

Ecological Assessment of University Campus' Waterfront Landscape: *With Guangzhou Higher Education Mega Center as a Case*

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Abstract. In recently years, the establishment of university campus has been on a rise, but the campus ecology is confronted with unprecedented challenges. Campus waterscape is one of the most important part of campus ecological system. The implementation of ecological design principle has been an important issue of planning programming. Besides, the current situation of campus ecology is worth being focused and studied. The paper has studied and analysed central waterscape of 5 universities in Guangzhou through field investigation. Based on the theory of water ecosystem service and Analytic hierarchy process (AHP), the paper aims to make a comprehensive comment on ecological environment of Guangzhou university town, whose problems are concluded. Corresponding policies are made to establish sustainable waterscape with good ecological environment, beautiful landscape and suitable activity venues, which will achieve the sustainable landscape effect for campus waterscape design.

1. Introduction

As an important natural resource, water is the material basis on which mankind depends, important factor influencing ecological balance and part of natural and urban environment. The university campus is like a small society in cities. Waterscape is a basis of forming good campus living environment and a substrate bearing outdoor activities and teaching. For university campus landscape, waterscape is both the reflection of campus ecology and an important channel for teachers and students to appreciate features and ecological culture of university waterscape [1]. There is a large waterscape near the school building and the author can see it when having a rest and looking far into the distance. There are few people staying there and the water is yellow where aquatic plants cannot grow. It is obviously that the ecological situation has been on an abnormal state. The reason for it is to be settled immediately through thinking, investigation and research.

2. Features and functions of campus waterfront landscape

2.1. An Introduction to Ecosystem of Campus Waterfront Landscape

The waterfront in campus is the junction between aquatic ecosystem and terrestrial ecosystem, including animals and plants, microbes, soils, air, rivers in the junction. The waterfront area is influenced by the two ecosystems. Its natural conditions are good to the proliferation and development of biomes. Numerous biological species have the features of amphibious and the food chains are also complex. It is closely related to the overall ecosystem of cities.



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2.2. Features of Ecosystem of Campus Waterfront Landscape

Ecological waterscape refers to a kind of waterscape type with sustainable ecological environment, good ecological image and abilities to achieve self-renewal and stability and harmonious existence between people and nature. After literature review, the author thinks that campus waterscape ecosystem can provide potential services. According to the Millennium Ecosystem Assessment Report of United Nations [2], the features mainly cover such four types as regulatory service (regulating ecological environment), supply service (supplying products for people), supportive service (supporting the overall ecosystem) and cultural service (providing spiritual feeling, entertainment, aesthetic experience or cultural education) [3].

2.3. Functions of Ecosystem of Campus Waterfront Landscape

As main open space in campus, campus waterfront space plays a role in ecology, leisure, landscape, culture, etc. The landscape can create micro climate, improve air quality, regulate humidity, beautify environment, increase diversity of species, protect and improve environment [4].

3. Investigation on overall evaluation of ecosystem of campus waterfront landscape

3.1. Research Objects

The paper has studied and analysed the central waterscape of Guangzhou university town through field investigation. Guangzhou Higher Education Mega Centre with an area of 34.4 square kilometres is located in Xin Zao Town, Pan Yu District, Guangzhou. It was constructed on 1st September, 2004, including such ten universities as Sun Yat-Sen University, South China University of Technology, South China Normal University, Guangzhou University, Guangdong University of Foreign Studies, Guangzhou University of Chinese Medicine, Guangdong College of Pharmacy, Guangdong University of Technology, Guangzhou Academy of Fine Arts, Xing Hai Conservatory of Music. As shown in “Figure 1”. The waterscape in university is investigated and the degree of being concerned is studied. As shown in “Figure 2-Figure 4”, the attention of South China University of Technology, South China Normal University, Guangzhou University of Chinese Medicine, Xing Hai Conservatory of Music, Guangzhou University of Technology is the highest. The paper does a further research on the five universities.

