

**USAGE AND CONSTRAINTS OF URBAN RIVER CORRIDORS AT HUTUO
RIVER, SHIJIAZHUANG, CHINA**

By

SHI LIN

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of
Philosophy**

August 2024

FRSB 2024 12

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fulfilment of the requirement for the degree of Doctor of Philosophy

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August 2024

Chairman : Associate Professor Sreetheran a/l Maruthaveeran, PhD
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This PhD thesis investigates the utilization and associated constraints of urban river corridors in inland Chinese cities, focusing on Shijiazhuang. Recently, local authorities have increasingly recognized the importance of the Hutuo River Corridor and have sought to balance its ecological needs with socio-economic development, aiming for sustainable revitalization and effective urban space use. However, planning and design processes often overlook user needs and expectations, particularly the variations in usage across different social demographics. To address these gaps, this study comprises three components: systematic literature review, survey, and thematic and textual analysis using social media data. The systematic review identified 59 relevant studies from 27 journals, leading to the proposal of a social-ecological framework that emphasizes the roles of individual, social, physical, and time-related factors in shaping urban river corridor utilization. A survey of 620 respondents, using both on-site and online semi-structured questionnaires, revealed that social demographics—such as gender, age, marital status,

education level, income, and residential proximity—significantly influence river corridor usage. Key constraints identified include accessibility issues (traffic congestion, crowding, inadequate facilities, and unavailable toilet services) and external factors like seasonality and weather. In the era of big data, social networks provide diverse data that facilitate investigating dynamic aspects of human activities and environmental factors. An analysis of 3,006 comments from Dianping revealed positive evaluations of the natural environment, planning, design, convenience facilities, and transportation, but also dissatisfaction with certain charged events. This study proposes a conceptual framework that advances the understanding of urban river corridor utilization and constraints by integrating social-ecological perspectives and employing a mixed-methods approach. The findings underscore the need for a people-oriented approach in urban planning by identifying user patterns and key constraints across diverse social demographics, offering practical insights for enhancing river corridor environments. The study provides actionable recommendations for urban planners and decision-makers to improve the management and design of river corridors in Shijiazhuang and similar urban settings.

Keywords: Urban River Corridor, Usage, Constraint, Socio-Ecological Model.

SDG: GOAL 11: Sustainable Cities and Communities

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**PENGUNAAN DAN KEKANGAN KORIDOR SUNGAI BANDAR DI
SUNGAI HUTUO, SHIJIAZHANG, CHINA**

Oleh

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Pengerusi : Profesor Madya Sreetheran a/l Maruthaveeran, PhD
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Tesis PhD ini melihat dari aspek kepenggunaan dan kekangan yang berkaitan dengan denai sungai di sepanjang Sungai Hutou, Shijiazhuang di wilayah Hebei, China. Sejak kebelakangan ini, pihak berkuasa tempatan di Shijiazhuang menitikberatkan kepentingan denai Sungai Hutuo. Pelbagai usaha telah diambil untuk mengimbangi kepentingan ekologi dengan pembangunan sosio-ekonomi bagi memastikan pemulihan yang lestari dan penggunaan ruang bandar yang berkesan. Namun, proses perancangan dan reka bentuk bandar sering mengabaikan keperluan dan pendapat pengguna, terutamanya dari aspek kelas demografi sosial yang berbeza. Untuk menangani isu ini, kajian ini telah dijalankan dari tiga sudut: tinjauan literatur sistematik, kaji selidik, dan analisis tematik serta teks dengan menggunakan data media sosial di China. Tinjauan sistematik yang telah dijalankan telah mengenal pasti 59 kajian yang berkaitan dengan isu kajian ini. Di mana dari 27 jurnal yang dikenalpasti, suatu rangka konsep (conceptual framework) sosial-ekologi yang menekankan peranan faktor individu, sosial, fizikal, dan masa telah dirangka. Dalam bahagian kedua kajian ini yang melibatkan survei

