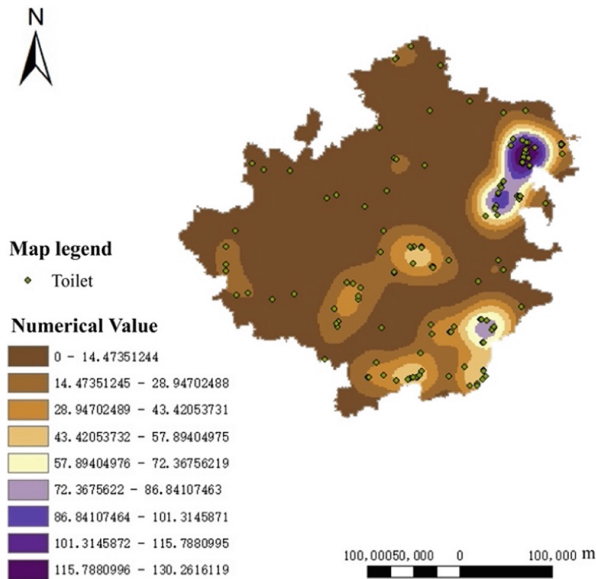


Fig. 7. Aba toilets nuclear density

4 Conclusions and Suggestions

4.1 Conclusions

The analysis of nuclear density provides important data to support the improvement of tourism infrastructure in Aba. Through the above study, the following conclusions can be drawn:

1. With the continuous promotion of regional tourism in Aba in recent years, local tourism facilities such as accommodation, catering, toilets, petrol stations and transport networks related to the cultural tourism industry have been greatly improved. However, the overall structure is characterised by “uneven development and mismatched facilities”, which fully reflects the important role of the construction of the “Plateau Water and Grass Gallery” in promoting the unified market of tourism in Aba.

2. Due to the early construction of Jiuzhaigou-Huanglong scenic spot, its high degree of development and strong popularity and attractiveness, as well as the scarcity and irreplaceability of natural resources, this area has a concentration of tourist attractions and a much higher nuclear density of tourist supporting facilities than other areas in the state, and has become the core of tourism in Aba Prefecture. The “Plateau Water and Grass Gallery” tourism brand.
3. Due to the remote location, poor traffic accessibility, such as the capital of Aba Malcom city supporting facilities is poor, can not give full play to the important role of the state’s political and cultural centre, and Ruorgei, Hongyuan County traffic accessibility is poor, road penetration is weak, seriously hindered the development of high-quality water and grass and other natural resources, but also unfavourable to the construction of Ruorgei National Park, the urgent need to rely on “traffic It is urgent to rely on the “transportation + tourism” model to play the role of “Plateau Water and Grass Gallery” in regional linkage and coordinated development.

4.2 Suggestions

In order to further improve the tourism infrastructure of Aba Prefecture, promote the high-quality development of the whole area of tourism, protect the natural ecological environment and build the “Plateau Water and Grass Gallery”, the following countermeasures are proposed.

4.2.1 Accelerate the Shortcomings of the Transportation Channel

Relying on the existing and planned traffic road network, build a whole area tourism traffic road network linking up the main scenic spots in the state, play the “traffic + tourism” mode, develop feeder traffic, open tourism shuttle buses and special buses, and open up various attractions; increase construction efforts to ensure the opening of the Chengchuan section of the state’s first railway, the Chenglan Railway, as scheduled; enhance Jiuhuang and Hongyuan airports The airport of Jiuhuang and Hongyuan will be upgraded and more tourist airlines will be opened; Aba Prefecture will be constructed with “iron, land and air” transportation to promote the development of the “Plateau Water and Grass Gallery”.

4.2.2 Accelerate the Improvement of Food, Accommodation, Tourism and Toilet Facilities

Integrate planning and overall layout, introduce social forces to the construction of the “Plateau Water and Grass Gallery”, create branded accommodation and catering services with distinctive characteristics, improve the quality and services of the supporting facilities in the Jiuhuang area, and increase the quantity and capacity of the supporting facilities in other areas; integrate resources, rationalize the layout, and increase the construction of tourist toilets, environmentally friendly toilets and intelligent toilets. Strength. Strengthen investment, develop tourism products with local characteristics, and create a whole chain of services for “food, accommodation, travel, shopping, entertainment and toilets”.

4.2.3 Accelerate the Comprehensive Quality of Scenic Spots

Adhere to ecological priority and green development, strengthen the ecological protection and construction of the upper reaches of the Yangtze River and Yellow River basins, strengthen the integrated protection and construction of mountains, water, forests, fields, lakes, grasses and ice, and establish a harmonious development model of “environmental protection, tourist experience and sustainable development”; adhere to high-quality development, develop low-carbon tourism, clarify the bottom line of the ecological carrying capacity of scenic spots, and regulate The “Plateau Water and Grass Gallery” will reduce the ecological burden and improve the quality of tourism in the scenic area. Breaking down regional barriers, promoting the mutual opening of regional tourism markets, enhancing the overall competitiveness of cultural tourism, and promoting the full construction of socialist modernization of Sichuan with the practical results of high-quality development to take solid steps.

5 Fund Projects

National-level Student Innovation and Entrepreneurship Training Program “Study on the Construction of Aba State-wide ‘Plateau Water and Grass Gallery’ Demonstration Area under the Perspective of Double Carbon Strategy” (202210656013), Southwest Minzu University, China.

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