

Current Situation and Optimization of Greenways in Hefei under the Background of Park City

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Abstract With the accelerating urbanization process, issues related to the urban ecological environment have become increasingly prominent. Among these, greenway optimization is regarded as one of the key approaches to improving urban ecological quality. As the capital of Anhui Province, Hefei is striving to build a comprehensive greenway network in line with its “Park City” strategy. However, the current development of Hefei’s greenways faces challenges such as delayed planning, limited functions, inadequate facilities, and weak operation and maintenance management. In this study, comparative analysis and literature review were combined to comprehensively summarize the current characteristics of greenway development in Hefei, and improvement suggestions were proposed in areas such as ecological restoration, functional expansion, facility establishment, and long-term management. It is suggested that Hefei should enhance the systematic and synergistic nature of its greenway system, create a city green space network with regional characteristics, and optimize the city’s environmental carrying capacity, so as to meet the diverse needs of the public and thereby provide theoretical support and practical guidance for the sustainable development of Hefei’s greenway system.

Keywords Park city, Urban greenway, Current situation, Optimization, Hefei

DOI 10.16785/j.jissn 1943-989x.2025.4.007

With the acceleration of urbanization, the expansion of urban spaces and the concentration of populations have placed significant pressure on the ecological environment. In this context, it has become crucial to scientifically plan and rationally construct urban green space systems and greenway networks, as they are regarded as effective means to improve urban ecological quality and promote residents’ health. Against this backdrop, Hefei has consistently maintained a proactive approach in its development. In recent years, the city has fully embraced the “Park City” concept by systematically planning and implementing initiatives to enhance the quality of urban greening and optimize spatial layout. In this process, greenway construction has been placed in the core position and has become an important supporting factor for creating an ecologically livable environment^[1]. A systematic study on the actual achievements, implementation status, and existing problems of greenway development in Hefei is urgently needed. To promote sustainable urban development and meet the diverse needs of residents, it is essential to explore issues from the perspectives of planning layout, implementation progress, and management maintenance, so as to formulate targeted improvement strategies and implementation pathways^[2].

In this study, taking Hefei’s Park City strategy

as the background and greenway development as the entry point, key elements such as greenway planning layout, functional positioning and implementation effectiveness were comprehensively evaluated from a macro perspective^[3]. Through in-depth analysis of existing problems, targeted and feasible improvement strategies were proposed, thereby providing theoretical support and practical guidance for the sustainable development of the city’s greenway system^[4].

Although certain achievements have been made in greenway-related research both at home and abroad, typical cities like Hefei still hold significant research value. In this study, a multi-source literature analysis method was applied to deepen the theoretical framework of regional greenways and explore interconnections among research findings across various disciplines, thereby providing empirical reference support for local greenway development. Field investigations have revealed notable deficiencies in Hefei’s greenways, particularly in spatial planning, functional categorization, and facility maintenance^[5]. After comparing the characteristics of different types of greenways, a series of comprehensive solutions were proposed, including optimizing planning layout, expanding service functions, improving supporting infrastructure, and enhancing regulatory operations. These measures

demonstrate both feasibility and foresight, and can promote the sustainable development of Hefei’s greenway system, thereby improving the overall urban ecological environment and residents’ quality of life^[6].

Based on an analysis of 35 educational and research publications from the past decade on urban park greenways using “OPEN KNOWLEDGE MAPS”, Fig.1 presents a word frequency chart. It shows that keywords such as “landscape”, “ecology”, “green”, and “health” have frequently appeared in the field of park cities over the last ten years. This trend aligns with China’s green and low-carbon transformation strategy and breakthroughs in ecological civilization institutional innovation during the “15th Five-Year Plan” period. Public health, urban ecology, landscape plants and landscape design are particularly closely linked to this concept. It indicates that optimizing and constructing a green and healthy urban greenway system is an urgent current need, as well as a vital livelihood benefit that aligns with the fundamental interests of the vast majority of people in the process of urbanization. In the field of urban renewal, the development of urban greenways should also focus on infrastructure construction, the surrounding environment, and current community conditions, so as to highlight the unique urban character and

Received: May 25, 2025 Accepted: July 9, 2025

Sponsored by Research Team Project of Anhui Xinhua University (kytd202202); Anhui Provincial College Student Innovation Training Program Support Project (S202212216138; S202212216133; S202212216147); National College Student Innovation Training Program Support Project (AH202112216114); Key Project for Scientific Research in Anhui Higher Education Institutions (Natural Sciences Category) (2024AH050601).