melalui penggunaan boring kaji selidik telah melibatkan 620 responden di tapak kajian dan juga secara dalam talian. Survei ini telah mendedahkan bahawa factor demografi sosial—seperti jantina, umur, status perkahwinan, tahap pendidikan, pendapatan, dan jarak tempat tinggal, mempengaruhi penggunaan denai sungai secara signifikan. Dari aspek kekangan pula, dikenal pasti isu seperti kesesakan lalu lintas, kesesakan orang, kemudahan yang tidak mencukupi, dan perkhidmatan tandas yang tidak tersedia dan faktor luaran seperti cuaca. Manakala dalam bahagian ketiga kajian ini yang melibatkan penggunaan data daripada media sosial di China iaitu Dianping. Dalam kajian ini, analisis terhadap 3,006 ulasan daripada responden telah mendedahkan respon positif terhadap persekitaran semula jadi, perancangan, reka bentuk, kemudahan keselesaan, dan pengangkutan, tetapi juga ketidakpuasan terhadap beberapa acara yang dikenakan bayaran. Kajian ini mencadangkan rangka kerja konsep yang memajukan pemahaman tentang penggunaan dan batasan koridor sungai bandar dengan mengintegrasikan perspektif sosial-ekologi dan menggunakan pendekatan kaedah campuran. Kajian ini telah menekankan keperluan pendekatan berorientasikan pengguna (orang awam) dari aspek perancangan bandar dengan mengenal pasti corak kepenggunaan dan kekangan utama merentasi pelbagai kelas demografi sosial dengan menawarkan cadangan praktikal untuk meningkatkan kualiti persekitaran denai Sungai Hutou. Kajian ini telah memberikan cadangan yang dapat dilaksanakan oleh arkitek landskap, perancang bandar dan pihak berkuasa tempatan untuk memperbaiki dari aspek pengurusan dan reka bentuk denai Sungai Hutou di Shijiazhuang dan denai-denai sungai di bandar-bandar yang lain di China.

Kata kunci: Koridor Sungai Bandar, Penggunaan, Kekangan, Model Sosio-Ekologi.

SDG: MATLAMAT 11: Komuniti dan Bandar Yang Lestari



ACKNOWLEDGEMENTS

This thesis is for people who share a love of gardening and landscape design. We are now in an era where the environment changes greatly challenge the survival and growth of cities. Our rivers are vulnerable to the severe issues resulting from the rapid urbanization and climate change. I chose the research topic for exploring urban river corridors because of my love of water in all its natural forms and my dream and passion for creating river corridors with dynamic and exciting appeals in cities. Consequently, I aspire to delve into the latent potential of urban river corridors in terms of their utilization and the associated constraints, thus contributing to the sustainable development of urban environments.

During past three years, I had a truly great and exciting PhD journey at UPM. The amazing journey has changed my life, and I feel very grateful for all the happiness that the study has brought to me and for all the people who have made invaluable contributions to my PhD study.

Firstly, I would like to acknowledge and genuinely appreciate all of my family members. I would like to thank my mother, Wei Huicong, my elder sister, Shi Liwei, and my brother-in-law, Wu Binghu, for assisting in taking care of my son. My heartfelt appreciation goes to my second sister, Shi Weina. Thank you for your encouragement and your tough questions to me that helped me grow as a person. Your love and support have kept me focused throughout this

research; I could not have walked this journey alone. Thank you very much. I love you.

My deepest and warmest gratitude also goes to my two supervisors, Assoc. Prof. Dr. Sreetheran Maruthaveeran and Assoc. Prof. Dr. Mohd. Johari. Mohd. Yusof, for your patience and generous guidance, and so many valuable technical suggestions on my research work during the whole study. Without your encouragement and invaluable advice, I could not have achieved all I have. You are very inspirational to me.

I am indebted to the members of Faculty of design and architecture for fostering an environment of academic rigor and intellectual growth. Their lectures, seminars, and scholarly contributions have been instrumental in broadening my horizons and equipping me with the necessary tools to navigate the complexities of this research.

Finally, to the participants of the case study in the Hutuo River Corridor, Shijiazhuang, China, your willingness to share your perspectives and experiences has been pivotal in shaping the empirical aspect of this research. Your contributions have lent a real-world dimension to this study, and I am profoundly thankful for your time and insights.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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TABLE OF CONTENTS

