HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES

URBAN PUBLIC PARK DEVELOPMENT AND DISTRIBUTIONAL EQUITY ASSESSMENT - A CASE STUDY OF ZHENGZHOU, CHINA

THESES OF THE Ph.D. DISSERTATION

DOI: 10.54598/004960

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2024

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TABLE OF CONTENTS

1. BACKGROUND AND CONTEXTS

With the development of cities, urban parks have gradually developed into an integral part of the urban environment and enhanced urban quality by providing a multitude of benefits across various dimensions including social, environmental, and economic aspects (Chiesura, 2004). Equitable access and use of urban parks refer to providing fair and inclusive opportunities for all individuals from diverse backgrounds to enjoy and benefit from urban parks. The inequitable access and use of urban parks can have significant impacts on individuals and communities. When some populations lack nearby parks or have poorly maintained ones, they are deprived of the benefits associated with physical activity, relaxation, social interaction, and exposure to nature, which can contribute to physical and mental health issues (Mowen et al., 2007). Additionally, limited access to and use of parks can lead to lower satisfaction and perception of parks, resulting in feelings of exclusion and isolation among disadvantaged groups. When certain communities are denied access to well-maintained parks, they miss out on opportunities for social interaction, community engagement, and cultural events, thereby hindering residents' ability to connect with and develop a sense of belonging to their communities or city (Shukur et al., 2012). Overall, these disparities can further reinforce social inequality and exacerbate existing divisions within communities and cities.

The "Park City" initiative in China and "nature-based solutions" within European environmental policy both advocate for effective, sustainable, and equitable implementation of urban parks, highlighting their role as critical green infrastructure and public service facilities towards ecological and social well-being in the face of urban challenges. Motivated by growing concerns about marginalization within urban social spaces, there is the need for a more systematic exploration and comprehensive understanding of how the equity of urban parks is conceptualized and operationalized within urban planning frameworks. In the broader context of global urbanization, more and more cities today are increasingly exposed to a series of social and environmental issues. In recent years, urban regeneration and social sustainability have become critical aspects of urban planning and development (Colantonio and Dixon, 2011). Particularly in China, major cities such as Zhengzhou have experienced extremely rapid urbanization in recent decades, leading to social differentiation, spatial segregation, and

environment issues (Wu et al., 2014; Li, 2021). Despite the recognition of urban parks as essential public services and green infrastructure with numerous benefits, inequities in their distribution persist, disproportionately affecting certain communities and groups.