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cultural identity of different regions.

2 Research trend analysis

2.1 Research trends abroad

As the first country to establish a greenway system in major cities, the United States began connecting various green spaces as early as the mid-20th century. The concept of “greenways” emerged in the 1970s, and a certain greenway network structure has now been formed. The “Emerald Necklace” project in Boston, USA, and Singapore’s “Park Connector Network” are among the most typical examples, gradually forming a systematic greenway network. Existing research primarily focuses on the ecological effects, recreational functions, and cultural values of greenways, while also delving into systematic planning and refined design optimization pathways. Charles Little, in his book *American Greenways*, provided the first comprehensive explanation of the concept of greenways, particularly emphasizing the importance of their multidimensional social attributes^[7].

Palmisano et al.^[8] applied Geographic Information Systems (GIS) and Multi-Criteria

Decision Analysis (MCDA) techniques to analyze greenway evaluation systems under different frameworks and applied genetic algorithms to aggregate greenway users’ preferences. Weber et al.^[9] studied the impact assessment of greenway users and found that greenways positively contribute to increasing property values, promoting physical activity, and enhancing social interactions, but they may also bring issues such as littering, crime, and vandalism. Palardy et al.^[10] evaluated the impacts of greenway use among residents from diverse ethnic and socioeconomic structures. Their study revealed that factors such as user perceptions and economic benefits directly influence residents’ support for greenway development. Hunter et al.^[11] investigated the effects of urban greenways on public health factors, including recreation, health, environment, and society. Adlakha et al.^[12] assessed the effects of changes in greenway environment on residents’ physical activity by studying their feedback during greenway use.

2.2 Research trends in China

Greenway construction has now become an international movement. While many countries

have conducted in-depth research and implemented practices related to greenways, China is still in the exploratory stage of greenway research and application, with significant room for improvement^[13]. Current studies on greenways in China remain insufficiently comprehensive. Deng^[14] investigated the physical space of the Greenway around Chaohu Lake and its surrounding green areas to explore factors influencing user experience. Based on field surveys and literature review methods, the study analyzed key indicators affecting user experience and proposed recommendations for improving the waterfront ecological environment. Zeng^[15] employed eye-tracking analysis from experimental psychology, as well as the AHP-SBE and BIB-ICJ methods commonly used in landscape visual quality assessment, to evaluate the landscape visual quality of the East Lake Greenway in Wuhan. Li et al.^[16] proposed humanistic evaluation indicators of beautiful highway landscape, focusing on four aspects: cultural landscapes, natural landscapes, roadside landscapes, and highway culture, based on the concept of beautiful highways and their cultural connotations. Chen et al.^[17] analyzed and evaluated the characteristics and adaptability of ecological resources in Anhui Province, proposing a planning method for the provincial greenway network. They developed comprehensive strategies for greenway planning and conservation, attempting to integrate the main provincial greenways into a development model centered on “two verticals, three horizontals, and two chains”, supplemented by five branch lines and greenway clusters. Zhan et al.^[18] pointed out that research on greenway satisfaction is an important approach to get genuine user feedback, and the main factors influencing satisfaction with rural greenways include transportation convenience, the setup of motorized non-mixed lanes, natural scenery, and environmental hygiene. Xie et al.^[19] took the East Lake Greenway in Wuhan as an example and used a natural experiment approach to investigate the impact of urban green space interventions on mental health. Liao^[20] established an evaluation system for the recreational function of urban greenways and the needs of recreational users, finding that the well-developed slow-traffic conditions of Chengdu’s urban greenways effectively alleviate fatigue and anxiety among city residents.

Greenway construction started relatively late in China, but has developed rapidly in recent years^[21]. Chengdu’s Tianfu Greenway system stands out as a leading example, as it has