	Page
ABSTRACT	i
ABSTRAK	iii
ACKNOWLEDGEMENTS	vi
APPROVAL	viii
DECLARATION	x
LIST OF TABLES	xv
LIST OF FIGURES	xvi
LIST OF APPENDICES	xviii
LIST OF ABBREVIATIONS	xix
CHAPTER	
1 INTRODUCTION	1
1.1 Introduction	1
1.2 Urban River Corridor in the Global Context	2
1.3 Urban River Corridor in the Chinese Context	8
1.4 Rapid Development of Big Data Technology	12
1.5 Problem Statement and Research Gap	13
1.6 Research Aim and Specific Objectives	20
1.7 Research Questions	21
1.8 Significance of Study	21
1.9 Research Scope and Limitation	23
1.10 Definition of Terms	24
1.11 Thesis Structure	26
1.12 Theoretical Background	27
1.12.1 Personal Factors	28
1.12.2 Social Factors	29
1.12.3 Physical Factors	29
1.12.4 Relationship Between Factors	30
2 LITERATURE REVIEW	32
2.1 Introduction	32
2.2 Overview of Urban River Corridors	33
2.2.1 The Definition of River Corridors	33
2.2.2 The Spatial Structure Characteristics of River Corridors	37
2.2.3 The Function of Urban River Corridors	40
2.2.4 The Research and Practice of Urban River Corridors	45
2.2.5 Urban River Corridor Planning and Practice in China	48
2.3 The Usage and Associated Constraints of Urban River Corridors	51
2.3.1 The Usage of Urban River Corridors	52

2.3.2	Constraints and Challenges Faced by Urban River Corridors	59
2.3.3	Research Progress on the Usage and Constraints of Urban River Corridors in China	64
2.4	Social Media Data	69
2.4.1	Overview of Social Media Data	69
2.4.2	Application of Social Media Data in Urban Studies	71
2.4.3	Benefits and Challenges of Using Social Media Data to Investigate Urban River Corridors	78
2.5	The Social-Ecological Framework	83
3	METHODOLOGY	87
3.1	Introduction	87
3.2	Convergent Parallel Design	89
3.3	Study Area	91
3.4	Systematic Review	94
3.4.1	Search Strategy	95
3.4.2	Inclusion and Exclusion Criteria	95
3.4.3	Study Selection	96
3.4.4	Data Extraction	98
3.4.5	Quality Appraisal	98
3.5	On-site Survey	99
3.5.1	Variables Used in This Study	100
3.5.2	Sample	101
3.5.3	Instrument Development	103
3.5.4	Survey Procedure	104
3.5.5	Questionnaire Reliability and Validity	105
3.5.6	Pilot Study	106
3.5.7	Data Analysis	107
3.6	Social Media Data	109
3.6.1	Data Collection	112
3.6.2	Data Cleaning	114
3.6.3	LDA-Gibbs Text Theme Model Construction	115
3.6.4	Text Content Analysis	120
3.6.5	Text Sentiment Analysis	122
4	RESULTS AND DISCUSSION	124
4.1	Introduction	124
4.2	Results of the Systematic Literature Review	124
4.2.1	Synthesis of Study Findings	125
4.2.2	Quality Review	130
4.2.3	Factors of Urban River Corridor Usage	132
4.2.4	Conceptual Framework	149
4.2.5	Conclusion of Systematic Review	154
4.3	The Usage of the Hutuo River Corridor	155
4.3.1	The Survey Results on the Usage of the Hutuo River Corridor	155
4.3.2	Analysis of Social Media Data on the Usage of the Hutuo River Corridor	179
4.3.3	Conclusion on the Use of the Hutuo River Corridor	230

4.4	Constraints Faced by Users in Utilizing the Hutuo River Corridor	231
4.4.1	Survey Results on the Constraints of the Hutuo River Corridor	231
4.4.2	Social Media Data Analysis Results on the Constraints of the Hutuo River Corridor	252
4.4.3	Conclusion on the Constraints of the Hutuo River Corridor	257
4.4.4	Conceptual Model of Factors Influencing the Use and Constraints of the Hutuo River Corridor from a Socio-Ecological Perspective	258
5	CONCLUSION & RECOMMENDATION	267
5.1	Introduction	267
5.2	Main Findings of the Study	267
5.3	Summary of Contributions of the Present Study	269
5.4	Optimization Strategies	271
5.5	Limitations and Recommendations for Future Research	274
	REFERENCES	276
	APPENDICES	320
	BIODATA OF STUDENT	361
	LIST OF PUBLICATIONS	362