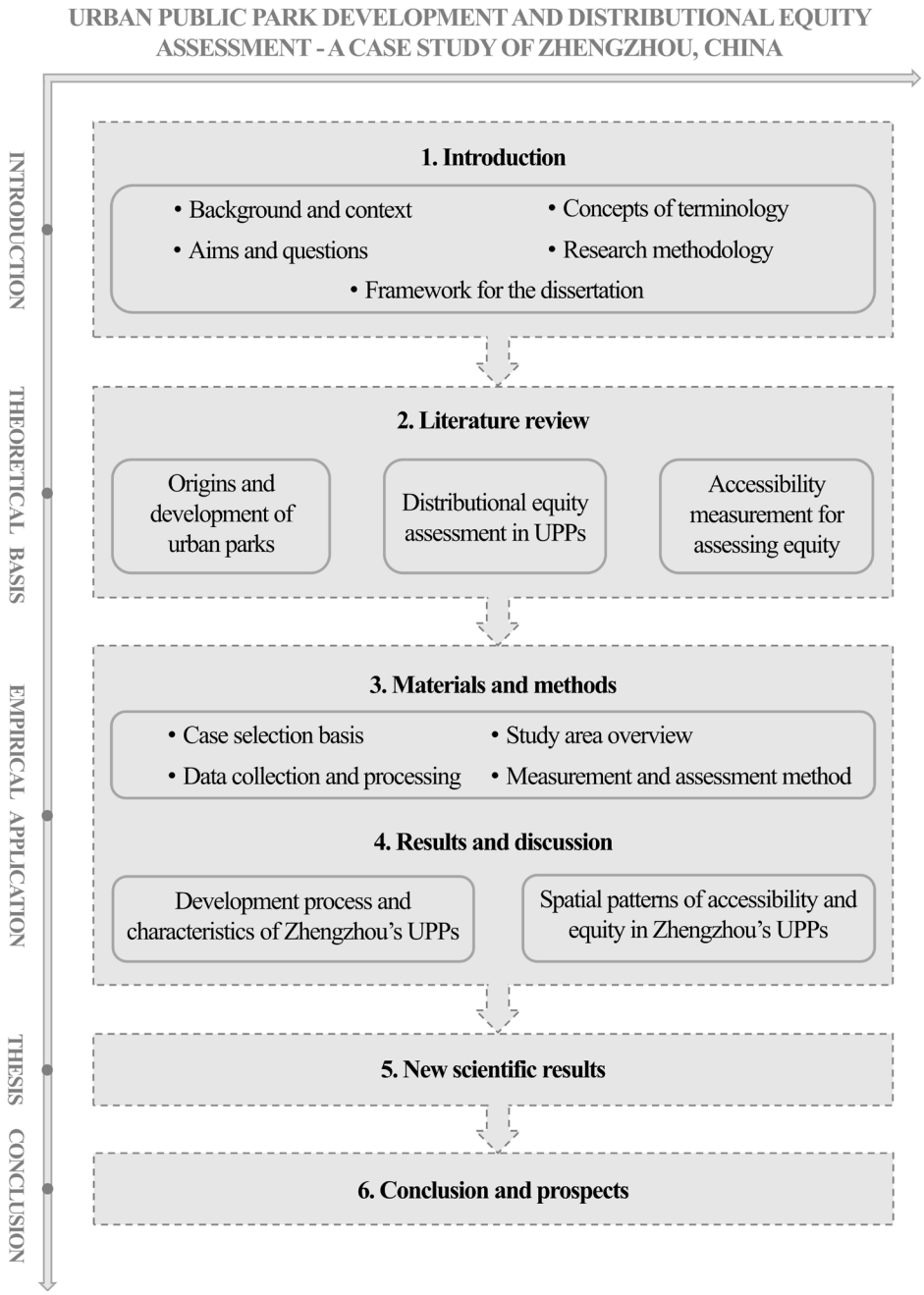

Figure 1: Research framework (Source: Author).

2. AIMS AND QUESTIONS

2.1 Research aims

The main aim of this research is to synthesize the basic historical development of UPPs worldwide and in China, and to explore the assessment and measurement of equity in their distribution, specifically concentrating on an in-depth examination of UPPs in Zhengzhou, China (***Figure 2***).

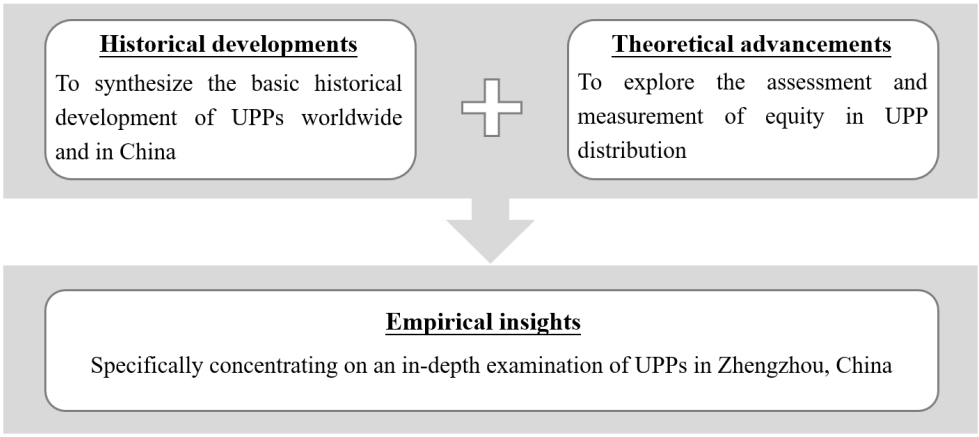

Figure 2: Research aims (Source: Author).

2.2 Research questions

Linked to these research objectives, the dissertation addresses the following related questions:

a) What are the general origins of UPPs, and how has their development unfolded both worldwide and in China?

b) What are the developmental process and characteristics of distributional equity assessment in UPPs?

c) What are the interpretations and measures of spatial accessibility for UPPs, and how can an appropriate accessibility method be specified?

d) How to evaluate and what are the developmental phases, trends, and strategies of Zhengzhou's UPPs?

e) How to examine and what are the spatial patterns of accessibility and equity in Zhengzhou's UPPs?

