Everyday life along a regenerated urban river in Shenzhen

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Abstract

Many developed Asian cities have prioritized urban river regeneration, which translates into radically transforming the cityscape by retrofitting multi-purpose blue and green infrastructure. Still, many questions remain about socialization and space: Who are the users? Which activities are performed? Do landscape settings and contextual urban conditions impact the use patterns of regenerated urban rivers? This study aims to answer these questions by focusing on a highly successful urban river regeneration: the Futian River in Shenzhen. In total, 3,373 users and 24 activity types were observed along the river three times (two weekdays, one weekend day). The observations revealed different uses throughout the period: aged 40+ visited in the morning and those below 40 visited mid-day; males (56.7%) and young adults (42.6%) are represented categories for sex and age group, respectively. The most popular activities were walking (28.6%), relaxing (15.2%) and picnicking (7.3%). Behavioural mapping highlighted the clustering of users and activities in specific locations, so the river space provides crucial recreational space for low-income villagers. Through these findings, this study can provide insights about user habits to designers and policy-makers producing responsive spaces and policies. This research will also contribute to the shifting attention towards the practice of everyday life.

1. Introduction

Rivers have always played a crucial role in urban development, but have also been perceived and managed differently in different historical phases. Before modernity, rivers were crucial to the provision of water and served as transport infrastructure; industrialization produced a radical transformation of watercourses regarding fluvial geomorphology, pollution levels and their employment as waterways. Industrial development and the rapid growth of cities then caused urban rivers to become flood control channels and repositories for sewage effluents, while the modal shift to road haulage followed the abandonment of many small and medium waterways. As a result, degraded landscapes crossed by open-air concrete sewers became a stigma for many developing cities. Growing awareness of these impacts of industrialization on ecosystems then began to spread following the harmful effects of synthetic substances on human and ecological communities. Water systems especially reflected the fragility of ecosystems, prompting calls for an integrated approach to their remediation. Contextually, policymaking crystallized this new ecological imperative into legislation. Urban river regeneration subsequently received the public investment of massive resources. In recent years, especially in Asia, urban river regeneration translated into the possibility of radically transforming the cityscape by retrofitting it with a blue and green infrastructure serving multiple purposes: environmental, economic and social. This paper focuses on the latter, which first interested urban designers following the popularity enjoyed by regenerated rivers in cities such as Seoul, Singapore and Shenzhen. Due to their success, these cases became undeniable design references and were uncritically reproduced in different contexts across and beyond Asia. Nevertheless, urban river regeneration is—and must be understood as—a context-dependent process that requires in-depth knowledge of the social and cultural conditions in which regeneration is implemented.

This article focuses on the case of Shenzhen to investigate its daily users and uses, information that will provide crucial for designers and policymakers attentive to producing responsive spaces and policies that address the local population's needs and cultural habits.

2. River regeneration policies

In East Asia, the adoption of policies for environmental protection and the establishment of stream renaturation frameworks remains uneven. In Japan, industrialization-driven channelization and the heavy pollution of rivers occurred first. The resulting effects on human health then called for environmental protection since the early 1950s and found answers in the Basic Law for Environmental Pollution Control (1967) and the Water Pollution Control Law (1970). Influenced by Switzerland and Germany, the River Bureau of Japan launched the first river renaturation initiative in the early 1990s—the Nature-Oriented River Works. South Korea took a similar path with the first Korean renaturation project being the Han Rivet Project (1982–1986), followed by The Four Major Riv-

ers Restoration Project. In Singapore, the first initiative of this type dates to 1977 with the cleaning of the Singapore River and the Kallagan Basin. In China, the process of extensive industrialization and pollution occurred much later, and only from the 1980s onwards did the concept of an ecological civilization start to be popularized following the translation of a USSR article (Lipitsky, 1984). In China, stream renaturation is a recent practice, initiated in the early 2000s, and has since been booming in the last decade with several significant projects all over the country. Despite these developments, many countries of Southeast Asia are still lagging and are not properly regulating the occurring process of industrialization, geomorphological transformation and steam pollution.\

2.1. Waterway transformations in the Greater Bay Area

The Greater Bay Area (GBA), comprising the 11 urban centres in southeast China, has become one of the most populous and economically productive urban megaregions globally. The much older toponym referring to the area, Pearl River Delta (PRD), evokes the genesis of this region as a cohesive cultural landscape, transport network and interacting system of settlements linked by a lattice of waterways converging on the Pearl River and its mouth at the South China Sea (Jachna, 2021). This location and topography cultivated the river's maritime civilization, profoundly influencing regional development. The region has abundant rivers and estuaries, and river ports and sea harbours have been developed throughout history (Bie et al., 2015). Since the 1990s, the rapid urbanization and industrialization in the PRD have led to the continuous enlargement of urban areas, which expanded to occupy ample cultivated land, forests and water bodies (Qu and Qi, 2021; Talamini et al., 2022). The intensive and rapid urbanization led to not only unique urban forms and situations, but also a fragmented urban fabric. As a result, the environmental impacts caused by the past and ongoing economic development quickly drew attention from the public and planning authorities, who wanted to preserve and enhance the ecological system in regional planning and design (Qu and Qi, 2021; Talamini et al., 2022).