LIST OF TABLES

Table	Page
1.1 Terms and definitions in the context of this study	25
2.1 Related concepts of river corridors proposed by different scholars	36
3.1 The independent and dependent variables impacting the usage and constraints of urban river corridors	101
4.1 Journal distribution of the 59 research papers reviewed in this study	126
4.2 The regional distribution of the 59 peer-reviewed papers reviewed in this study	127
4.3 Respondents' demographic characteristics (N=620)	156
4.4 User pattern by respondents at urban river corridors (N=620)	159
4.5 Important factors during visit to the urban river corridor (descriptive analysis)	178
4.6 High-frequency feature words in user reviews of the Hutuo River Corridor in Shijiazhuang (urban section): top 100 rankings	181
4.7 Frequency list of LDA feature words for each theme (top 30)	188
4.8 LDA theme description	191
4.9 Environmental and perceptual factors by respondents that constrain use (N = 620)	233
4.10 High-frequency feature words in user comments on constraints in the Shijiazhuang Hutuo River Corridor (urban area): Top 100 rankings	253
4.11 Factors influencing the usage and constraints of urban river corridors from a socio-ecological perspective	259

LIST OF FIGURES

Figure	Page
1.1 River, city, people framework	6
1.2 Flow chart presenting organization structure of the thesis	26
1.3 Conceptual framework of the research: personal, social and physical factors of urban river corridor usage and constraints	28
2.1 Four-dimensional structure diagram of river corridor	38
2.2 Cross-sectional structure diagram of the river channel	39
2.3 The social-ecological framework	86
3.1 The research process flow chart	88
3.2 Convergent mixed method design model	90
3.3 Location of Shijiazhuang, Hebei Province, China	93
3.4 Location of Hutuo River Corridor for the public interview in Shijiazhuang, China	93
3.5 Steps involved in a systematic review	97
3.6 Social media data processing flowchart	112
3.7 Schematic diagram of the LDA model	117
4.1 Number of articles on usage and constraints of urban river corridors published from 2012 to 2023	128
4.2 A conceptual framework for analyzing the usage and constraints of urban river corridors based on social ecology approach	153
4.3 Activities of users along the Hutuo River Corridor in Shijiazhuang: (a) fishing; (b) taking photos; (c) camping; (d) walking dogs; (e) flying kite; (f) riding; (g) horse riding; (h) boating; (i) play with water; (j) walking	161
4.4 The depictions of the Hutuo River Corridor in the urban section of Shijiazhuang: (a) riverside; (b) square; (c) path area; (d) roadside; (e) open grassland; (f) flat semi-enclosed green space; (g) enclosed highland forest; (h) flower sea	166
4.5 Respondents' preferred area for visiting the Hutuo River Corridor	169

4.6	Respondents' motives for visiting the Hutuo River Corridor	171
4.7	Word cloud diagram of high-frequency feature words in Hutuo River Corridor	183
4.8	Semantic network centrality of social network texts in Hutuo River Corridor	184
4.9	Number of theme-perplexity line graph	186
4.10	Monthly number of comments on Shijiazhuang Hutuo River Corridor (2022-2023)	194
4.11	Seasonal number of comments on Shijiazhuang Hutuo River Corridor (2022-2023)	194
4.12	The scenery of four seasons along the Hutuo River Corridor in Shijiazhuang: (a) spring; (b) summer; (c) autumn; (d) winter	198
4.13	Activities of users along the Hutuo River Corridor in Shijiazhuang: (a) sketching; (b) water activities; (c) sand play; (d) skateboarding; (e) balance biking; (f) interaction with animals; (g) play in the snow; (h) lying in hammock; (i) barbecue; (j) picnic	212
4.14	The natural landscape of the Hutuo River Corridor: (a) water body; (b) butterfly; (c) bird; (d) vegetation	214
4.15	The artificial facilities of the Hutuo River Corridor: (a) "I Love Shijiazhuang" sign; (b) Jizhiguang Tower; (c) Lanxiu Tower; (d) Scenic Road; (e) Fitness Trail; (f) Landscape Bridge; (g) Musical Fountain; (h) Children's Play Area; (i) Sculpture; (j) Windmill; (k) Hot Air Balloon; (l) Train-themed Restaurant; (m) Rest Pavilion; (n) Signboard; (o) Benches; (p) Restrooms	217
4.16	The ratio of three emotional polarities	227
4.17	User star rating score distribution	228
4.18	Monthly distribution of user comments with different attitudes	228
4.19	The respondents' constraints in using Hutuo River Corridor	234
4.20	Word cloud diagram of high-frequency feature words on constraints in Hutuo River Corridor	254
4.21	Semantic network centrality of social network texts about the constraints in Hutuo River Corridor	255
4.22	Factors influencing urban river corridor usage and associated constraints from socio-ecological perspective	262

