

Article

# User, Public, and Professional Perceptions of the Greenways in the Pearl River Delta, China

Nannan Zhao <sup>1,2</sup>, Zheng Liu <sup>1,3,\*</sup> , Yanliu Lin <sup>4</sup> and Bruno De Meulder <sup>3</sup>

<sup>1</sup> School of Architecture, South China University of Technology, Guangzhou 510640, China; nannazhao3-c@my.cityu.edu.hk

<sup>2</sup> Department of Public Policy, City University of Hong Kong, Hong Kong 999077, China

<sup>3</sup> Department of Architecture, University of Leuven, 3001 Leuven, Belgium; bruno.demeulder@kuleuven.be

<sup>4</sup> Department of Human Geography and Planning, Utrecht University, 3584 CB Utrecht, The Netherlands; y.lin@uu.nl

\* Correspondence: liuzheng@scut.edu.cn or zheng.liu@urbanstudy.net

Received: 14 November 2019; Accepted: 10 December 2019; Published: 16 December 2019



**Abstract:** The perception of greenways has been intensively investigated to understand the attitudes of stakeholders and to study the preferences of greenway users. In the Pearl River Delta, there has been a long-term debate on the form and function of greenways in campaign-style development, but few studies have focused on the public perception of greenways. Through both onsite and online investigations, this study obtained first-hand data about the user perceptions of greenways in selected case studies and developed an overall understanding of the public perception of the Pearl River Delta (PRD) greenways. Moreover, to examine the academic debate, we further distributed questionnaires to groups that had professional educational backgrounds related to greenway planning. The results showed that, in contrast with the academic debate, the user, public and professional perceptions were positive toward PRD greenways. Although it has been commonly recognized that bikeways compose the primary form of PRD greenways, the results suggested that the public has multiple needs for greenways, in which the primary demands are recreation and transportation. The investigation also identified many issues in greenway practices regarding the accessibility of greenway spaces, the coherence of nonmotorized routes, and the landscape characteristics of the greenways. Finally, this study suggests that more effort should be placed on the everyday demands of greenways, including accessible recreational resources and safe, comfortable, and coherent nonmotorized routes.

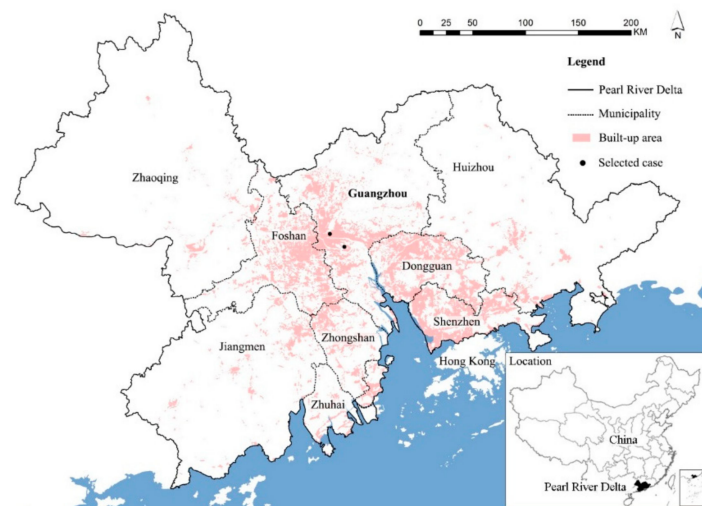
**Keywords:** greenways; perception; preference; Pearl River Delta; importance-performance analysis

## 1. Introduction

Greenways are linear green corridors that are planned, designed, and managed for multiuse purposes and are widely adopted as a planning strategy for sustainable landscapes [1,2]. As responses to urbanization, greenways are driven by basic human needs [3] and require an in-depth understanding of the user patterns and preferences. However, greenways could also result in policy conflicts between the mainstream greenway policy and local initiatives [4] and between public interest and private ownership [5,6]. The inconsistency of policy implementation and the opposition of local stakeholders have been serious challenges to greenway projects [3]. Therefore, community support and user preferences have been the primary focus in the existing literature. On the one hand, community support plays a crucial role in the process of land acquisition, which could result in the failure of the greenway project. On the other hand, user preferences can determine the planning and design. Furthermore, it is now difficult to develop a precise definition of greenways, which have a high heterogeneity in form and function [7]. There is a new issue in studying the public perception of

greenways. In particular, the emergence of transportation-led greenways requires further investigation of their influence on public perception [4,8]. In many cities, such as London, Portland, and Boston, these transportation-led urban greenways are implemented as responses to the urban residents' needs for nonmotorized travel, to the institutionalized arrangements of urban greening and street greenery and to the insufficiency of green corridors in the context of the urban landscape. These "landscaped and traffic-calmed pathways with a mix of bicycle facilities and other streetscape improvements" are called the "new urban greenways" [9] (p. 716). However, insufficient green corridors and recreational resources could lead to conflicts in public perceptions, especially in areas in which the greenways have been newly implemented.

Locating in the southern China, the Pearl River Delta (PRD) is comprised of nine cities and now is now one of the largest metropolitan regions in the world (see Figure 1). In the PRD, over 12,500 kilometers of greenways have been rapidly implemented during the last decade as the result of a regional policy aiming to achieve social, economic, and ecological benefits [4]. For this emerging greenway network in the largest metropolitan area in the world, there is a growing body of research on the regional governance [10–12], usage patterns [13–15], quality of the space [16], and rural economy [17]. However, little research has been conducted to understand the public perception of greenways, especially at the regional scale. Moreover, recent studies have shown that the majority of greenways in PRD cities overlap with transportation corridors and therefore serve transportation purposes [4,16]. For the large number of transportation-focused greenways, there have been long-term debates among experts on whether these PRD greenways fulfill the anticipated purposes, particularly whether the established greenway spaces can embody the greenway definition according to the practices in Western countries. However, the differences among the users and public and professional groups are still overlooked in the existing literature. Therefore, in this article, we present an illustration of the various perceptions of the Pearl River Delta greenways based on a mixed investigation of onsite and online questionnaires.



**Figure 1.** Location map of the Pearl River Delta and selected cases.

## 2. User, Public and Professional Perceptions of Greenways

The perceptions of and perspectives on greenways have been one of the primary research fields in the literature. Some scholars argue that investigation of the user preference can help to support the designation, design and management of greenways [18,19]. Although greenways are usually recognized for their ecological, environmental, social, recreational, esthetic, educational, and economic benefit benefits, conflicting perceptions of the impacts of greenways usually exist because landowners and nearby residents may oppose greenway planning because of the interference by tourists or the additional regulations. Therefore, there is a growing scholarly interest in assessing the perceptions of

greenways of different social groups, such as landowners [20], communities [6,7], recreational users and travelers [21–25], and planning authorities [26]. Although these groups usually overlap with each other, their perspectives on the conditions, benefits, and impacts of greenways can be further investigated as the user, public, and professional perceptions.