3. MATERIALS AND METHODS

The research methodology depicted in ***Figure 3*** comprises two parts: basic research relying on a theoretical approach and applied research based on an empirical approach. The first part involves a literature review and investigation methods, primarily adopting inductive and qualitative research perspectives. The second part employs a case study and investigation methods, integrating both inductive and deductive reasoning, and combining qualitative with quantitative analyses. Specifically, a variety of data analysis methods, such as historical analysis, content analysis, and statistical analysis, are applied utilizing techniques mainly within MS Excel and ArcGIS.

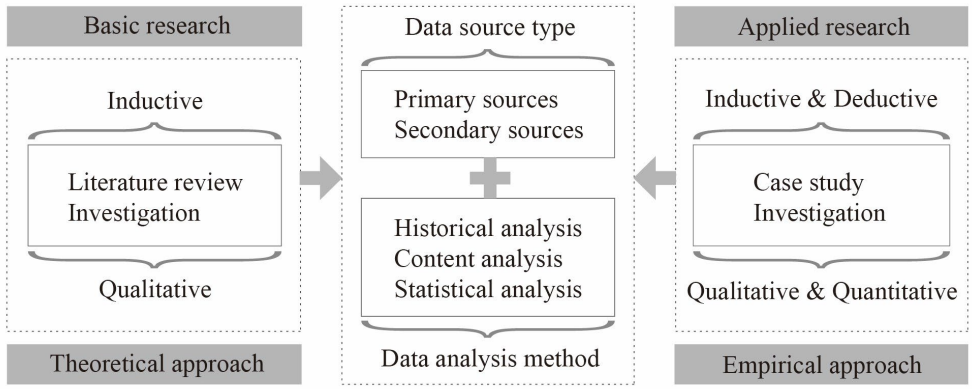

Figure 3: Research framework (Source: Author).

In the beginning of the research process, an extensive literature review was carried out, relying on secondary data such as textbooks, reviews, and bibliographies sourced from multiple scientific databases. Through the systematic reading, sorting, and analysis of diverse literature, the main historical developments and theoretical advancements of UPPs and their distributional equity were identified. In general, this research phase serves to establish a theoretical foundation and a source of ideas for further research. To develop applied research, a case study was employed. The selection of Zhengzhou, China, as the case was grounded in its significant role among Chinese cities, the global representative of rapidly urbanizing regions, and the typicality observed in its UPP development in the Chinese context. This comprehensive case study provides deeper insights into the research subject. The investigation was conducted through two primary methods: online investigation and fieldwork. The online investigation was undertaken to collect various available materials related to the basic development and

distributional equity of UPPs, with a specific focus on Zhengzhou, China. These materials comprised statistical yearbooks, census data, historical records, and other texts and images sourced from the websites of libraries, archives, and municipality. Additionally, digital maps, remote sensing datasets, and other social big data for the case study were obtained from online data platforms. The fieldwork conducted within the case study area aimed to gather on-site information, including details on park category and quality, and park functions and uses. The fieldwork involved comprehensive documentation through observation, measurements, and recording including detailed notes and photographs. The data acquired from these investigations facilitates both qualitative and quantitative analyses.

The 2SFCA method has been extensively applied to assess the accessibility and equity of public facilities and services, thereby forming a crucial foundation for my research. An improved 2SFCA method was developed to measure the spatial accessibility of UPPs in Zhengzhou. It integrates actual factors affecting residents' access to urban parks by utilizing multi-source data related to supply of parks, demand of population, and travel cost, with a specific emphasis on the attraction coefficient of parks and selection probability of residents (***Figure 4***). This comprehensive method is expected to significantly enhance the accuracy of park accessibility measurement, encompassing improvements in both the model and the data utilized. Following this, to further examine the characteristics and causes of accessibility distribution, K-means cluster analysis is utilized to scrutinize influencing factors of accessibility.

Classic 2SFCA method

$$A_i = \sum_{j\in\{d_{ij}\le d_0\}} R_j = \sum_{j\in\{d_{ij}\le d_0\}} \frac{S_j}{\sum_{k\in\{d_{kj}\le d_0\}} P_k}$$

- $\mathbf{S_j}$ denotes the attraction coefficient of park j;
- **A** is park size of park **j**; $\mathbf{A_m}$ is the per capita park area corresponding to the category of park **j**;
- $\mathbf{q_j}$ is the quality index of park **j**.
- $\mathbf{G(t_{ij})}$ is travel impedance coefficient;
- $\mathbf{Prob_{kj}}$ denotes the selection probability of population at **k** visiting park **j**;
- $\mathbf{t_{kj}}$ is the travel time from k to **j**; $\mathbf{t_0}$ represents the travel time threshold;
- $\mathbf{R_j}$ denotes the supply-demand ratio of park **j**;
- $\mathbf{P_k}$ is the population of neighborhood **k**;
- $\mathbf{A_i}$ denotes the park accessibility in neighborhood **i**.