LIST OF APPENDICES

Appendix	Page
1 Questionnaire	320
2 Summary of findings from reviewed articles	333
3 Quality ratings	338
4 Studies reporting attributes investigated for usage and constraints of urban river corridors	340
5 Usage patterns by respondents in Hutuo River Corridor (chi-square measure χ^2 and p-value)	344
6 The main purposes for visiting Hutuo River Corridor (chi-square measure χ^2 and p-value)	349
7 Important factors during visit to the urban river corridor (ordered logistic regression model measure the odd ratio (OR) and p-value)	351
8 LDA theme description and comment examples	353
9 Constraints by respondents in Hutuo River Corridor (chi-square measure χ^2 and p-value)	357
10 The respondents' constraints in using urban river corridor (binary logistic regression model measure the odd ratio (OR), 95% confidence intervals (CIs), and p-value)	358

LIST OF ABBREVIATIONS

AHP	Analytic Hierarchy Process
AI	Artificial Intelligence
APIs	Application Programming Interfaces
BMEEB	Beijing Municipal Ecology and Environment Bureau
CCAT	The Crowe Critical Appraisal Tool
CUSRA	The China Urban Science Research Association
DID	The Department of Irrigation and Drainage of Malaysia
FISRWG	Federal Interagency Stream Restoration Working Group
fsQCA	Fuzzy set qualitative comparative analysis
GIS	Geographic Information Systems
IWRM	Integrated Water Resources Management
KDE	Kernel Density Estimation
KMO	Kaiser-Meyer-Olkin
LBS	Location Based Services
LDA	Latent Dirichlet Allocation
MEA	The Millennium Ecosystem Assessment
MEE	The Ministry of Ecology and Environment of the People's Republic of China
MWR	Ministry of Water Resources
NBS	National Bureau of Statistics
NDVI	Normalized Difference Vegetation Index
NLP	Natural Language Processing
POI	Point of Interest
PPGIS	Public Participation Geographic Information System

PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
SD	Semantic Differential Method
SDT	Self-Determination Theory
SEM	Social-ecological Model
SOPARC	The System for Observing Play and Recreation in Communities
SPSS	Statistical Package for the Social Sciences
SSB	Shijiazhuang Statistics Bureau
TOPSIS	The Technique for Order of Preference by Similarity to Ideal Solution
UGC	User-Generated Content model

CHAPTER 1

INTRODUCTION

1.1 Introduction

Due to rapid urbanization and climate change, urban river corridors have undergone significant physical and spatial transformations, resulting in various social and ecological challenges (Best, 2019; Gurnell et al., 2007; Nguyen et al., 2019; Remondi et al., 2016; Wantzen et al., 2016; Zainal Abidin & Lee, 2011). China has also recognized this phenomenon in recent years and tried restoring river corridors through ecological design approaches while enhancing their recreational and leisure value. Urban river corridors serve not only as carriers of biodiversity and habitats for flora but also as essential ecological corridors for ensuring the well-being of urban residents (Nguyen et al., 2021; Oertli & Parris, 2019). However, there remains a lack of research on community consultations regarding how to design urban river corridor landscapes better to meet the public's high expectations for riverside green spaces, which hinders the development of urban river corridors in the Chinese context. Therefore, this study aims to investigate the current usage status of urban river corridors and identify the associated constraints different cultural groups face to establish a conceptual framework. Based on these findings, design and management recommendations for urban river corridors are proposed, providing a scientific reference for future development and improvement. Given its historical, geographical, physical, and cultural

significance, the Hutuo River Corridor in Shijiazhuang, Hebei Province, China, was selected as the case study site for this research. This chapter introduces the research, beginning with a discussion of the global context and Chinese contexts of urban river corridors, followed by problem statements, research gaps, research aims, objectives and questions, significance, limitations, and term definitions, and concludes with an overview of the thesis's structure.

1.2 Urban River Corridor in the Global Context

The urban population continues to grow, with more than 50% of the global population residing in cities since 2007, and it is projected to reach 60% by 2030 (United Nations, 2022). However, the rapid development of dense cities has led to significant alterations in the natural state of rivers, resulting in a host of pressing challenges, including water pollution, flooding, habitat fragmentation, and a decline in biodiversity (Austin, 2014; Bond & Lake, 2003; Clark & Johnston, 2017; Postel & Richter, 2012). These issues severely threaten the sustainability and livability of cities. Consequently, promoting urban biodiversity and providing ecosystem services have become crucial priorities for global urban planners and policymakers (Haase et al., 2014).