Over the past decade, water management has been essential for the Guangdong province of China. The implementation of the Plan for Comprehensive Improvement of the Pearl River Water Environment in Guangdong Province in 2002 mainly focused on sewage treatment. In 2013, the Southern Guangdong Water Cleaner Action Plan (2013–2020) also positioned surface water purification as the main remediation target. Since 2014, Shenzhen and Dongguan have facilitated pollution management on riverside enterprises to treat river sewage while also optimizing the land functions along the river. The innovative measures both improved the water ecological environment and promoted upgrading the riverside industrial development specifically and the environment generally. In June 2018, against the background of the construction of an Ecological Civilization, the Guangdong provincial government proposed the construction of high-quality blueways, link-

ing water management and river bank design (Ma et al., 2020). Subsequently, the Blueway Planning and Design Initiative was launched, aiming to reimagine over 16,000 kilometres of waterways in the region (RCSOG, 2020). The bold initiative proposed an extension of the scope of the blue infrastructure beyond the geographical limits of Guangdong and the scope of water management to contribute to shaping the development of the GBA with an essential blue and green infrastructure. Employing an integrated approach and falling outside the conventional green corridor and river regulation works, the Blueway Initiative targeted industrial transformation and urban renewal, addressing ecological, recreational and cultural needs.

2.2. River space for sociability

The space generated by river regeneration typically shapes a green linear corridor across the urban fabric. Regenerated rivers, as linear parks and greenways, offer significant ecological services by connecting urban habitats and associated biodiversity (Ahern, 2013; Bryant, 2006) and by providing opportunities for positive interactions between humans and nature in congested cities (Chon and Shafer, 2009; Gobster, 1995). Greenways improve the micro-climate, compensate for the lack of green spaces in developed areas, and link urban parks and neighbourhoods (Shafer et al., 2000), reducing human-vehicle conflicts. Further, greenways provide venues for citizens to engage in stress-relieving and recreational activities, thus promoting residents' neighbourhood attachment (Pearlin, 1993) and enhancing residents' quality of life (Dallat et al., 2014). Greenways are a unique type of urban green space and perhaps have a greater capacity than other types to integrate natural resource conservation and public health promotion (Keith et al., 2018). Relevant literature on blue and green infrastructure has identified social interactions and psychological benefits as crucial for health (de Bell et al., 2017; Talamini, 2020). As public spaces, greenways provide venues and opportunities for different types of social interactions (Lofland, 2017). Considerable research has substantiated that green open spaces positively impact social cohesion and provide an attractive and pleasant environment for social activities (Wan et al., 2021; Elands et al., 2018; Swanwick et al., 2003; Kuo et al., 1998). Compared to compact parks, linear spaces may have better impacts on the urban neighbourhood environment and interactions due to the narrow and long shape of such spaces, which can provide more access to the neighbourhood. Brown et al. (2014), comparing different opportunities for physical activities offered by different urban park types, indicated that linear parks provide the greatest overall physical benefits than other neighbourhood-bounded ones. Despite the extant research findings, the unanswered questions noted above still apply in the context of a fast-developing Asian city. This paper therefore aims to identify daily users, their activities, and whether the landscape and urban conditions impact the daily use patterns of regenerated urban rivers by examining these factors in the context of the Futian River in Shenzhen, China. Who are the users? Which kind of activities are

performed? Do landscape settings and contextual urban conditions impact the daily use patterns of regenerated urban rivers? This paper aims to answer some of these questions by focusing on a vibrant Asian city with one of the most successful cases of urban river regeneration: the Futian River in Shenzhen.

3. Methods

3.1. Study area

For this study, we selected the Futian River in Shenzhen as a case study for analyzing the relationship between riverfront landscape characteristics and people's recreational preferences. Shenzhen is a river-rich city with 310 streams with a more than 1-km2 catchment area. However, amid the rapid development of urbanization, water resources today are in short supply in Shenzhen, and surface water pollution is severe. The Shenzhen government has, in response, carried out river regeneration projects in recent years to improve the water environment and people's quality of life (Talamini et al., 2017). Among those projects, the Futian River is the most successful case of river regeneration, with the linear park being well-recognized and highly used.