First, the user perception of greenways has been heavily investigated for the overall benefits, detailed preferences, and perceived problems. In general, greenways are appreciated for the preservation of important open spaces with natural features (e.g., trees and water bodies) and to provide opportunities to exercise, relax, and appreciate nature [19,23]. Based on the investigation of user perception and preferences, researchers have concluded many detailed factors that could influence greenway uses, such as attractiveness, accessibility, visibility, water bodies, proximity, trail surface, cleanliness, safety, lighting, drinking water, and restroom facilities [21,23,27]. However, crowded, neglected, unsafe, or poorly maintained greenways could also result in a decline in use or complete avoidance by users [22,28]. In addition, there are apparent differences between recreational uses and transportation activities in urban greenways [19,29].

Second, the public perception of greenways usually involves addressing the attitudes of communities and landowners, which plays a crucial role in greenway planning and implementation. In contrast with the greenway users who benefit from public access, residents have to face some negative impacts, which range from increased traffic volumes, trespassing greenway users, damage to property, and increasing property taxes [6,7,30,31]. Moreover, it should be noted that public perception is also a crucial way to investigate the overall condition of the greenway network, especially when greenways have high heterogeneity in form and location. In *The Image of the City*, Lynch chose public perception as the primary data source to categorize the five elements of a city image [32]. Likewise, from the perspective of greenways, public perception can reveal both the perceived space and observed activities of accessible greenways, which help to identify the primary form of greenway network that involves various projects and different proximities.

Third, based on the studies of user and public perceptions, some researchers focused on the perception of the planning authorities. Expert perspectives have served as important research data in the existing literature [24,33,34]. Because greenways are deeply intertwined with planning policies and institutional practices, the perception of planning authorities further determines the policy outcomes. For instance, the investigation of the planning authorities in the United Kingdom showed that one of the primary questions was the professional perception of the definition of greenways [26]. Turner further argued that enthusiasm and direction were lacking in greenway planning, which resulted in insufficient emphasis on the multi-objective landscape [26]. In addition, researchers indicate that divergences exist between public and expert preferences, both of which should be carefully considered in practice [35,36].

However, few studies have examined the regional discourse from the perspective of perceptions of greenways and have especially integrated the user, public, and professional perceptions of greenways. Furthermore, the widely implemented transportation-led greenways increase spatial and functional heterogeneity in many greenway networks, which makes it more difficult to give a precise definition of greenways. The traditional perceptions of greenways, such as ecological corridors, recreational trails, and park systems, also need to be examined, while the demands of non-motorized transportation are growing worldwide and particularly in cities that are experiencing rapid urbanization. Therefore, user, public and professional perceptions are crucial in understanding the social feedback toward the evolving greenways.

### 3. Controversies on Greenway Forms and Functions in the Pearl River Delta

Initiated in 2010, the PRD greenways are the first regional greenway network in China, which have been deeply affected by the institutional, environmental and social contexts [4]. They were planned as strategies for supporting recreational activities, protecting ecological systems and increasing the tourism economy, for which recreational and ecological greenways in other countries (e.g., the United

States, Germany and Singapore) were adopted as ideal references [4]. In order to promote greenways in all nine municipalities in the PRD region, the provincial government started a three-year campaign for a greenway network that should be “preliminarily connected in one year, comprehensively established in two years, and fully perfected in three years” [37]. Under the tight schedule, a centralized institutional structure was established to promote multi-government and multi-agency cooperation of actors from the provincial government, nine municipal governments, and local agencies. Moreover, the provincial government highlighted the political importance of greenways and encouraged competitive development, so that the cadres could prevail in governing performance. As a result of the three-year campaign, the PRD greenways achieved rapid development, reaching over 12,500 kilometers in 2015 [38]. However, Liu et al. argue that the majority of greenways in PRD cities overlap with transportation corridors and therefore primarily serve as transportation infrastructures rather than recreational and ecological greenways [4]. The primary reason is that, the fragmented landscape and limited land quota become the primary challenges to acquire greenway resources. In order to fulfill the numeric policy goals, local government preferred utilizing existing transportation infrastructures and other open spaces with public rights-of-way. Thus, existing resources could be conveniently transformed into greenways, while most of the negotiations can remain inside governmental agencies. In the end, more emphasis had been placed on the length and structural connectivity of the greenway network, rather than on the landscape and recreational resources of the greenways.

Therefore, among government officials and academic researchers, there have been continuous debates and critiques of greenway development ever since the beginning of the greenway scheme. In this debate, the central argument is whether the bikeway-like greenways have been implemented “correctly” in reference to the greenways for recreational, historical heritage and especially ecological purposes in other countries. In response to this issue, Mr. Wang and Mr. Xu, the governmental leaders of the PRD greenway movements, argued that it is incorrect to simply equate greenways with bicycle routes [39] (pp. 24, 64). However, some researchers argue that greenways are just bicycle routes with greenery [40], while others criticize the lack of attention to ecological concerns in current greenway development [41–43]. In this debate, it has not been recognized that it is difficult to find a “correct” form or a precise definition of greenways because they adapt to different contexts. Moreover, the public perception is also overlooked in this debate since most of the arguments are established by professional experts. Therefore, this article investigates the user and public perception of greenways compared with the professional perception.

#### 4. Methods and Data

To develop an overall understanding of the public perception of the PRD greenways, we conducted a series of empirical investigations during 2014 and 2019, which included discourse analysis, semi-structured interviews, onsite questionnaires, and online questionnaires.

First, we collected and conducted a comprehensive review of the related governmental documents in the three-year campaign during 2010 and 2012, including the planning documents issued by the provincial department, the greenway plans issued by nine local municipalities, the internal working newsletters, and a number of management documents and reports issued by local governments.

Second, during 2014 and 2019, we conducted semi-structured interviewed with more than 20 key actors in order to establish a preliminary understanding of the experts’ perceptions of greenways. These actors included seven government officials from provincial, municipal and county departments, two planning experts with practical experience in the greenway development in 2009 and 2010, one academic expert who conducted assessments on the PRD greenways in 2011 and 2014, and more than ten participants of the planning and implementation of greenways schemes during 2010 and 2019. Each in-depth interview was face-to-face and lasted approximately 1–3 h. These interviews focused on the actors’ perception of the definition and functions of greenways, perspectives on the established greenways in the PRD, and suggestions for improvement of future greenway projects.