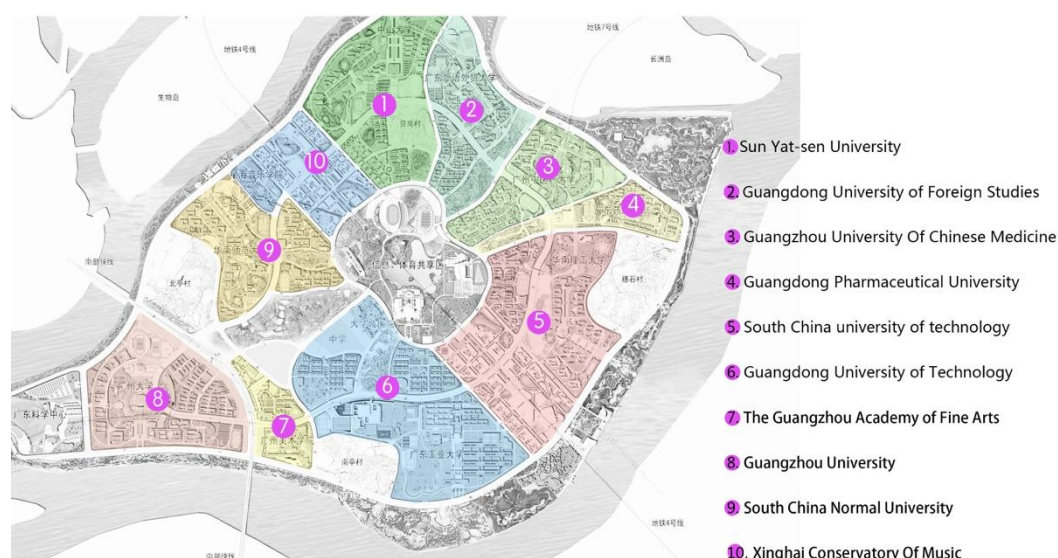


Figure 1. Guangzhou Higher Education Mega Centre



Figure 2. South China University of Technology & Guangzhou University of Chinese Medicine



Figure 3. Xing Hai Conservatory of Music & South China Normal University



Figure 4. Guangzhou University of Technology

3.2. Evaluation methods

3.2.1. Evaluation Factors System

Evaluation of ecosystem of campus waterfront landscape involves many indicators. A set of evaluation factors are defined according to data from the investigation, the theory of water ecology system, evaluation methods for international waterscape, systematic, objective and feasible principles and with Likert scale. Likert scale is the most common scale of summated rating scale, which was improved in 1932 by Likert (an American social psychologist) on the basis of original sum scale [5]. Primary factors showing the ecological situation of waterscape are selected [6], including regulatory service, supply service, supportive service and cultural service. Secondary factors include sewage interception, runoff control, self-purification of water, maintaining the diversity of waterfront plants, maintaining wildlife diversity, improving campus aesthetics and increasing opportunities of campus recreation. Tertiary factors include 22 indicators. It aims at constructing a comprehensive evaluation index system of ecological status of waterfront landscape.

3.2.2. Evaluation Factors Weight and Assignment

This template was designed for two affiliations. Evaluation factor weight is the key of overall evaluation and level analysis is an effective way to define weight coefficient. It is especially suitable to complicated problems that are difficult to analyse with quantitative indicators [7]. It makes the factors clear through dividing them into connected orderly levels. According to fuzzy judgement for reality, quantitative indicators are given on the basis of relative importance of such levels. Then mathematics methods are used to define weight coefficient of all elements' order of relative importance [7]. The steps of level analysis are as follow: A set of comparative values: The general comparison value is 1,3,5,7,9, As see from "Table.1". Standard group of numerical setting.

Table 1. Standard group of numerical setting

A pair of comparative value	Make up your mind
1	equal importance
3	weak importance
5	strong importance
7	very importance
9	absolute importance

Calculate the weight of the first grade evaluation factor, as see from “Table. 2”.

Table 2. Weight of the first grade evaluation factor

a pair of comparative value	Supportive service	Regulatory service	Cultural service	Supply service	The geometric average	The weight
Supportive service	1	3	5	5	2.943	0.54570
Regulatory service	1/3	1	3	5	1.495	0.27721
Cultural service	1/5	1/3	1	1	0.508	0.09419
Supply service	1/5	1/5	1	1	0.447	0.08288
In Total					5.393	1

Finally, the two and three grade evaluation factors were compared. As see from “Table 3”, the evaluation index set of waterfront landscape ecological condition was summarized. A comprehensive evaluation index system of ecological status of waterfront landscape.