The Futian River extends along a 6.8-km stretch through the central area of the Futian District. In the early 2000s, the river had severe water pollution. By August 2009, a river improvement project was started to prioritize five tasks: flood control, pollution control, water quality improvement, landscape improvement and greenway construction. The Futian River then became an ecological urban greenway park in 2013, with 3.4 km2 of green space and a 6.8-km greenway. From north to south, the park connects two other major city parks (Bijiashan Park and Central Park) and provides citizens with many leisure and fitness facilities. The greenway park also enhances public facilities' spatial distribution and improves residents' accessibility to open public green spaces (Shenzhen Municipal Government, 2013).

3.2. Behaviour Mapping

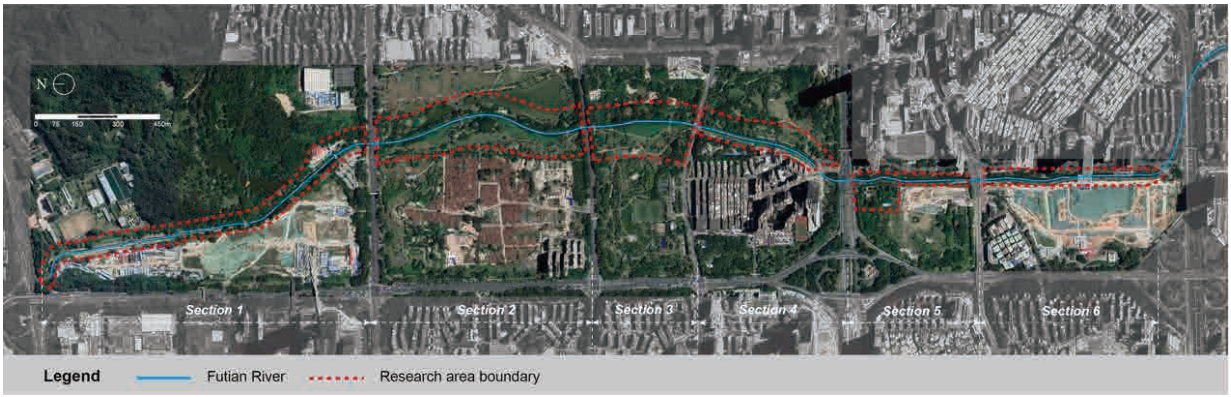

Figure 1. Study area: Futian River.

In this study, we used behaviour mapping to investigate and visualize the spatial patterns in the clustering of users (Villani and Talamini, 2021; He et al., 2021). Behaviour mapping is a well-established method that relies on the unobtrusive observation of human behaviour for the analysis and visualization of spatial occupancy patterns to investigate the association between users' locational choices and design features of the built environment (Bechtel and Zeisel, 1987; Cosco et al., 2010; Gehl, 1987; Marušić, 2016; Villani and Talamini, 2019; Villani et al., 2020a; Villani et al., 2020b). Typically conducted in three phases, behaviour mapping involves a survey of spatial settings for their representation in a scale map, the classification of activity types, and activity plotting and georeferencing for further analysis and visualization (Marušić and Marušić, 2012; Villani and Talamini, 2020). In this study, we used behaviour mapping to analyze the users' distribution and people's activity types in the linear riverside space (Talamini, 2020). Extensive on-site systematic observations were conducted by unmanned aerial vehicles (UAVs) and handheld cameras. The UAV can record people's activities at a relatively high angle and cover a wide range of areas with more comprehensive information in a shorter time than a traditional camera (Park and Ewing, 2017). However, UAVs have some blind angles that require using the handheld camera to make auxiliary records on the ground. Data on user activities, attributes (age and sex) and spatial patterns were collected on two working days and one weekend in March 2019. Each collection day comprised three stages: morning (9 am–10 am), noon (12 pm–1 pm) and late afternoon (3 pm–4 pm). For the selection of time intervals and data collection days, temperature and weather factors were considered.