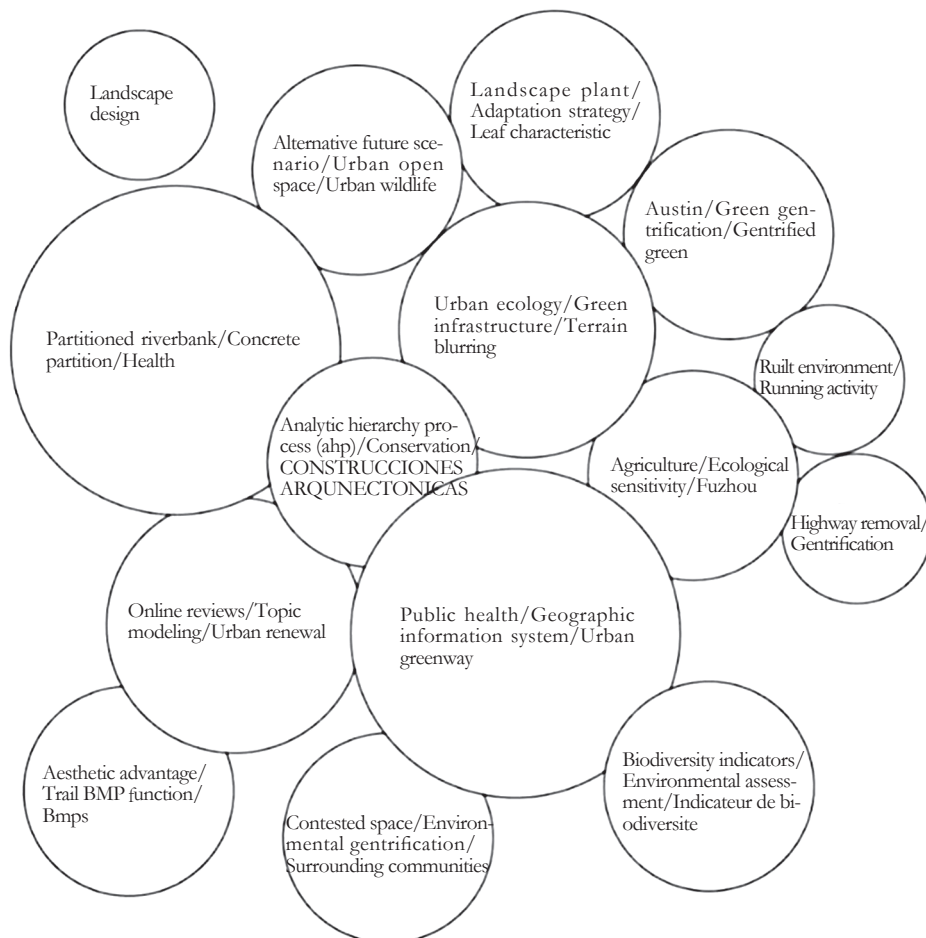


Fig.1 Visual analysis of keywords retrieved by Open Knowledge Maps

established a three-level greenway network comprising regional, urban, and community levels. In China, the research primarily focuses on aspects such as greenway planning, design, construction, and management^[22], including the integration of greenways with urban spatial structures, enhancement of greenway landscape effects, and improvement of greenway infrastructure. Meanwhile, most Chinese scholars believe that the concept of park green space equity has evolved from accessibility, which has become a crucial indicator for studying environmental justice issues and measuring the fairness of urban public resource allocation^[23]. Urban park green spaces are an essential component of cities, capable of delivering ecological benefits, improving living environments, and promoting sustainable urban development^[24].

3 Analysis of the current status of greenways in Hefei

3.1 Current status of urban greenways in Hefei

Aiming to become “first-class domestically and renowned globally”, Hefei has prioritized the development of greenways based on the dual carriers of “parks + rivers”, guided by *Greenway Planning and Design Guidelines* and the city’s “13th Five-Year Plan”. Future efforts must focus on addressing issues such as the isolation of community greenways, standardization of facilities, and coverage of underserved areas to achieve a transition from “scale expansion” to “quality upgrade”^[25].

Hefei’s greenway system has initially formed an ecological corridor network, with the Nanfei River Greenway (northeast-southwest orientation) and the Kuang River Greenway (east-west orientation) serving as its backbone. This network connects key ecological patches such as Luzhou Park and Xinghua Park, and features a circular greenway around the Huancheng Park. Currently, the system comprises 23 greenways, primarily developed along waterfront spaces, protective greenbelts, and park green spaces. Among these, park-type greenways dominate (16 routes), followed by waterfront-type greenways (5 routes).

From a functional perspective, greenways can be categorized into leisure and recreation types (e.g., Luzhou Park Greenway), ecological and recreational composite types (e.g., Nanfei River Greenway), and daily service types (e.g., Guzhen Road Greenway). Spatially, Hefei’s greenways exhibit significant disparities in service capacity. Areas such as Mingguang Road

Subdistrict, Heping Road Subdistrict, Tongling Road Subdistrict, Sanxiaokou Subdistrict, Sipailou Subdistrict, and Silihe Subdistrict largely meet the service demands of a 15-minute social circle. However, service levels within 10-minute or even 5-minute social circles still require improvement, while peripheral marginalized regions continue to face service gaps^[26].