Table 3. A comprehensive evaluation index system of ecological status of waterfront landscape

Primary factors	Secondary factors	Tertiary factors
Regulatory service (0.28)	Sewage interception (0.3)	Water volume (0.010)
		Water quality level (0.024)
		Sewage flowing automatically (0.030)
		rainwater collection (0.030)
	Runoff control (0.2)	Drainage method (0.036)
Supply service (0.08)	self-purification of water (0.5)	Water permeability of soil (0.020)
		Water bottom material (0.040)
		Aquatic plant coverage (0.060)
		Waterscape plant coverage (0.040)
	Fresh water supplementat ion (1.0)	Water cycle (0.080)

Primary factors	Secondary factors	Tertiary factors
Supportive service (0.55)	Maintaining the diversity of waterfront plant (0.55)	Width of waterfront planting belt (0.090)
		Reasonable structure of revetment pore (0.070)
		Arboreal coverage (0.080)
		Species of aquatic plants (0.063)
Cultural service (0.09)	Maintaining the diversity of wildlife (0.45)	Invasion of alien species (0.090)
		Growing of aquatic plants (0.078)
		Natural wetland rate (0.080)
	Improving campus aesthetics (0.4)	Coast shape (0.020)
		Water aeration (0.018)
		Usage (0.020)
	Increasing opportunities of campus recreation (0.6)	Population threat (0.014)
		Hydrophilic (0.020)

3.2.3. Evaluation Score Calculation and Classification

Cumulative summation formula is used to calculate comprehensive score of each campus waterscape investigated. Natural breakpoint classification of ArcGIS is used to classify the five universities according to the waterscape ecological situation into good, middle and bad situation.

The result shows that one is “good” with a proportion of 20% of all the investigated landscapes and 21.8% of the total area. Three are “middle” accounting for 60% of all investigated universities and 63.12% of the investigated area. One is “bad” accounting for 20% of the investigated waterscapes and 15.06% of the investigated area, as see from “Table.4”.

Table 4. Ecological status evaluation level

Number	Key investigation school name	Composite scores	Ecological status evaluation level
1	South China University of Technology	4.806	Bad
2	Guangzhou University of Chinese Medicine	5.303	Middle
3	Xinghai Conservatory of Music	5.601	Middle
4	South China Normal University	5.419	Middle
5	Guangzhou University of Technology	6.195	Good

4. Overall Evaluation

The investigation and analysis has shown that the ecological situation of waterscape in Guangzhou university town is serious and few universities are “good” in this aspect. An obvious problem is that usage rate of large area is low, so people’s activities has light influence on it. The “middle” situation accounts for the largest portion, which constitutes the main body of waterscape in Guangzhou university town. The development and utilization for it is unreasonable, changing and even

degenerating some aquatic features and posing threat on sustainable development of water. The “bad” situation accounts for the least portion, but some waterscapes have lost basic ecological functions. Main problems can be listed as follow:

4.1. Problems in regulatory service

The waterscape systems in South China University of Technology and Xing Hai Conservatory of Music are the type of container with weak water circulation, low self-purification capacity, degenerating capacity of regulating runoff. There is no connected campus aquatic ecosystem. The two universities use a lot of ground floor, causing large-area impermeable and low soil immersion rate. Waterscape revetment focuses on hard retaining wall, pursuing one-side formality and causing running water to become dead water, which has exerted negative influence on biological migration.

4.2. Problems in supply service

The water cycle management systems in the five universities are not efficient and have a long water cycle period. The fresh water resource (rainwater, etc.) is not effectively collected and used.

4.3. Problems in supportive service

The biological diversity in the five areas has decreased with few waterfront plants, imperfect species, which is related to the treatment of revetment. Waterfront plants don't connect water with hard landscape (pavement and path) to form a transition. The arboreal coverage is low and few aquatic plants are used in campus waterscape.

4.4. Problems in cultural service

The usage rates of the five waterscapes are not high and few hydrophilic platforms are established in the five universities. Though aquatic area is large enough, there exist many dead angles. Accessorial building and incomplete leisure facilities bring inconvenience to the using of waterscape.

5. Conclusions and Recommendations

According to previous investigation and documentation, the paper comes up with an idea that as to waterscape in Guangdong university town, perfect ecological protection and management system should be established and campus ecological protection and management capabilities should be improved. In waterscape ecology, water quality should be improved and multi-level filter strip should be widened and constructed to raise the water self-purification rate. At the same time, reuse of water circulation system can be established. Waterfront landscape designed to protect biological diversity should be built; vegetation types and landscape configuration should be enriched; landscape wetlands of internal ecological water treatment should be built; space should be opened to enrich the spatial morphology of vegetation communities and stratification of landscapes. Besides, opportunities of recreation can be increased by covering such topics as popular science education, public participation, leisure activities through three levels-watching and staying, entering and participating, exploring and interacting [8].

In a word, water is the source of life. People have an innate yearning for water and the environment of people is closely related to water environment. Waterscape in campus is an integrated natural system and landscape, providing a continuous leisure space and environmental cognitive space for campus life. The paper aims at emphasizing the idea of protecting ecology in terms of waterscape design. If we do good to water, campus waterscape will bring more pleasant appreciation and huger public profit.

6. References

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