Improved 2SFCA method

Attraction coefficient of parks

$$S_j = \frac{A}{A_m} \times q_j$$

Gaussian decay function

$$G(t_{ij}) = \begin{cases} \frac{e^{-(1/2)\times(t_{ij}/t_0)^2} - e^{-(1/2)}}{1 - e^{-(1/2)}} & (t_{ij} \le t_0) \\ 0 & (t_{ij} > t_0) \end{cases}$$

Selection probability of residents

$$Prob_{kj} = \frac{S_j G(t_{ij})}{\sum_{k\in\{t_{kj}\le t_0\}} S_j G(t_{ij})}$$

Supply-demand ratio for each park

$$R_j = \frac{S_j}{\sum_{k\in\{t_{kj}\le t_0\}} Prob_{kj} P_k G(t_{ij})}$$

Park accessibility

$$A_i = \sum_{j\in\{t\le t_0\}} Prob_{kj}\, R_j G(t_{ij})$$

Figure 4: Improved 2SFCA method (Source: Author).

4. NEW SCIENTIFIC RESULTS

The new scientific findings from the present dissertation results are summarized in the following theses:

Thesis 1: I synthesized the basic historical development of UPPs with regard to their origins and publicness development worldwide.

UPPs have emerged and developed in response to the needs of urban life and as solutions to unique urban problems across various developmental contexts. Examining the origins and development of UPPs can provide valuable insights into their roles, functions, and planning strategies, which are tailored to address the opportunities and challenges inherent in contemporary urban settings.

Two roots of urban parks within cities in history are traced. One is private open spaces, including royal gardens and noble gardens, typically reserved for the privileged class and not accessible to the general public. The other is public open spaces, encompassing natural scenic areas, open spaces associated with religious activities, and other open spaces designated for specific public purposes, primarily serving special functions with corresponding design or offering limited public service benefits. The development of publicness in urban parks can be categorized into three main stages. Initially, the so-called "public parks" originated during the 17th century with the transformation of royal and noble gardens into spaces accessible to the public, albeit with restricted access. In continental Europe, the early public gardens traced back to at least the late 18th century, rooted in the tradition of setting aside green spaces for public use, though the practice was largely permissive and unorganized. Modern public parks, as recognized today, emerged in the mid-19th century during a period marked by industrialization and urbanization. These parks, laid out and managed by public institutions, were freely accessible to people of all social classes and incorporated integrated park planning.

Thesis 2: I identified the advances in distributional equity assessment of UPPs, considering the context, content, and characteristics across different developmental stages.

Given the inherent complexity of the concept of distributional equity, despite its central role in UPP planning and assessment, there exists a dearth of integrated analyses regarding the development of connotations and criteria

associated with distributional equity. Across different developmental stages, assessing the equity of park distribution demonstrates cognitive distinctions and differs significantly in planning objectives and equity principles.

Drawing on the developmental characteristics of societal context and corresponding public values advocated, this study argues that the distributional equity assessment in UPPs has undergone four main modes: territorial equality, locational fairness, group justice, and social equity. Within the paradigm of traditional public administration, characterized by a focus on efficiency, territorial equality prioritizes equal share weight in different territories. It strives for spatial guarantee and aligns with the welfare-based principle. Subsequently, within the framework of new public management, marked by an emphasis on effectiveness, locational fairness underscores fair opportunity of homogeneous persons. It pursues spatial balance and adheres to the egalitarianism-based principle. In contrast, in the context of civil rights movement, characterized by its emphasis on justice, group justice focuses on just availability for disadvantaged groups. It seeks socio-spatial matching and follows the need-based principle. More recently, within the framework of new public service, distinguished by its emphasis on democracy, social equity concentrates on equitable benefit to groups of individuals. It aspires to socio-spatial satisfaction and adheres to the demand-based principle. The advances are closely linked to the development of urbanization and the construction of urban parks.

Thesis 3: I highlighted the developmental characteristics of four distributional equity models in the assessment subjects and measurement criteria.