In addition to these concerns, the concepts of social and ecological resilience have become increasingly important in urban river corridor planning. Social resilience refers to the ability of communities to adapt and thrive in the face of social, economic, or environmental stressors (Kirmayer et al., 2009), while ecological resilience focuses on the capacity of ecosystems to recover from

disturbances while maintaining their essential functions (Gunderson, 2000). Urban river corridors are not only ecological assets but also crucial elements in enhancing social resilience, as they provide spaces for recreation, mental well-being, and community engagement (Bodmer, 2021; Gote, 2019; Kumar et al., 2013). Integrating these resilient features into urban planning ensures that cities can better withstand and adapt to various challenges, such as climate change and rapid urbanization.

To address these challenges, carefully designed "blue-green infrastructure," also known as "nature-based solutions," such as river corridors, are increasingly gaining recognition (Asakawa et al., 2004; Bae, 2011). Additionally, the COVID-19 pandemic and associated social restrictions have underscored the importance of green spaces, especially in urban areas where residents seek solace from prolonged indoor isolation (Darcy et al., 2022; Doughty et al., 2022). Urban river corridors are considered unique community assets that provide valuable and beneficial opportunities for residents to reconnect with nature (Rafferty, 2004).

Most of the world's significant cities have been built along rivers (Baschak & Brown, 1995). For instance, throughout history, numerous ancient civilizations settled along rivers such as the Tigris and Euphrates in Mesopotamia, the Nile in Egypt, the Ganges in India, and the Yellow River in China (Macklin & Lewin, 2015). Contemporary examples of cities located along rivers include London along the Thames, Paris along the Seine, Rome along the Tiber, Prague along the Vltava, and Budapest along the Danube. Nevertheless, human activities

driven by urban development projects and restoration efforts have altered and disrupted urban rivers (Che et al., 2012; Kondolf & Pinto, 2017; Pouya & Baskaya, 2018). Since the 1970s, cities worldwide have reconsidered the degradation of their urban river environments and sought to return them to a more natural state (Vian et al., 2021). For example, countries such as the United States, Germany, France, the Netherlands, Switzerland, and Japan have primarily removed previously placed hard materials from riverbeds and adopted ecological design approaches to restore and enhance their rivers. In the UK and Europe, implementing the "Water Framework Directive" introduced a more ecological framework for river restoration, significantly improving water quality and flood control (Smith et al., 2014).

As environmental awareness among citizens continues to grow (Kibel, 2007), policymakers have developed a renewed interest in urban rivers (Vian et al., 2021). Specific riverfront locations are now considered optimal for residential, commercial, and, notably, recreational developments (Sudia, 1974; Lerner & Holt, 2012). Simultaneously, recreational uses of urban rivers are gaining popularity, resulting in the construction of various public open spaces along rivers that interact with river ecosystems in various ways (Vian et al., 2021). Integrating ecological sustainability principles into these developments is critical, as it ensures that urban river corridors continue to provide the necessary ecosystem services while supporting the ecological and social health of urban populations.

As the proliferation of urban riverfront revitalization projects in developed nations continues to surge, it is time to reflect on the relationship between cities and rivers: How do rivers influence urban development? How do cities treat their riverbanks over time? How does the spatial relationship between cities and rivers constrain and improve the connection between urban populations and rivers? Initiatives aimed at river improvement or transformation should likewise consider the confluence of biophysical processes and the intricacies of the socio-economic realm (Selman et al., 2010; Westling et al., 2014). Hence, when considering urban landscape ecological planning methods, the perspectives of residents hailing from diverse cultural backgrounds and socio-demographic characteristics become pivotal in guiding the future development of river systems. Regarding urban rivers, some researchers have proposed a three-dimensional approach that considers three main evaluative perspectives related to rivers, cities, and people (Pouya & Baskaya, 2018) (Figure 1.1). In this context, rivers can be defined as the physical and biological world, cities as the social and humanized world, and people can act as individuals with emotional and perceptual connections to these places (Lothian, 1999). To understand the implementation of river corridors, it is necessary to investigate both the physical and ecological aspects of cities and rivers at the human level.