This study then applied offline data processing; video data were acquired and processed after the on-site survey was completed (Khan et al., 2017). The collected information was extracted via manual interpretation of the recorded videos. To ensure accuracy of the recorded results, two trained assessors independently watched the same videos and recorded the activities. The activities to be analyzed and their classifications were accurately set and defined in advance to not only to avoid subject judgments but also obtain high inter-rater agreement. In the data processing phase, the spatial data and user activity information collected were converted into spatial data points with coordinates in ArcGIS. Age groups were categorized based on facial features (Horng et al., 2001): children below 13 years old, teenagers between 13 and 19 years old, young adults between 20 and 39 years old, middle-aged adults between 40 and 59 years old, and mature adults 60 years old or more. Establishing different layers for different types of activities enabled the convenient analysis of behavioural patterns. After the dataset was completed, an analysis on behavioural patterns and space use was performed, and activity density patterns were illustrated by generating maps in ArcGIS.

4. Findings

A total of 3,373 users and 24 activity types

Activities	Sex		Age					All	%
	Male	Female	Children	Teenagers	Young adults	Middle-aged adults	60+ adults		
Calligraphy	3	0	0	0	0	1	2	3	0.1
Chatting	63	38	0	0	19	51	31	101	3.0
Cycling	172	45	20	16	129	52	0	217	6.4
Dancing	24	136	0	0	17	124	19	160	4.7
Fishing	34	2	1	0	9	23	3	36	1.1
Exercizing or training	107	61	12	23	56	67	10	168	5.0
Flying kites	8	1	4	1	2	2	0	9	0.3
Jogging	128	47	0	5	84	84	2	175	5.2
Photography	27	17	0	5	17	17	5	44	1.3
Picnic	110	135	62	3	147	27	6	245	7.3
Playing chess	22	2	0	0	0	11	13	24	0.7
Playing games	93	52	110	2	27	6	0	145	4.3
Playing music	10	4	0	0	2	10	2	14	0.4
Playing water	103	74	93	14	64	6	0	177	5.2
Playing with kids	22	32	5	0	34	14	1	54	1.6
Reading	5	4	2	0	7	0	0	9	0.3
Relaxing or resting	295	219	53	7	228	149	77	514	15.2
Selling	11	9	0	0	6	14	0	20	0.6
Singing	3	14	0	0	0	9	8	17	0.5
Skateboarding	18	4	16	3	3	0	0	22	0.7
Walking	538	427	97	30	414	339	85	965	28.6
Walking baby	74	117	1	0	147	40	3	191	5.7
Walking pets	30	22	1	0	25	23	3	52	1.5
Practicing Wushu and Taiji	11	0	0	0	0	2	9	11	0.3
Total	1911	1462	477	109	1437	1071	279	3373	100.0
%	56.7	43.3	14.1	3.2	42.6	31.8	8.3	100.0	

Table 1. People's daily activities along the Futian River

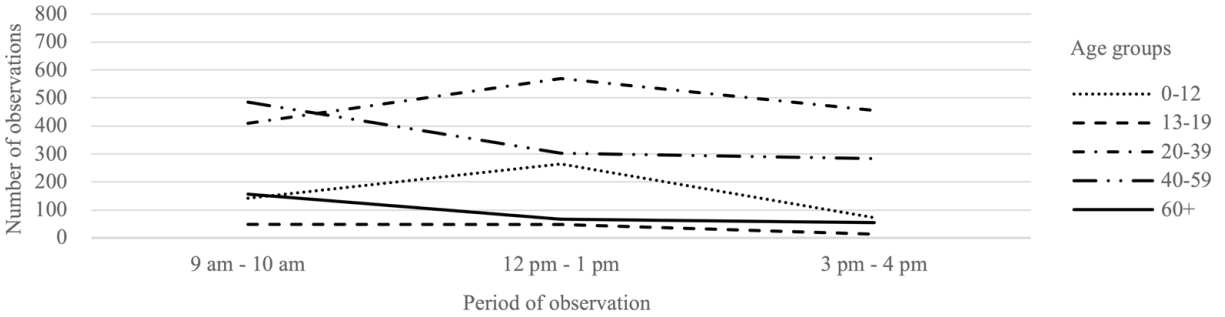

Figure 2. The percentage of different kinds of users in three time periods.

were observed along the river (Table 1). Among all users, 56.7% were male, and 43.3% were female. Compared with the population data in Shenzhen, 51.8% male and 48.2% female (Shenzhen Statistical Yearbook, 2015), more male visitors than female ones were observed along the Futian River. Most visitors came in groups (76.6%) rather than alone (23.5%). We also found that the proportion of young adults (42.6%) and middle-aged adults (31.8%) was relatively higher than for other groups (14.10% children, 8.3% older adults and 3.2% teenagers). These differences show that young and middle-aged people are primary users of riverfront space. Figure 2 shows that people of different age groups visit the riverfront spaces at different times as well. Most middle-aged 60+ users generally visit the riverside in the morning, while most young people play on the riverside in the noon and late afternoon periods. Further, the five most popular activities observed along the Futian River were walking (28.6%), relaxing and resting (15.2%), picnicking (7.3%), cycling (6.4%) and walking baby (5.7%).