Third, we chose onsite closed questionnaires to understand greenway users' perceptions of greenways, which helped us to establish basic knowledge about the greenway users' activity patterns, preferences and attitudes toward greenways. Each questionnaire contains 29 questions, focusing on users' usage patterns and perception of greenways. For instance, questions of usage patterns contain "the primary purpose of greenway use," "frequency of using this greenway," and "primary days of visiting this greenway." Questions on users' perceptions contain "the term used to describe this greenway," "primary attractiveness of this greenway," and "preferred greenway form."

In August 2014 and January 2015, we distributed onsite questionnaires to greenway users in two different greenways in Guangzhou, including Donghaochong Greenway and Biotech Island Greenway (Figures 1–3). Donghaochong Greenway and Biotech Island Greenway are two pilot greenway projects in Guangzhou. The cases were selected due to their flagship roles in Guangzhou, as well as the different locations and diverse surrounding landscapes. Donghaochong Greenway is a waterfront revitalization project in the historical center of Guangzhou, while Biotech Island Greenway is a belt park in a science and industrial compound surrounded by the Pearl River. Moreover, according to observation in our field investigation, Donghaochong Greenway and Biotech Island Greenway represent flagship projects that received more attentions in planning and implementation and therefore have higher quality of space, in contrast with many other greenways that overlap with transportation corridors. In the end, we collected over 383 valid questionnaires.



**Figure 2.** Location map of Donghaochong Greenway and Biotech Island Greenway.

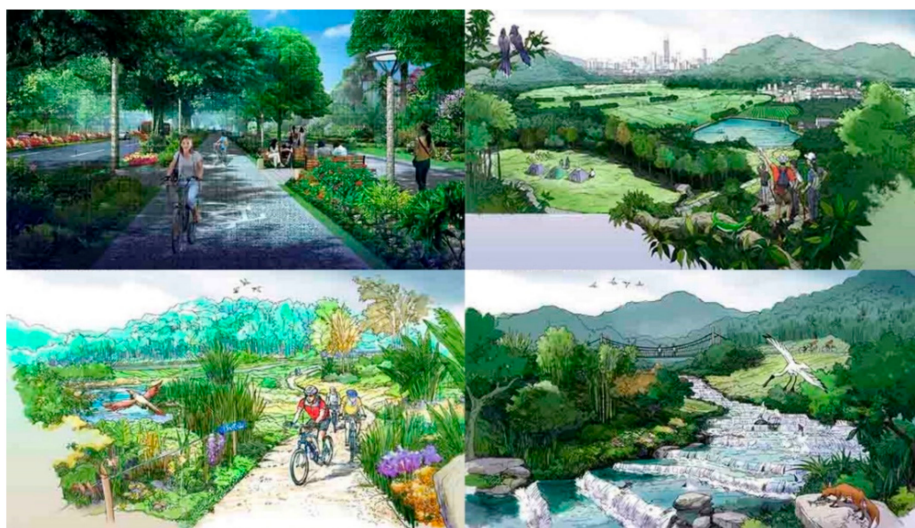


**Figure 3.** Donghaochong Greenway (a) and Biotech Island Greenway (b). (Source: Photo by the second author).

Fourth, we chose online closed questionnaires to understand the public perception of greenways, which not only increased the diversity of respondents but also expanded the perception of greenways

from certain routes to the overall network. In July 2016, we developed an open questionnaire on the WJX website ([www.wjx.cn](http://www.wjx.cn), case number 9202228) and distributed it through WeChat to targeted groups in the PRD. The targeted groups contain three parts—architects and planners in major institutions (i.e., Guangzhou Urban Planning & Design Survey Research Institute, Guangdong Urban & Rural Planning and Design Institute, Urban Planning & Design Institute of Shenzhen); interested groups in the local organization (i.e., Green Bike Transit); and local residents in groups of communities, schools, and friends. Based on the observation and results of the onsite investigation, we made adjustments to the onsite questionnaires and added new questions, including the background explanation, specifying key questions of perception, and questions for Importance Performance Analysis (IPA).

Each questionnaire contains 30 questions, focusing on the perception and preference of greenways. For instance, the questions of greenway perception contain “primary effect of the greenways,” “primary function of the PRD greenways,” and “primary form of the PRD greenways.” The questions of greenway preference contain “most needed location for greenways,” “appropriate space along transportation roads for greenways,” and “appropriate corridor width of greenways.” The public and professional groups were divided according to the respondents’ answers to whether they had obtained a degree in architecture, urban planning or landscape architecture. For those respondents who did not understand the greenway concept or were not familiar with the PRD greenways, we provided conceptual scenes (Figure 4) and an official definition at the beginning of the questionnaire so that they could establish a preliminary understanding of the greenways.



**Figure 4.** The conceptual scenes of the Pearl River Delta (PRD) greenways that were provided as a reference for the respondents. (Source: Department of Housing and Urban-Rural Development of Guangdong Province [37] (pp. 251–253)).

In the on-line questionnaires, we further adopted the importance-performance analysis (IPA) approach, which was used to compare the importance and performance of public perception and to develop improvement strategies [6,44]. Based on a literature review on policy documents for the PRD greenways and planning guidance of greenways, we chose 13 attributes that ranged from environmental, social, economic and transportation dimensions. These attributes include A) “access to natural environment,” B) “biodiversity of species,” C) “urban greening,” D) “environmental pollution control,” E) “recreational resources,” F) “experience of rural life,” G) “cultural heritage,” H) “tourism economy,” I) “rural economic transformation,” J) “coherence,” K) “safety,” L) “comfort,” and M) “attractiveness.” They were scored by the respondents from “−2,” “−1,” “0,” “1,” and “2,” in which “−2” refers to most unsatisfied or most unimportant, and “2” means most satisfied or most important.” With the average score of respondents’ feedbacks for each attribute, we conduct cross-hair placement

and divide the attributes into four quadrants—Quadrant I: “Concentrate Here,” Quadrant II: “Keep Up the Good Work,” Quadrant III: “Low Priority,” and Quadrant IV: “Possible Overkill.”

Finally, we collected 464 copies of online questionnaires, out of which 279 copies were completed by typical local residents, and 185 copies were completed by professional planners or architects. The questionnaire focuses on the usage patterns, perceptions, and preference toward greenways.