In the assessment of UPP allocation and delivery, four primary models for distributional equity have been identified, each demonstrating significant distinctions in terms of planning objectives and equity principles. Accordingly, there has been a discernible shift in the assessment subjects and measurement criteria associated with the level of urbanization, the degree of urban construction, and the corresponding mode of park development.

During the early and accelerated phases of urbanization, within the context of large-scale underway construction of modern urban functions and spatial systems, urban parks exhibit an extensive development mode. Park resource allocation is approached from a “place-based” and “consequence-oriented” perspective. In the phase characterized by the fundamental completion and

self-enhancement of urbanization in developed regions, the development of urban parks manifests a refined mode, emphasizing the micro-renewal and governance of urban space. Park service delivery is directed by a "people-based" and "rule-oriented" perspective. However, the development of the concept of distributional equity in UPPs is not characterized by the mutual substitution of old and new ideas. Instead, it unfolds in conjunction with the support of urban construction development, gradually expanding in tandem with the progression of public value governance. Specifically, the aspirations for distributional equity at each stage typically built on the accomplishment of objectives of distributional equity from the preceding stage. The inadequacies in the cognition of distributional equity at each stage usually function as a prerequisite for deepening the conceptualization of distributional equity in the subsequent stage.

Thesis 4: I recognized the transformations of four distributional equity models in measurement between parks and residents, as well as the relationships of these models with contextual equity and procedural equity.

The measurement of park distribution has progressed incrementally, shifting from a primary emphasis on physical space to an exploration of the dynamic interplay between space and society. The relationship between distributional equity and the other two dimensions of the equity framework depends on how distributional equity is understood and how its concepts are applied to planning proposals.

Based on quantified spatial relationships, the assessment of territorial equality and locational fairness focuses on the question: "Where and how many resources are provided?". Consequently, the associated metrics highlight the resource quantity and spatial location of parks. Through spatial statistics and analysis method, indicators such as resource density or place opportunity are employed to analyze the park distribution patterns. Territorial equality and locational fairness implement one-size-fits-all solutions without considering the differentiation of social spaces and the stratification of social groups. Clearly, contextual equity and procedural equity are not necessary to achieve either of these narrowly defined types of distributional equity. In terms of group justice and social equity, premised on a broader and deeper intersection between parks and residents, this assessment explores the question of "Who receives what kind of services?".

As a result, the associated metrics assess the service quality and benefit output for residents. Through socio-spatial survey and evaluation method, indicators of group availability and service performance are used to systematically measure the distributional equity. Group justice and social equity require solutions tailored to specific needs of social groups or diverse demands of individuals. In this context, procedural equity is necessary to guarantee that the mechanisms governing park allocation are just and inclusive, while contextual equity ensures that distributional equity is achieved in a meaningful and targeted way.

Thesis 5: I identified the distinctive characteristics of five primary accessibility measures for urban parks and highlighted the advantages of the 2SFCA method through a detailed analysis of their conceptual differentiation.

The varied conceptualization and operationalization of spatial accessibility have given rise to diverse measurement methods. The efficacy of specific accessibility measures in reflecting the essence of equity models and guiding planning orientations depends on the specific interpretation of the accessibility concept and the precise specification of these measures.

There are five primary accessibility measures for urban parks: container method, buffer method, distance-cost method, cumulative-opportunity method, and gravity-based method. Each of these methods exhibits respective properties, with distinct strengths and limitations at both theoretical and practical levels. Conceptual differentiation among these measurement methods is primarily grounded in four key components: spatial reference, measurement attributes, integration mechanism, and decision making. Upon comparison, it is evident that the gravity-based method appears to be a more effective measure. This is attributed to its ability to comprehensively articulate differences across various aspects, including the spatial distribution of parks and residents, travel impedance, park attractiveness, and resident population. As a special case of the gravity-based method, the 2SFCA model incorporates the advantages of both cumulative-opportunity method and buffer method. This integration enables it to consider effective travel distances by imposing a distance threshold. Consequently, it has emerged as one of the most employed and developed accessibility measure, with a range of extensions to the classic 2SFCA model.

Thesis 6: I proposed an improved 2SFCA method for measuring urban park accessibility through model optimization and data refinement.

The improved accessibility method integrates the actual factors affecting residents' access to urban parks including park quality and park competition. Compared to the classic 2SFCA model, this improved method enhances the accuracy of measuring urban park accessibility regarding park supply, population demand, and travel cost utilizing multi-source data.