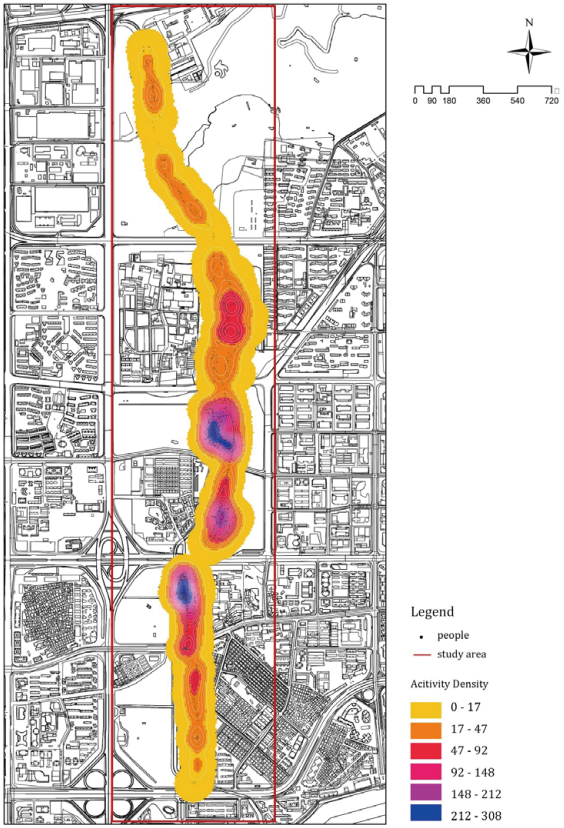

Figure 3. Activity density over four days along the Futian River.

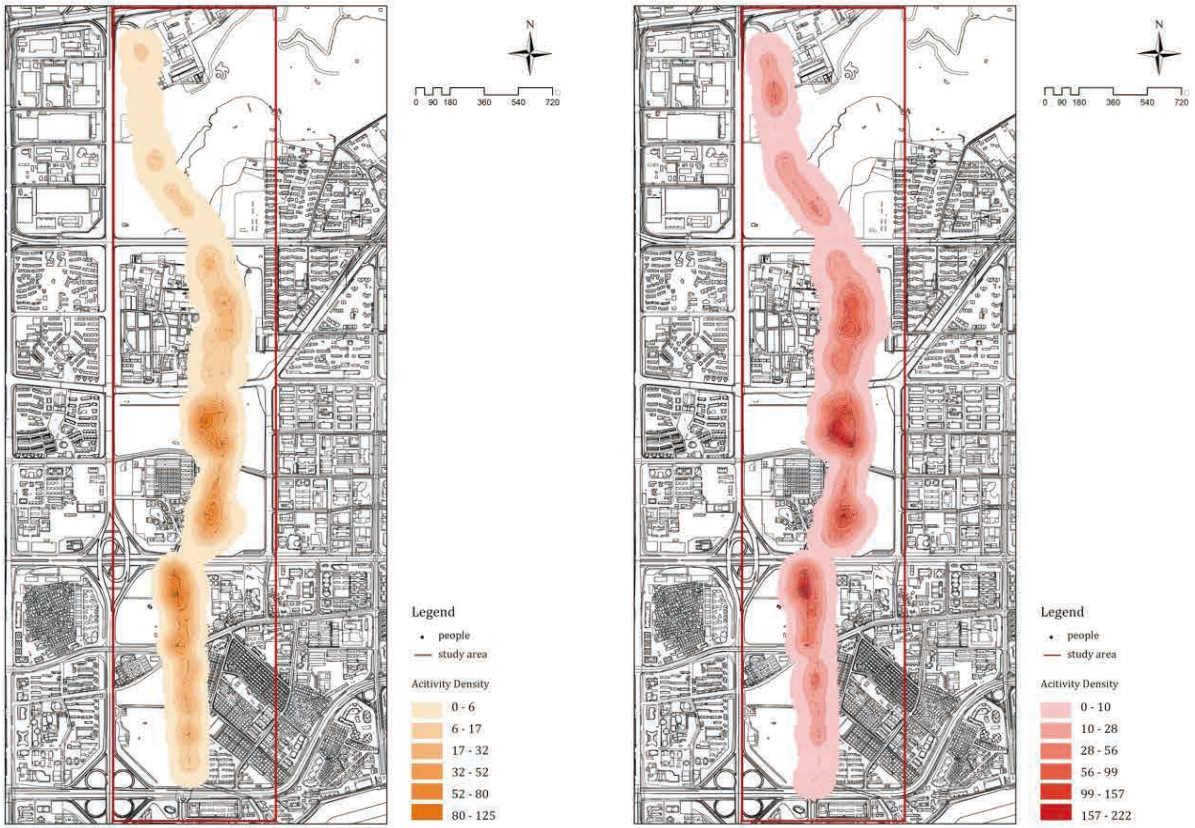

Figure 4. Weekday (left) and weekend (right) activity density along the Futian River