## 5. Usage Pattern and User Perception of Selected Greenways in Guangzhou

Donghaochong is a stream that goes through the central part of the city and has been covered by an elevated highway since 1993. The sewage systems of nearby communities used to directly connect with the stream, resulting in serious pollution and a foul-smelling stream. Moreover, because of the elevated highway that covers the river and is close to the nearby buildings, the riverside spaces were dark, noisy, and lacking in management. Before the 2010 Olympic Games, the Guangzhou municipal government initiated a linear park project along the stream connecting the Pearl River and Lu Lake. The project proposed to improve the green space along the stream and managed to demolish the buildings that were surrounded by the elevated highway and connected the green spaces by nonmotorized paths and linear green corridor. In the meantime, the municipality proposed a scheme for Biotech science and industrial compounds on an undeveloped island outside the central part of the city since the 1990s. On this island, a green belt was planned as a linear riverside park to highlight the amenity and to attract investors. In 2008, a three-year construction project began, which built 6.6 kilometers of bikeways in the greenbelt and facilitated greenways with public rental bikes. Because of the riverside views and public accessibility, the project soon become one of the most popular greenway spots in Guangzhou. The increasing volume of greenway users even became a serious burden to the management of the Biotech Island Greenway, as the local media reported “over 70,000 tourists per day on the 10-kilometre greenway” [45].

Through observations from field investigations, we found that both greenways accommodated a large number of users and dynamic social activities. The results of the questionnaires showed the usage pattern of these greenways (Table 1). Generally, outdoor exercise and recreational activities are the primary purposes of greenways (Question 1 in Table 1). The majority of the respondents were not frequent users of both greenways; the usage frequency was lower than once a month (Question 2 in Table 2). Moreover, users of both greenways differed between cases in terms of visiting days, transportation method, and time and length of visit. Biotech Island Greenway was more popular to visitors on the weekends and holidays, while the Donghaochong Greenway primarily supported everyday activities (Question 3 in Table 1). Consequently, users preferred to spend more time at Biotech Island Greenway than the users in the Donghaochong Greenway (Question 4 in Table 1). Moreover, the users in the Donghaochong Greenway preferred walking, and those in Biotech Island Greenway preferred driving as their primary method of transport to access the greenways (Question 5 in Table 1). The primary reasons were that Biotech Island Greenway is father away from the central part of the city, and compared with the Donghaochong Greenway, the Biotech Island Greenway has fewer residential communities nearby and a higher availability of parking lots.

**Table 1.** Usage patterns of greenway users in Donghaochong and Biotech Island Greenways.

	Donghaochong ( <i>n</i> = 99)	Biotech Island ( <i>n</i> = 284)
1. The primary purpose of greenway use		
Outdoor exercise	12.12%	41.20%
Recreational activity	60.60%	47.89%
Cultural experience	3.03%	1.05%
Collective events	3.03%	9.86%
Travel through	21.21%	0.00%

Table 1. Cont.

	Donghaochong (n = 99)	Biotech Island (n = 284)
2. Frequency of using this greenway		
Fist time	26.26%	33.10%
Less than six times per year	23.23%	24.65%
Between six times and 12 times per year	12.12%	22.18%
More than 12 times per year	38.38%	20.07%
3. Primary days of visiting this greenway		
Holidays	7.07%	15.49%
Weekends	27.27%	62.32%
Workdays	10.10%	4.23%
Not particular days	55.56%	17.96%
4. The time spent in this greenway		
Less than one hour	43.43%	4.58%
Between one hour and three hours	41.41%	50.35%
More than three hours	15.15%	45.07%
6. The travel method to reach this greenway		
Metro	34.34%	32.86%
Bus	12.12%	4.24%
Private vehicle	2.02%	46.64%
Bike	2.02%	13.07%
Walking	49.49%	3.19%
5. The time cost of traveling to this greenway		
Less than 30 min	37.78%	69.01%
Between 30 min and 60 min	32.65%	25.00%
Between 60 min and 120 min	25.51%	5.28%
More than 120 min	3.06%	0.70%

Although the two greenways varied from each other in location, form and usage pattern, the users shared similar perceptions of greenways. Respondents recognized that both greenways fit the description of green open spaces (Question 1 in Table 2); the primary attractiveness of Donghaochong was the nonmotorized travel, and that of Biotech Island Greenway was the green spaces (Question 2 in Table 2). However, their perceptions of the PRD greenways suggested that only the minority of the respondents frequently used the spaces, and many of them were unfamiliar with the term (Question 3 in Table 2). Moreover, most of the respondents preferred scenic trails in natural environments as their ideal form of greenway (Question 4 in Table 2); nevertheless, many respondents also expected greenways in community parks and everyday commute routes (Question 5 in Table 2).

Table 2. Perceptions of the Donghaochong and Biotech Island Greenways.

	Donghaochong (n = 99)	Biotech Island (n = 284)
1. The term used to describe this greenway		
Bikeway	27.27%	18.66%
Nonmotorized route	15.15%	11.27%
Waterfront park	7.07%	18.31%
Street park	10.10%	4.23%
Tourism route	6.06%	5.28%
Green open space	34.34%	42.25%
2. The primary attractiveness of this greenway		
Green spaces	31.31%	63.03%
Exercise resources	11.11%	8.80%
Proximity	7.07%	9.86%



Table 2. Cont.

	Donghaochong ( <i>n</i> = 99)	Biotech Island ( <i>n</i> = 284)
Food culture	3.03%	1.06%
Open to public	17.17%	17.25%
Nonmotorized travel	30.30%	0.00%
3. Frequency of using the PRD greenways		
Never heard	31.31%	28.52%
Occasional use	48.48%	38.03%
Frequent use	20.20%	33.45%
4. Preferred greenway form		
Urban greenways with green parks	18.19%	13.73%
Scenic trails in natural environment	81.81%	86.27%
5. Preferred greenway location		
Community parks	31.31%	15.49%
Everyday commute route	26.26%	19.73%
Inner city large parks	17.17%	15.14%
Suburban parks	12.12%	19.01%
Rural villages	2.02%	13.38%
Natural reserved area	11.11%	17.25%
6. Average scores of the greenway (0–10: 0 for the worst; 10 for the best)		
	7.34	7.64

We found that project-based investigation has both advantages and limitations for studying the perception of the PRD greenways. On the one hand, the project-based investigation could provide a spatial boundary to identify the greenway users, as well as a specific context that helps to elaborate on the questions to the respondents. On the other hand, the project-based investigation primarily focused on the user perception of the selected greenway cases, while a few cases can hardly represent the heterogeneity of the greenway spaces in location, landscape and functions. Therefore, both the number of respondents and projects should be expanded so that an overall understanding of the public perception could be developed. In this study, we chose online questionnaires as a complementary approach.