3.2 Limitations in Hefei’s greenway development

Although Hefei’s greenway system has initially formed a network pattern, it still faces numerous development challenges. In terms of spatial layout, the greenway network structure exhibits significant regional imbalances and low internal connectivity efficiency^[27]. These issues are primarily reflected in an outdated planning system^[28], poor integration of greenways with the urban spatial structure, and a lack of systematic and forward-looking top-level design^[29]. From a functional perspective, Hefei’s greenway system currently focuses primarily on single uses such as leisure recreation and sports activities^[30], while its diverse values in ecological restoration and cultural heritage have not been fully realized^[31]. Although the overall operational performance is satisfactory, supporting infrastructure remains inadequate, and key components such as signage systems, rest areas, and lighting facilities require further improvement^[32]. The operation and maintenance management system is relatively weak, with issues such as aging equipment and unclean environments frequently occurring, significantly impacting the overall usability and sustainable development of the greenways^[33].

3.3 National policy guidance

The “15th Five-Year Plan” period is a critical phase of strategic efforts for China’s green and low-carbon transition and a breakthrough period for ecological civilization system innovation. Addressing current challenges such as weak grassroots ecological governance, insufficient technical equipment, and formalism in certain sectors, it is essential to adhere to the spirit of the 20th National Congress of the Communist Party of China and the Third Plenary Session of the 20th Central Committee. This involves fully implementing tasks to deepen the reform of the ecological civilization system, balancing high-quality development with high-level environmental protection, and achieving the goals of the “14th Five-Year Plan” with high standards to lay a solid foundation for the “15th Five-Year Plan”^[34-35].

The core mission of this period is to achieve a strategic leap in promoting green development. Focusing on the supply of ecological products

as the central function, efforts will be made to enhance service quality on the basis of stabilizing the scale of ecosystem supply, regulation, support, and cultural services. It involves building a diverse, stable, and sustainable ecological foundation, developing green and low-carbon models for the exploitation and utilization of ecological products, and forming an inclusive conservation path for harmonious coexistence between humans and nature. Ecological regions will become a key support for the new national spatial security and development framework. It is essential to enhance the spatial synergy between ecological barriers and development patterns, build a national ecological security barrier, optimize the layout of key ecological functional zones, integrate the protected area system, and strictly enforce ecological conservation red lines^[36].

3.4 Provincial policy support

Anhui Province, as a province at the intersection of the Yangtze River Economic Belt and the integration of the Yangtze River Delta, guided by General Secretary Xi Jinping’s ecological civilization ideology, closely follows the coordinated promotion of the “Five Beauties” in implementation based on the strategic positioning of “building a solid ecological barrier in the Yangtze River Delta and constructing a green development transformation demonstration zone”. The beauty of natural ecology focuses on strengthening environmental management and ecological restoration, achieving fundamental improvements in air and water quality, and building a solid foundation for the supply of high-quality ecological products. The beauty of green development emphasizes constructing an industrial ecologization and ecological industrialization system under the “dual carbon” goals, fostering green production and lifestyles through industrial structure optimization and energy efficiency enhancement. The beauty of urban and rural livability focus on improving sewage and garbage treatment facilities, ensuring a 100% excellent rate of drinking water quality, constructing 62 m² of park green space per capita, and shaping urban and rural landscapes that “embrace mountains and waters, and prompt homesickness”. The beauty of cultural characteristics involves deepening ecological civilization education and fostering social consensus, while refining the value system of ecological culture. The beauty of governance excellence is achieved through innovatively integrating rigid systems with flexible management, improving ecological supervision and market mechanisms, and addressing gaps

in grassroots monitoring and enforcement capabilities. By enhancing the spatial linkage between ecological barriers and development patterns, highlighting the benchmark role of the Yangtze River Delta in green contributions, and creating a replicable Anhui model of “ecological province construction”, we will ultimately establish a practical exemplar of modern ecological civilization construction with Chinese characteristics that demonstrates Anhui’s distinct features, contributes to the Yangtze River Delta, and leads the nation.