A supply-demand improved 2SFCA method was developed to evaluate spatial accessibility and equity, particularly introducing the attraction coefficient of parks and selection probability of residents. Specifically, for the study, the attraction coefficient of parks combined the park size, category and quality based on efficient big data and on-site investigation data. Selection probability of residents among multiple available parks was quantified by combining the park attractiveness and travel impedance. This was applied as selection weights to both steps of the model to fit possible supply and demand relationship. In terms of the demand, the population of the neighborhood-scale unit was estimated based on residential building attributes (including footprint area and floors) derived from map service platform, rather than rough administrative unit demographics. Additionally, travel time instead of travel distance was used to measure travel cost based on real-time navigation data, which can more accurately reflect the actual travel situation of residents and is relatively more convenient than traditional data collection. Overall, the accuracy of the park accessibility measurement has been improved in terms of both the model and data.

Thesis 7: I established a comprehensive and systematic procedure for accessibility analysis and equity assessment of urban parks.

Most of the literature on equity has emphasized the identification of distributional disparity and underserved areas within the study area, while failing to examine the causes behind the spatial differences. An attempt was made to establish a comprehensive and systematic procedure for urban park accessibility analysis and equity assessment by applying a supply-demand improved 2SFCA method and K-means cluster analysis.

Spatial accessibility of urban parks was firstly measured by an improved 2SFCA method with comprehensive consideration of supply and demand. Then, to advance systematic equity research and targeted strategy

development, the spatial patterns, differences, and causes of park accessibility were further examined by K-means cluster analysis. By clustering the results of five main factors (accessibility, average travel time, population density, total park size, and total park quality index), I got integrated spatial patterns of supply, demand, and accessibility for neighborhoods. The findings of this study could serve as a tool for identifying areas of urban park shortage and how they differ from other areas, which can guide urban planning and landscape design to address specific inequities. This study also illustrated the feasibility and limitations of the research framework for park accessibility and equity assessment in the central urban area of Zhengzhou, which can be flexibly applied to other cities with the use of appropriate data following the approach.

Thesis 8: I provided a comprehensive overview of the developmental phases and trends of UPPs in Zhengzhou, introducing developmental strategies aimed at tackle existing problems.

Empirical analysis of urban park development from a historical and local point of view is the basis for further research into urban parks. According to the periods of urban development and the opportunities for green space development, a qualitative and inductive review of the evolution processes and trends of urban parks in Zhengzhou from the perspective of implementation approaches, spatial layout, functions and uses is conducted. Following this, development issues and strategies were discussed.

The results show that the urban park development in Zhengzhou is a continuous and changing process. It has gone through four progressive phases: the emergence phase (1949-1977), the growth phase (1978-1996), the acceleration phase (1997-2012), and the promotion phase (after 2012). On the whole, an evolution of Zhengzhou's urban parks is evident in terms of diversification of implementation approaches, systematization and balance of spatial layout, humanization of functions and uses, and sustainability of nature-based solutions. The future developmental strategies to tackle existing problems mainly lie in innovative land-use approaches, response to user group needs in a social context, and improvement of public participation mechanisms. The findings may help formulate adaptive and effective policies and planning tools for urban parks in Zhengzhou.

Thesis 9: I illustrated spatial patterns of accessibility and equity in UPPs at multiple urban scales in Zhengzhou, formulating corresponding solutions aimed at mitigating the spatial disparities.

Empirical evidence of distributional equity in UPPs in rapidly urbanizing regions is important and necessary. By applying an improved 2SFCA method and K-means cluster analysis, based on the application of multi-source data, an equity study on urban park accessibility at the neighborhood scale and urban ring scale was conducted in the central urban area of Zhengzhou. Corresponding solutions were proposed to improve existing situation of accessibility and equity in urban parks.

The results suggest that the spatial access to parks in Zhengzhou is generally unevenly distributed among neighborhoods, and both the mean and standard deviation of accessibility show an increase from the center to the periphery. The cluster analysis reveals a set of four types of neighborhoods, including a high-supply medium-demand medium-accessibility type (HMM), a low-supply medium-demand low-accessibility type (LML), a high-supply low-demand high-accessibility type (HLH), and a medium-supply high-demand low-accessibility type (MHL), each with different characteristics and causes. The spatial distribution of the accessibility types exhibits both similarities and differences between the urban rings. Specific to different types of regions, the following solutions encompassing five dimensions may help reduce spatial disparity in urban park accessibility: (1) Increase parks or expand existing parks; (2) limited opening or innovative application of certain types of open spaces; (3) improve unpopular parks through renovation and management; (4) improve road connectivity between parks and surrounding neighborhoods; (5) integrate residential area planning and urban park allocation. The findings could guide decision makers and urban planners to target underserved neighborhoods and formulate effective policies and strategies aimed at urban park equity.