## 6. Public and Professional Perceptions of the PRD Greenways

As the results of online questionnaires show, the majority of respondents (75%) stated that the PRD greenways had positive effects on the quality of life (Question 1). The PRD greenways were commonly recognized to support outdoor recreation, daily commutes, street amenities and tourism (Question 2 in Table 3). More specifically, the PRD greenways were primarily seen as bikeways (28.66%), street greenery (22.63%), sidewalks with greenway signs (20.91%), and parkways (14.01%) (Question 3 in Table 3). While ecological benefits have been repeatedly argued in Chinese academic research, respondents rarely agree that ecological corridors are the common type of PRD greenway (Question 3 in Table 3) or that species habitat is the primary function of the PRD greenways (Question 2 in Table 3). The investigation further indicated that there were still several issues associated with the greenways (Question 4 in Table 3). First, the respondents stated that it was still difficult to find greenways (46.77% of 464 respondents), especially for greenways that are indistinguishable from bikeways or sidewalks (52.59%). Second, for recreational uses, the survey showed that accessibility was a key issue because of the remote location (46.98%) and insufficient public transport facilities (49.57%). Third, detailed greenway designs were still lacking for bikeway uses (48.06%) and service facilities (49.57%).

**Table 3.** Public and professional perceptions of the existing PRD greenways ( $n = 464$ ).

	Public ( $n = 279$ )	Professionals ( $n = 185$ )	All ( $n = 464$ )
1. Primary effect of the greenways:			
Positive effects on life quality	81.72%	64.86%	75.00%
No effect	17.92%	34.59%	24.57%
Negative effects	0.36%	0.55%	0.43%
2. Primary function of the PRD greenways:			
Daily commute	59.86%	55.14%	57.97%
Outdoor recreation	76.34%	69.73%	73.71%
Street amenity	55.91%	43.78%	51.08%
Access to the natural environment	37.28%	36.76%	37.07%
Education	4.30%	8.65%	6.03%
Species habitat	3.58%	2.70%	3.23%
Disaster protection	4.30%	5.95%	4.96%
Economic growth	4.66%	5.41%	4.96%
3. Primary form of the PRD greenways:			
Bikeways	25.45%	33.53%	28.66%
Street greenery	24.71%	19.46%	22.63%
Sidewalks with greenway signs	19.00%	23.78%	20.91%
Parkways	16.49%	10.27%	14.01%
Motorized ways with greenway signs	6.10%	3.78%	4.53%
Tourism routes	2.87%	2.16%	2.59%
Linear parks	2.15%	2.70%	2.37%
Green open space	3.23%	4.32%	3.66%
Ecological corridors	0.00%	0.00%	0%
4. Existing issues of greenway uses (multiple choice):			
Unable to identify greenways from bikeways	53.41%	51.53%	52.59%
Lacking attention to the concerns of cycling	48.03%	48.11%	48.06%
Lacking transport facilities	46.95%	53.51%	49.57%
Poor accessibility	43.37%	51.89%	46.98%
Hard to find greenways	44.80%	49.73%	46.77%
Crowded and noisy	34.77%	31.89%	33.62%
Amenities and pollution	22.58%	16.22%	20.04%
Lacking attractive views and resources	15.41%	18.38%	16.59%
No issue	3.94%	3.24%	3.66%

The results suggest that public and professional groups have similar perceptions and preferences for greenways. Most of the respondents preferred “daily commute route” and “community park” as the most needed locations for greenways (Question 1 in Table 4). The “bikeway on sidewalk” and the corridor width between 0 m and 12 m were agreed to be the appropriate forms of greenways (Questions 2 and 3 in Table 4), while the primary activities of greenway use were walking and cycling (Question 5 in Table 4). However, it should be noted that, compared with the public group of respondents, the professional groups of respondents used greenways less frequently (Question 4 in Table 4). The professional groups of respondents had a higher preference for off-road greenways (Question 2 in Table 4) and wider green corridors (Question 3 in Table 4). They had less participation in greenway activities (Question 4 in Table 4). In the end, the majority of the professional group (93.51%) showed great confidence in arguing that greenways are now a common element in planning and design, and they would incorporate greenways as planning strategies in their future careers (97.30%).

**Table 4.** Public and professional preferences for greenways ( $n = 464$ ).

	Public ( $n = 279$ )	Professionals ( $n = 185$ )	All ( $n = 464$ )
1. Most needed location for greenways			
Daily commute route	55.20%	49.73%	57.75%
Community park	25.45%	14.05%	22.77%
Inner city large park	5.73%	7.03%	6.81%
Suburban scenic park	4.30%	4.86%	4.93%
Cultural village	3.58%	3.24%	3.76%
Natural reserved areas	2.15%	2.16%	2.35%
Other location	1.79%	1.08%	1.64%
2. Appropriate space along transportation roads for greenways (multiple choice)			
Bikeway on sidewalk	49.10%	62.70%	54.53%
Sidewalk	51.25%	42.16%	47.63%
Off-road trails	40.50%	50.27%	44.40%
Relief road	28.32%	26.49%	27.59%
Motorized road	7.53%	6.49%	7.11%
3. Appropriate corridor width of greenways			
0–3 m	37.99%	29.19%	34.48%
3–12 m	48.75%	52.43%	50.22%
12–30 m	8.60%	11.35%	9.7%
30–60 m	1.08%	4.86%	2.59%
60–100 m	1.08%	1.08%	1.08%
100–200 m	1.43%	0.54%	1.08%
More than 200 m	1.08%	0.54%	0.86%
4. The frequency of greenway uses is:			
Never	18.28%	19.46%	18.75%
Less than 10 times per year	37.28%	52.43%	43.32%
Between 10 times and 30 times per year	19.00%	16.76%	18.1%
Between 30 times and 50 times per year	7.53%	4.32%	6.25%
More than 50 times per year	17.91%	7.03%	13.58%
5. Primary activities of greenways uses:			
Walking	48.03%	47.03%	58.62%
Cycling	30.47%	29.73%	37.14%
Driving	2.15%	2.70%	2.92%
Jogging	1.08%	1.08%	1.08%

We further adopt the importance-performance analysis (IPA) to conduct an in-depth investigation on the perceptions of greenway functions and performance. The result of the public group (Figure 5) showed that the respondents had a general positive perception of the greenways and that the greenways were recognized for the benefits and performance in the recreational dimension, including C) “urban greening,” M) “attractiveness,” E) “recreational resource,” L) “comfort,” and A) “access to natural environment.” Moreover, public group respondents suggested disinterest in some of the policy goals that were proposed in greenway planning, such as I) “rural economic transformation,” G) “cultural heritage,” F) “experience of rural life,” B) “biodiversity of species,” and H) “tourism economy.” In comparison with the results of the public group, the IPA analysis on the professional group (Figure 6) had a similar pattern, in which the recreational benefits were recognized and indicated that greater emphasis should be placed on J) “coherence.” Moreover, the professional group indicated that the social, economic, and environmental policy goals should be highlighted in future improvement strategies.