Figure 3 shows user activity density along the Futian River within a four-day period. The darker the area in the heatmap, the more people gathered. In the 100-metre diameter range, the highest-density area has 212–308 people, while the lowest-density area has 0–17 people. Figure 4 shows that the activity density on weekdays is much lower than on weekends, for which the highest density (157–222 people) is nearly twice that of weekdays. Figures 5 and 6 illustrate the activity density at different times of the day and the spatial patterns of people for different age groups. According to the heat maps for the different classifications, the two highest-density areas where people congregate are shown in sections 3 and 5 in Figure 1.

To explore the relationship between the riverfront landscape characteristics and people's recreational preferences, we summarized the landscape characteristics of each section of the Futian River, including access, crossing bridges,

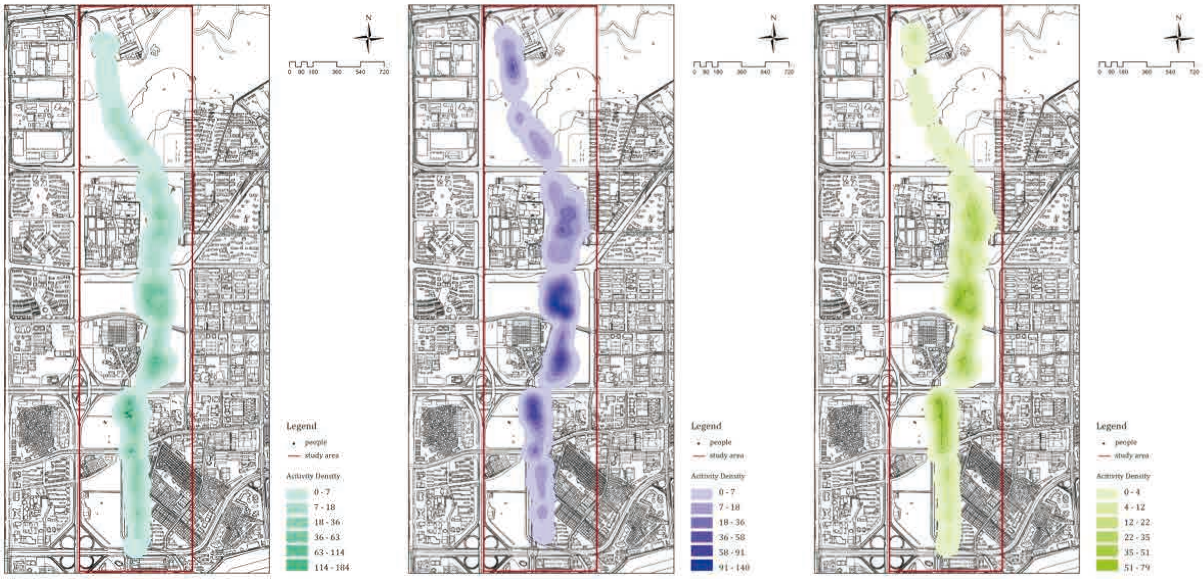

Figure 5. Activity density along the Futian River in different periods: morning, 9 am–10 am (left); noon, 12 pm–1 pm (centre); and late afternoon, 3 pm–4 pm (right).

hydrophilic areas, lawns, squares and presence of urban villages nearby (see Table 2 and Figure 7).

First, among the six sections, sections 3, 4 and 5 have the highest number of accesses (15, 11 and 10, respectively), which is two to three times as many as sections 1 and 6. The higher accessibility makes it easier for people to reach the riverfront spaces. Second, two hydrophilic spaces are present in section 3, which can explain why young people, especially kids and teenagers, are more willing to choose this area for activities. The area also contains large lawn and squares, which can provide people with more space and more activity choices. Although section 2 also has large lawns and squares, the accessibility of this section is relatively low. Third, the three urban villages within one kilometre around section 5 of the Futian River and one urban village around section 3 play a significant role in providing a large pool of potential users of the riverspace. Residents in urban villages face a relatively crowded living environment and a low quality of life. For these poor urban populations, adjacent public spaces are thus good choices for recreation and exercise.