5. CONCLUSION AND PROSPECTS

5.1 Summary of the dissertation

UPPs are widely acknowledged for their multifaceted social, environmental, and economic advantages. Consequently, the Chinese national government champions the "Park City" concept, and within European environmental strategies, urban parks are regarded as essential "nature-based solutions". However, disparities in access to park benefits within urban areas have led to a growing concern about the distributional equity of UPPs. This issue is increasingly emphasized in the context of urban regeneration and is crucial for advancing ecological civilization and social sustainability.

This dissertation aims to synthesize the basic historical development of UPPs worldwide and in China and to explore the assessment and measurement of equity in their distribution, specifically through the lens of UPPs in Zhengzhou, China. Employing a combination of theoretical and empirical research methodologies, this research presents significant historical developments, theoretical advancements, and empirical insights relevant to UPP development and distributional equity.

(1) The research first provides a detailed synthesis of the historical development of UPPs, encompassing their origins and the development of publicness worldwide, alongside the developmental phases of Chinese urban parks.

    a) The study traces the origins of urban parks, distinguishing between private open spaces like royal and noble gardens, and various types of public open spaces. The publicness development of parks has been recognized in three stages: so-called "public parks" during the 17th century, early public gardens from the late 18th century, and modern public parks post-mid-19th century. For China specifically, the study investigates the earliest categories of urban parks within unique societal contexts and outlines the distinct phases of park development since the mid-20th century, driven by significant national policies. This historical context provides a foundation for understanding contemporary park allocations.

(2) The research then develops a theoretical framework for assessing and measuring equity in UPP distribution, including the advances in

distributional equity assessment, a review of spatial accessibility measurement, and a supply-demand improvement of the 2SFCA method.

a) The study identifies four main modes of distributional equity assessment in UPPs: territorial equality, locational fairness, group justice, and social equity, each with distinct planning objectives and equity principles. These models fall into two types, differentiated by their assessment subjects and measurement criteria, metrics between parks and residents, and their relationships with contextual and procedural equity. It deepens the understanding of connotations and criteria associated with distributional equity.

b) The study systematically reviews primary park accessibility measures: container method, buffer method, distance-cost method, cumulative-opportunity method, and gravity-based method. The conceptual comparison underscores the efficacy of the gravity-based method, especially the 2SFCA model. The study further improves the 2SFCA model by incorporating the attraction coefficient of parks and the selection probability of residents, enhancing the accuracy of accessibility assessment based on multi-source data.

(3) The research finally conducts an empirical analysis of UPPs in Zhengzhou, examining their developmental process and characteristics, as well as the spatial patterns of accessibility and equity.

a) According to periods of urban development and opportunities for green space development, the study identifies four phases of urban park development from emergence to growth, acceleration, and promotion. It also highlights trends in the evolution of urban parks from various perspectives and proposes appropriate strategies to enhance their development.

b) Utilizing an improved 2SFCA method and K-means cluster analysis, based on the application of multi-source data, the study reveals uneven distribution of park accessibility across both the neighborhood and urban ring scales. It identifies various accessibility types and regions and offers practical recommendations for more equitable park distribution.

The findings significantly enhance our understanding of distributional equity

in UPPs and offer practical insights for urban planners and policymakers. By addressing inequitable distribution of urban parks, this research meets the critical needs of urban populations. Furthermore, it contributes to the broader discourse on sustainable urban development, providing a foundation for future strategies aimed at achieving equity in urban park planning.

5.2 Recommendations for future research

This dissertation endeavours to explore the assessment and measurement of equity in the distribution of UPPs, employing both theoretical and empirical approaches. Nevertheless, it acknowledges existing shortcomings and proposes recommendations for further exploration and enhancement.

(1) There is a deficiency in the empirical assessment of distributional equity for UPPs from "people-based" and "rule-oriented" perspective.