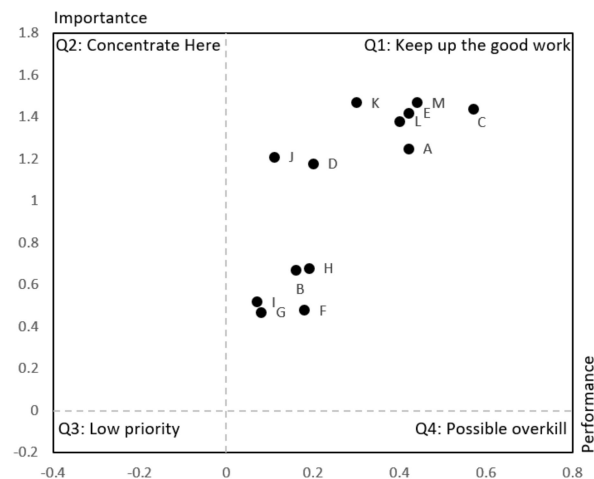


Figure 5. Importance-performance analysis (IPA) of the public perception of the PRD greenways.

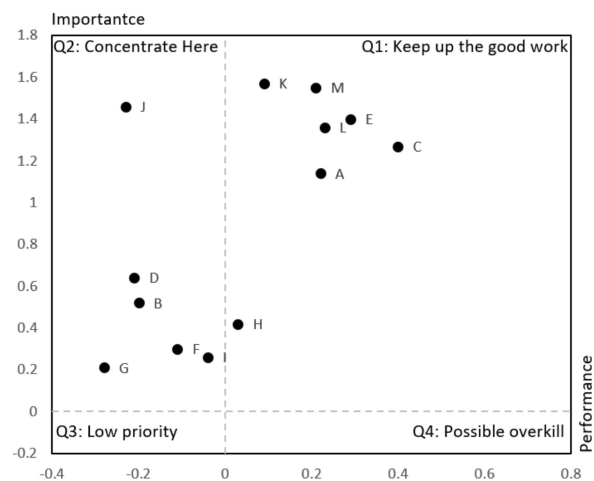


Figure 6. IPA of professional perception of the PRD greenways.

## 7. Discussion and Conclusions

The perceptions of greenways are responses in the human dimension to the greenway policy and planned activities. They were widely investigated to understand the attitudes of stakeholders and the patterns and preferences of greenway users. Moreover, the perceptions of greenways could also be used as evidence to test the multiple proposed benefits and particularly the consistency of the policy goals. In the PRD, there have been long-term debates on the function, form and policies of the PRD greenways in China. A few researches have investigated the perception of flagship greenway projects, such as Wutong Greenway [13] and Liantang Village [4,17]. However, whether the perception of the flagship projects can present the overall greenway network is still overlooked, considering the diverse function and forms of greenways in the PRD. Therefore, this study aimed to fill this research gap through onsite and online questionnaires. The respondents of these questionnaires comprised three groups; onsite questionnaires were distributed to the users of the Donghaochong Greenway and Biotech Island Greenway, and online questionnaires were distributed to public respondents and professional respondents who had obtained related education backgrounds. The professional group was added to increase the completion rate of the questionnaires, because, in the onsite investigation, many of the respondents were found to be unfamiliar with the greenway policy and spaces. Moreover, the study also aimed to examine whether professional knowledge could be a key factor influencing the perception of greenways.

The results of the onsite questionnaires showed that most of the respondents were not frequent users and visited greenways for recreational activities on holidays and weekends. In the Donghaochong

Greenway and the Biotech Island Greenway, the proportion of everyday greenway use grew as the proximity to the residential communities increased. Within the context of the selected greenways, most of the respondents suggested positive perceptions of the greenways, while the average scores in both cases had moderate-high scores. Moreover, in the onsite investigation, we also found issues of perceptions. On one hand, many respondents rarely noticed the greenway spaces because of disinterest and the lack of related information. On the other hand, the perception of the selected greenways did not refer to the overall greenway network. Therefore, we further conducted online questionnaires and distributed them to target groups including common respondents, cycling enthusiasts, architects and planners, and the governmental managers of greenways. The results of the online questionnaires also supported the positive perception that we found in the onsite investigations. The majority of the respondents recognized the positive effects on quality of life. In the importance-performance analysis, the respondents further suggested that greenways bring recreational benefits by providing urban greening and accesses to the natural environment. Moreover, the professional groups indicated that they had seen greenways as a basic planning element and would like to incorporate greenways in their future careers.

The empirical findings also show that there is a gap between the regional discourse and the public perception of the PRD greenways. Although whether greenways should be implemented as bikeways has been the core issue in the academic debate, both onsite and online questionnaires indicated that the respondents view bikeways as a common form of greenway. Moreover, the perceptions of the appropriate space and corridor width of greenways refers to the greenways along motorized roads and with narrow green corridors. There could be several reasons of such outcomes, such as the influences from the established greenways in the PRD, urgent demands for nonmotorized transportation, and the lack of knowledge of greenways in other regions. However, for policy makers and planners, the empirical findings also suggest that it is necessary to review the existing policies and documents about greenways, which could not only help to understand the effects of the greenway policy, but also help to develop more accurate policy goals in future practices. For instance, for greenways that serve as green spaces for recreational uses, more emphasis should be placed on the attractiveness, proximity, and accessibility of greenways. In contrast, for greenways that serve as non-motorized transportation infrastructure, the comfortability, safety and coherence should be highlighted in future greenway practices.