5. Conclusion

This study employed unobtrusive observations to collect primary data about the uses and users of a successfully regenerated urban river in the GBA of China. More than three thousand users

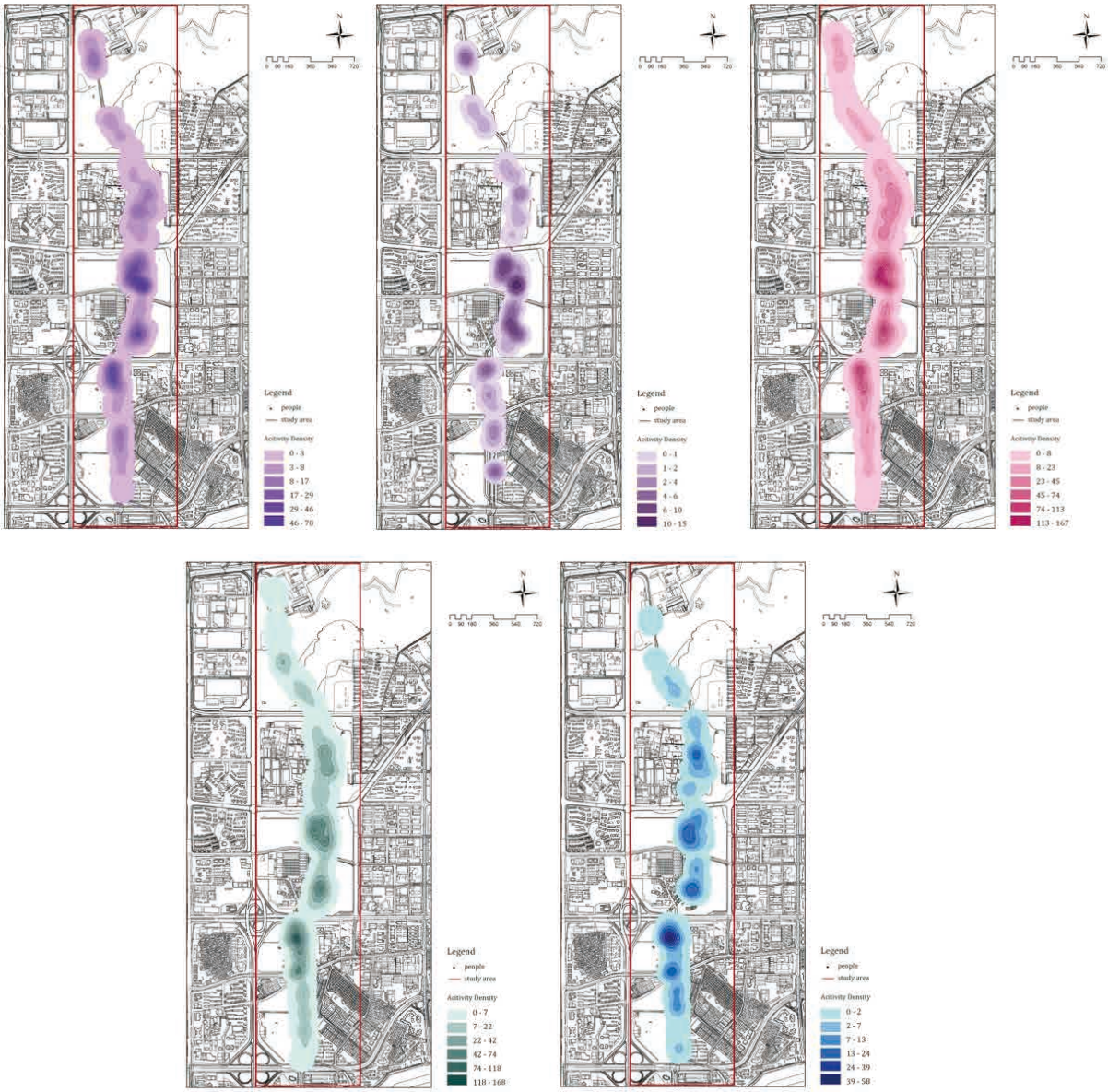

Figure 6. Age-based activity density along the Futian River among children (top left), teenagers (top centre), adults (top right), middle-aged (bottom left), and 60+ (bottom right).