3.5 Greenway optimization paths for Hefei

To comprehensively enhance the overall effectiveness of Hefei’s greenway system, it is essential to coordinate the planning of greenway layout and urban spatial structure, establishing a systematic and networked greenway system that aligns with the strategic intent of sustainable urban development. While maintaining traditional recreational, leisure, and fitness functions, efforts should also be made to expand its diverse values, such as ecological restoration and cultural dissemination, to better meet the varied needs of the public. It is essential to strengthen infrastructure development, with particular emphasis on improving both the functionality and aesthetic design of facilities to enhance the overall user experience. Establishing a sound operation and maintenance management organization is also crucial. Greenways can be ensured to remain in optimal operating condition by refining daily maintenance mechanisms and strengthening supervision.

3.5.1 Promoting ecological restoration of greenways. Based on the concept of sustainable development, urban ecological construction should be placed at a key position in greenway design. The ecological development of Hefei’s greenways must follow the guiding documents of Anhui Province’s ecological development. During the process of urban ecological landscape design, full consideration should be given to the possibility of low-carbon urban development, thereby achieving the effects of purifying the living environment and enhancing the quality of urban development. In ecological environment improvement strategies, the core concept of “natural restoration as the main idea, supplemented by artificial intervention” should be adopted to repair damaged ecological bases and continuously enhance the quality of the natural geographical environment underpinning greenway construction. Particular attention must be paid to the management and maintenance of water environment quality in

waterfront greenways. For example, aquatic plants with water purification functions can be introduced to improve water quality while enhancing biodiversity within the greenway service area, adding missing natural elements to the surrounding human settlements, and thereby strengthening the connection between humans and nature. Throughout the restoration process, emphasis should be placed on the grid-based construction of biological habitats. Plant allocation must adhere to the principles of “localization, community integration, and low maintenance”, while employing an “adaptive” management model to achieve a shift from single-project governance to the collaborative evolution of natural-human composite ecosystems.

3.5.2 Strengthening the construction of greenway facilities. The layout of recreational facilities should fully consider public usage habits while ensuring landscape harmony and aesthetics. In terms of materials, diverse combinations can spark public interest and provide rich user experiences. Particularly for children’s play equipment, selections must not only be visually appealing but also environmentally friendly and safe. Materials must comply with child-accessible safety standards to eliminate potential hazards at the source. Facility color is a key element in landscape design. The overall color scheme of facilities should harmonize and unify with the landscape, while also incorporating bright and vibrant hues aligned with human visual habits to enhance color appeal. This approach can increase facility usage frequency and enrich public experience. Functionally, greenway facilities should prioritize high-quality and convenient services. Service stations should be graded to cater to diverse needs, including public services, management, transportation, consumption, and recreation.

3.5.3 Enhancing operation and maintenance management capabilities. Plant landscapes and service facilities are two core elements of urban greenways. Over time and with increased usage, the quality of greenways will inevitably decline. In terms of plant landscapes, the ornamental plants initially cultivated during greenway construction may exhibit uneven growth due to individual variations. Withered or decayed plants should be promptly replaced, and pest infestations must be addressed with immediate eradication and treatment measures. Routine maintenance should include designated personnel for weeding and watering, timely removal of visual clutter from usage traces, and necessary actions to prevent damage to flora, ensuring all plants remain in optimal condition

for viewing. In terms of service facilities, damaged facilities should be repaired, such as replacing faulty streetlights, fitness equipment, and leisure benches, while promptly repairing damaged road surfaces and clearing road pollutants. Regular safety inspections should be conducted to replace security facilities like fire hoses and eliminate potential hazards. Necessary service facilities, such as bicycle rentals and vending services, should be added. The content of popular science education facilities should be updated to ensure the dissemination of current knowledge.

4 Research conclusions

In Hefei’s construction of a park city, the construction of greenways has initially taken shape, providing citizens with diverse spaces for leisure and exercise. However, several issues requiring optimization remain. Outdated planning has led to disorganized and unscientific layouts. Limited functionality restricts potential for diversification. A lack of essential facilities significantly diminishes user satisfaction. And inadequate maintenance and management compromise environmental quality. In light of this situation, the following improvement suggestions are proposed: strengthening top-level design, refining the planning system, expanding the service functions of greenways, enhancing comprehensive benefits, improving supporting facilities to elevate overall service standards, and establishing a long-term maintenance mechanism to ensure sustainable development. Looking ahead, Hefei should further advance the grid-based layout of greenways, construct a regionally distinctive green ecological structure, and genuinely optimize residents’ quality of life and urban ecology.

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