The PRD greenways have provided valuable experience and lessons for the emerging “new urban greenways.” The high dependence on urban road systems and street greenery were the primary reasons for the rapid greenway development and are a major challenge for future greenway development in the PRD. Like greenways in many other regions, the PRD greenways follow the greenways in North America and Western Europe, which are seen as ideal models. However, the greenways are challenged by limited land recourses and fragmented natural landscapes. In the end, a large proportion of the PRD greenways are transportation-led greenways in urban areas [16], which fit the description of “new urban greenways” [9]. However, the PRD greenways also had more issues with the development of “new urban greenways.” It should be noted that unclear planning goals and mismatched planning activities could lead to conflicting perceptions of the greenway concept, as well as unnecessary investment in amenities and symbolic outcomes. Therefore, the greenway concepts and the local demands should be carefully considered in future greenway planning practices.

This research further indicates that the participation of stakeholders and users is essential in greenway planning, implementation, and follow-up maintenance, particularly for greenways that are developed under a regional agenda. As it has been found in the PRD greenways, the original discourse might experience unanticipated adaptations in multi-government cooperation, while the participation of stakeholders is usually overlooked. From this perspective, instead of comprehensive planning that aim at a one-size-fits-all solution, project-based collaborative planning is urgently needed in developing specific planning strategies to accommodate the diverse usage demands and to adapt into the various contexts. Moreover, more efforts should be placed on establishing effective dialogues

among experts, users and the public, in which professionally trained social organizations play crucial roles, such as the LivableStreets Alliance in Boston and the Atlanta Development Authority in Atlanta. However, although such organizations usually play important roles in financing, developing and managing greenways in the Western countries, they are still absent in many projects that are government-led in China.

**Author Contributions:** All authors have contributed to the development of the research and in the elaboration of this article. Specifically, conceptualization, Z.L.; methodology, Z.L. and N.Z.; investigation, N.Z. and Z.L.; data curation, N.Z.; writing—original draft preparation, Z.L.; writing—review and editing, B.D.M., Y.L. and N.Z.; supervision, B.D.M.; funding acquisition, Z.L.

**Funding:** This research was funded by the China Postdoctoral Science Foundation (Grant number 2019M662914), the Guangdong Natural Science Foundation (Grant number 2019A1515010717), the Guangzhou Municipal Philosophy and Social Science Program (Grant number 2019GZGJ07), the Fundamental Research Funds for the Central Universities (Grant number 2018BSXM13).

**Acknowledgments:** This research was supported by the Major Research Institute of Humanities and Social Sciences in Guangzhou, National Key Research and Development Plan (Grant number 2018YFC0704603), and National Natural Science Foundation (Grant number 51878285). The authors thank Huilin He, Qian Xiao, Shiwei Chen, Jinyu Zhang, Donghai Long, Liangwei Zhang, Yu Lu, Yixuan Fan, Jiawen Du, Xu Jing, Wendi Deng, Zhejia Xu, Jiancheng Lin, and Qingsheng Zeng for their valuable contributions to data collection.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

- Ahern, J. Greenways as a planning strategy. *Landsc. Urban Plan.* **1995**, *33*, 131–155. [[CrossRef](#)]
- Hellmund, P.C.; Smith, D.S. *Designing Greenways: Sustainable Landscapes for Nature and People*; Island Press: Washington, DC, USA; Covelo, CA, USA; London, UK, 2006.
- Searns, R.M. The evolution of greenways as an adaptive urban landscape form. *Landsc. Urban Plan.* **1995**, *33*, 65–80. [[CrossRef](#)]
- Liu, Z.; Lin, Y.; De Meulder, B.; Wang, S. Can greenways perform as a new planning strategy in the Pearl River Delta, China? *Landsc. Urban Plan.* **2019**, *187*, 81–95. [[CrossRef](#)]
- Little, C.E. *Greenways for America*; Johns Hopkins University Press: Baltimore, MD, USA, 1990.
- Weber, S.; Boley, B.B.; Palardy, N.; Gaither, C.J. The impact of urban greenways on residential concerns: Findings from the Atlanta BeltLine Trail. *Landsc. Urban Plan.* **2017**, *167*, 147–156. [[CrossRef](#)]
- Palardy, N.P.; Boley, B.B.; Gaither, C.J. Residents and urban greenways: Modeling support for the Atlanta BeltLine. *Landsc. Urban Plan.* **2018**, *169*, 250–259. [[CrossRef](#)]
- Ma, L.; Dill, J. Associations between the objective and perceived built environment and bicycling for transportation. *J. Transp. Health* **2015**, *2*, 248–255. [[CrossRef](#)]
- Ngo, V.D.; Frank, L.D.; Bigazzi, A.Y. Effects of new urban greenways on transportation energy use and greenhouse gas emissions: A longitudinal study from Vancouver, Canada. *Transp. Res. Part D Transp. Environ.* **2018**, *62*, 715–725. [[CrossRef](#)]
- Chung, C.K.L.; Zhang, F.; Wu, F. Negotiating Green Space with Landed Interests: The Urban Political Ecology of Greenway in the Pearl River Delta, China. *Antipode* **2018**, *50*, 891–909. [[CrossRef](#)]
- Liang, Y.; Zhou, Z.; Li, X. Dynamic of Regional Planning and Sustainable Development in the Pearl River Delta, China. *Sustainability* **2019**, *11*, 6074. [[CrossRef](#)]
- Xu, J.; Yeh, A. Interjurisdictional Cooperation through Bargaining: The Case of Guangzhou-Zhuhai Railway in the Pearl River Delta, China. *China Q.* **2013**, *213*, 130–151. [[CrossRef](#)]
- Chen, Y.; Gu, W.; Liu, T.; Yuan, L.; Zeng, M. Increasing the use of urban greenways in developing countries: A case study on Wutong Greenway in Shenzhen, China. *Int. J. Environ. Res. Public Health* **2017**, *14*, 554. [[CrossRef](#)] [[PubMed](#)]
- Liu, K.; Siu, K.W.M.; Gong, X.Y.; Gao, Y.; Lu, D. Where do networks really work? The effects of the Shenzhen greenway network on supporting physical activities. *Landsc. Urban Plan.* **2016**, *152*, 49–58. [[CrossRef](#)]
- Liu, X.; Zhu, Z.; Jin, L.; Wang, L.; Huang, C. Measuring patterns and mechanism of greenway use—A case from Guangzhou, China. *Urban Urban Green.* **2018**, *34*, 55–63. [[CrossRef](#)]