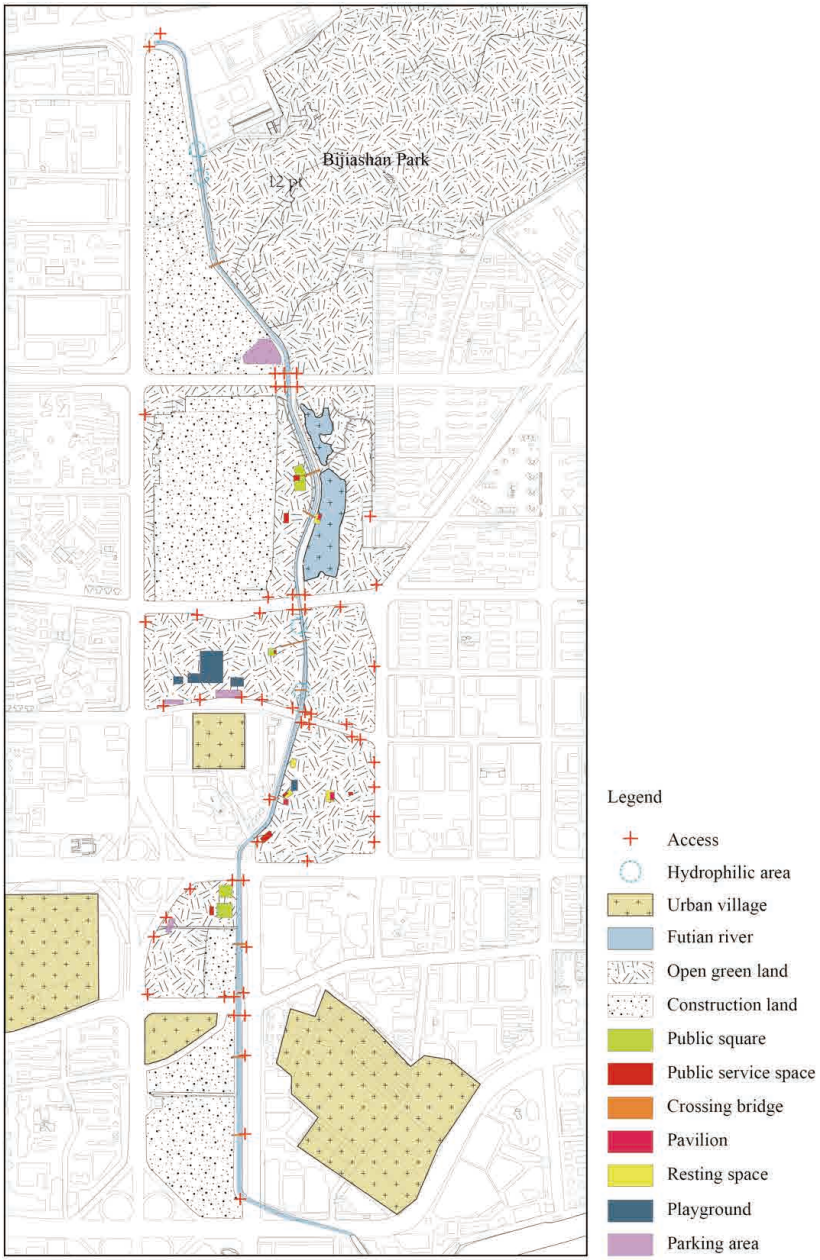

Figure 7. The landscape characteristics of each section in the Futian River.

	Access	Crossing bridge	Hydrophilic area	Big lawn	Squares	Urban villages nearby
Section 1	5	1	2	X	X	0
Section 2	9	2	0	✓	✓	0
Section 3	15	2	2	✓	✓	1
Section 4	11	1	0	✓	✓	1
Section 5	10	1	0	✓	✓	3
Section 6	5	2	0	X	X	2

Table 2. The Geographic Features of Each Part of the Futian River

were observed across three periods and three days. Descriptive statistics and behavioural mapping highlighted specific patterns of use by different social groups across the day, with males and young adults identified as the majority. Users clustered in groups while walking, relaxing or picnicking. hydrophilic areas and the possibility of direct interaction with water (5.2% were playing with water, and 1.1% were fishing) both appeal to users. Concurrently, accessibility and locational attributes were found to play an essential role in users' choices. In the context of an economically dynamic city of migrants, such as Shenzhen, river regeneration is emerging as an essential strategy to provide crucial space for recreation and social interaction to the disadvantaged residents of urban villages, thus increasing spatial justice. These findings inform policymakers and designers attentive to producing responsive spaces and policies that address the local population's needs and cultural habits, ultimately calling for responsive and context-sensitive urban planning and design strategies grounded on observing people's needs in everyday life.

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