Due to the limitations in gathering data on the social attributes of various groups and their demand characteristics for urban parks, this dissertation did not perform an empirical assessment of distributional equity through the lens of group justice or social equity. The advent of advanced digital technologies, such as urban big data and PPGIS, facilitates a more detailed analysis of socio-spatial data on an individual basis, offering advantages in terms of cost, scale, and efficiency over traditional survey methods. The future extensive utilization of these tools is anticipated to significantly mitigate current limitations. Certainly, it is crucial to recognize that the perspective of distributional equity assessment and the formulation of appropriate measurement metrics must be tailored to the developmental stage of the urban area and its specific socio-cultural context. Accordingly, the assessment of distributional equity is expected to provide targeted park planning guidance.

(2) The spatio-temporal dynamics and evolutionary mechanisms underlying distributional equity in UPPs necessitate further research.

This dissertation conducts a cross-sectional analysis, comparing park accessibility across various spatial units. It focuses on the static spatial pattern of accessibility and equity in UPPs, rather than investigating the dynamics of the pattern. Therefore, it doesn't consider the changes in accessibility and equity patterns and fails to address how these changes are influenced by both spatial and social gradients. Future research should

undertake spatio-temporal analysis of the spatial patterns of accessibility and equity in UPPs to identify the dynamic process and characteristics of their distributional equity. This would allow for a deeper exploration of the factors and forces contributing to disparities in existing park accessibility. With a comprehensive understanding of the evolutionary mechanisms shaping the spatial patterns of accessibility and equity, it will be possible to devise adaptive optimization strategies for park planning.

6. LIST OF PUBLICATIONS

6.1 Journal articles

1. **YANG, Y**., HE, R., TIAN, G., SHI, Z., WANG, X. & FEKETE, A. 2022. Equity Study on Urban Park Accessibility Based on Improved 2SFCA Method in Zhengzhou, China. *Land,* 11 (11) 2045. p.
2. **YANG, Y**., HE, R. Z., NING, D. G., WANG, G. F., LIU, M. S. & FEKETE, A. 2021. An Overview of Urban Park Development in Zhengzhou, China. *Acta Biologica Marisiensis,* 4 (2) 1-13. p.
3. **YANG, Y**., FEKETE, A., TIAN, G., LI, H., NING, D. & HE, R. 2022. Comprehensive zoning scheme for vernacular landscapes of China. *Acta Horticulturae et Regiotecturae,* 25 (1) 8-20. p.
4. WANG, X., SHI, Z., KOLLáNYI, L., **YANG, Y.**, LIU, M. & ZHANG, X. 2023. Exploration of Urban Subsystem Coupling Coordination Based on Resilience in Luohe City. *4D Journal of landscape Architecture and Garden Art*, 22-29. p.
5. NING, D. G., FEKETE, A. & **YANG, Y.** 2020. Ecological Aspects of Traditional Chinese Waterscape. *4D Journal of landscape Architecture and Garden Art,* (57) 70-91. p.

6.2 Conference papers

1. WANG, G., LI, H., **YANG, Y.**, JOMBACH, S. & TIAN, G. 2019. "City in the park," Greenway Network Concept of High-Density Cities: Adaptation of Singapore Park Connector Network in Chinese Cities. Fábos Conference on Landscape and Greenway Planning. Amherst, MA , USA.
2. LIU, M., SHI, Z., WANG, G., **YANG, Y**. & KOLLáNYI, L. 2022. Comprehensive identification of ecologically important areas in Zhengzhou, China. Proceedings of the Fábos Conference on Landscape and Greenway Planning. Budapest, Hungary.
3. WANG, X., KOLLáNYI, L., SHI, Z., LIU, M. & **YANG, Y**. 2022. Study On Land Use Aggregation Pattern Of Luohe City Based On Spatial Heterogeneity. Proceedings of the Fábos Conference on Landscape and Greenway Planning. Budapest, Hungary.
4. NING, D. G., **YANG, Y.** & FEKETE, A. 2021. Sustainable Water Management Strategies from A Historical Landscape - Case Study of Ganzhou, China. Teka Komisji Urbanistyki i Architektury XLIV. Târgu Mureş, Romania.
5. DONGGE, N., ALBERT, F., ERNEST, A.-A. & **YANG, Y.** 2021. Sustainable waterfront landscape paradigm based on traditional Chinese philosophical perspectives - the Xiangjiang River Basin case study. 6th Conference on Horticulture and Landscape Architecture in Transylvania.