16. Liu, Z.; Lin, Y.; Zhao, N. Developing greenways under a top-down institutional structure: A case study in the Pearl River Delta, China. In Proceedings of the 5th Fábos Conference on Landscape and Greenway Planning, Budapest, Hungary, 30 June–3 July 2016.
17. Zhao, F.; Nie, R.; Zhang, J. Greenway implementation influence on agricultural heritage sites (AHS): The case of Liantang village of Zengcheng District, Guangzhou City, China. *Sustainability* **2018**, *10*, 434. [[CrossRef](#)]
18. Lee, J.; Lee, H.; Jeong, D.; Shafer, C.S.; Chon, J. The Relationship between User Perception and Preference of Greenway Trail Characteristics in Urban Areas. *Sustainability* **2019**, *11*, 4438. [[CrossRef](#)]
19. Shafer, C.S.; Lee, B.K.; Turner, S. A tale of three greenway trails: User perceptions related to quality of life. *Landsc. Urban Plan.* **2000**, *49*, 163–178. [[CrossRef](#)]
20. Schrader, C.C. Rural greenway planning: the role of streamland perception in landowner acceptance of land management strategies. *Landsc. Urban Plan.* **1995**, *33*, 375–390. [[CrossRef](#)]
21. Akpinar, A. Factors influencing the use of urban greenways: A case study of Aydın, Turkey. *Urban Forestry Urban Green.* **2016**, *16*, 123–131. [[CrossRef](#)]
22. Asakawa, S.; Yoshida, K.; Yabe, K. Perceptions of urban stream corridors within the greenway system of Sapporo, Japan. *Landsc. Urban Plan.* **2004**, *68*, 167–182. [[CrossRef](#)]
23. Gobster, P.H. Perception and use of a metropolitan greenway system for recreation. *Landsc. Urban Plan.* **1995**, *33*, 401–413. [[CrossRef](#)]
24. Gobster, P.H.; Westphal, L.M. The human dimensions of urban greenways: Planning for recreation and related experiences. *Landsc. Urban Plan.* **2004**, *68*, 147–165. [[CrossRef](#)]
25. Pettengill, P.R.; Lee, B.H.Y.; Manning, R.E. Traveler Perspectives of Greenway Quality in Northern New England. *Transp. Res. Rec. J. Transp. Res. Board* **2013**, *2314*, 31–40. [[CrossRef](#)]
26. Turner, T. Greenway planning in Britain: Recent work and future plans. *Landsc. Urban Plan.* **2006**, *76*, 240–251. [[CrossRef](#)]
27. Balestrieri, M.; Congiu, T. Rediscovering rural territories by means of religious route planning. *Sustainability* **2017**, *9*, 363. [[CrossRef](#)]
28. Boone, C.G.; Buckley, G.L.; Grove, J.M.; Sister, C. Parks and People: An Environmental Justice Inquiry in Baltimore, Maryland. *Ann. Assoc. Am. Geogr.* **2009**, *99*, 767–787. [[CrossRef](#)]
29. Turner, S.M.; Best, M.E.; Schrank, D.L. *Measures of Effectiveness for Major Investment Studies*; Report No. SWUTC/96/467106-1; Texas Transportation Institute: College Station, TX, USA; Texas A&M University: College Station, TX, USA, 1996.
30. Corning, S.E.; Mowatt, R.A.; Charles Chancellor, H. Multiuse Trails: Benefits and Concerns of Residents and Property Owners. *J. Urban Plan. Dev.* **2012**, *138*, 277–285. [[CrossRef](#)]
31. Lindsey, G.; Maraj, M.; Kuan, S.C. Access, Equity, and Urban Greenways: An Exploratory Investigation. *Prof. Geogr.* **2001**, *53*, 332–346. [[CrossRef](#)]
32. Lynch, K. *The Image of the City*; MIT Press: Boston, MA, USA, 1960.
33. Teng, M.; Wu, C.; Zhou, Z.; Lord, E.; Zheng, Z. Multipurpose greenway planning for changing cities: A framework integrating priorities and a least-cost path model. *Landsc. Urban Plan.* **2011**, *103*, 1–14. [[CrossRef](#)]
34. Türk, E. Multi-criteria Decision-Making for Greenways: The Case of Trabzon, Turkey. *Plan. Pract. Res.* **2018**, *33*, 326–343. [[CrossRef](#)]
35. Colombo, S.; Angus, A.; Morris, J.; Parsons, D.J.; Brawn, M.; Stacey, K.; Hanley, N. A comparison of citizen and “expert” preferences using an attribute-based approach to choice. *Ecol. Econ.* **2009**, *68*, 2834–2841. [[CrossRef](#)]
36. Rogers, A.A. Public and expert preference divergence: Evidence from a choice experiment of marine reserves in Australia. *Land Econ.* **2013**, *89*, 346–370. [[CrossRef](#)]
37. Department of Housing and Urban-Rural Development of Guangdong Province. *Memoir of Guangdong Greenway Network: Planning and Construction*; China Architecture & Building Press—China City Press: Beijing, China, 2014. (In Chinese)
38. Liu, Z. *Urbanism in Transformation: The Planning and Implementation of the Pearl River Delta Greenways*. Ph.D. Thesis, South China University of Technology, Guangzhou, China, 2017. (In Chinese).
39. Guangdong Provincial Department of Housing and Urban-rural Construction. *Memoir of Guangdong Greenway Network: Planning and Construction*; China Architecture & Building Press—China City Press: Beijing, China, 2013. (In Chinese)

40. Fang, K. *Greenway fore Greenways, Two Thousand Kilometers of Greenways Accomplished in One Yea*; B16; Southern Weekly: Guangzhou, China, 19 January 2011. (In Chinese)
41. Chen, K.; Zhou, Y. A Review of the Greenway Construction in the Background of Integrated Urban and Rural Development in China. *Mod. Urban Res.* **2015**, *5*, 51–57. (In Chinese)
42. Sheng, M. Thoughts and strategy to current “Craze” on greenway network planning and construction in China. *Landsc. Archit.* **2015**, *5*, 31–37. (In Chinese)
43. Li, Y.; Zhang, Y.; Yan, T. Urban greenway planning method updating under “Urban Renovation and Ecological Restoration” guidance. *Chin. Landsc. Archit.* **2017**, *33*, 75–80. (In Chinese)
44. Boley, B.B.; McGehee, N.G.; Tom Hammett, A.L. Importance-performance analysis (IPA) of sustainable tourism initiatives: The resident perspective. *Tour. Manag.* **2017**, *58*, 66–77. [[CrossRef](#)]
45. Li, D. *The Crowded Biotech Island Will Restrict Inflow Vehicles at Weekends*; A5; Guangzhou Daily: Guangzhou, China, 28 June 2016. (In Chinese)



© 2019 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).