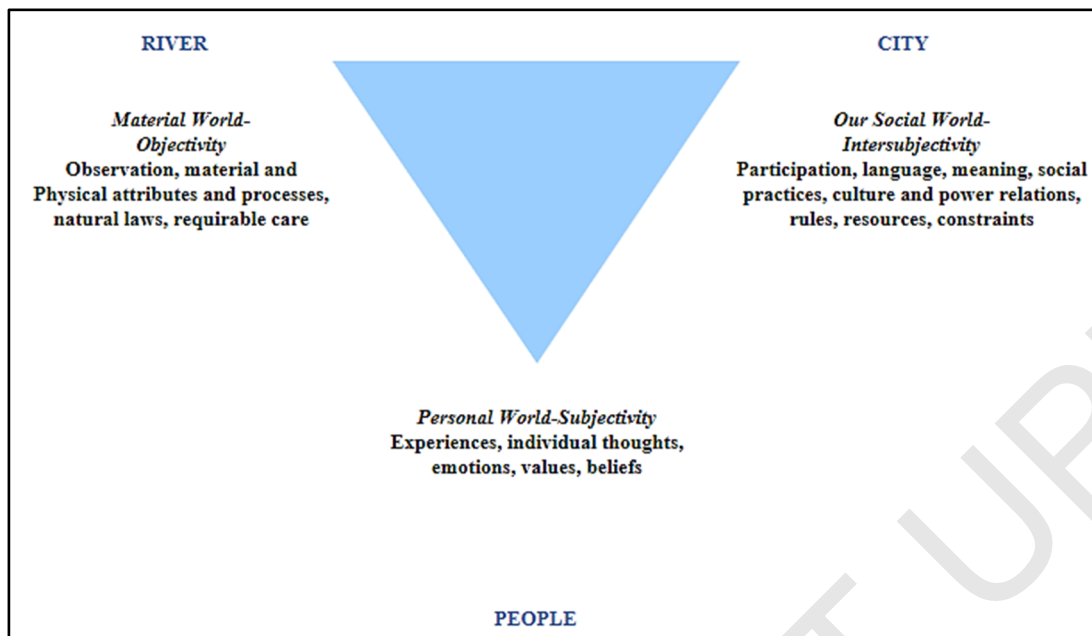


Figure 1.1: River, city, people framework

(Source: Silva et al., 2005)

River corridors refer to the vegetated areas along river channels and their adjacent zones, serving as transitional zones between the river and surrounding terrestrial ecosystems (Forman, 1995). Research has demonstrated that urban river corridors, as blue-green infrastructure, perform a dual role as natural and social corridors, thereby contributing significantly to urban stability, comfort, and sustainability (Janiszek & Krzysztofik, 2023; Ji et al., 2012). On one hand, urban river corridors hold the potential as green spaces, providing residents with a multitude of valuable ecosystem services, including the regulation of urban microclimates, alleviation of the urban heat island effect, soil and water retention, purification, and conferring psychological benefits through attention restoration (Guimarães et al., 2021; Hathway & Sharples, 2012; Kenwick et al., 2009; Vaeztavakoli et al., 2018). On the other hand, river corridors offer diverse social values such as cultural, recreational, and touristic aspects (Che, 2001; Garcia et al., 2017). Natural riverbanks

contribute to the city's aesthetic landscape, constituting an essential element in shaping urban scenery (Che, 2001). Urban river corridors are ideal public attractions for showcasing vegetation and optimizing the city's visual landscape. Furthermore, they provide citizens with water-related spaces, fostering a connection to nature (Zainal Abidin, 2017). These and similar studies show that urban river corridors, as vital public amenities, constitute critical determinants of individual and societal well-being and overall quality of life.

However, relying solely on ecological methods to enhance urban river corridors may not align with residents' preferences and expectations (Pouya & Baskaya, 2018), as individuals' use and preferences for urban river corridors vary significantly (Buijs et al., 2009). It has been suggested that urban river corridors be investigated by considering residents' perspectives and exploring their experiences, cultural values, and social memories attached to the landscape (Pouya & Baskaya, 2018). There remains a debate on whether residents' preferences should be prioritized in landscape projects. Some researchers have noted how the physical characteristics of river corridors and the social-cultural and perceptual attributes of individuals and social groups influence public preferences for river restoration (Garcia et al., 2020). Physical factors refer to the configuration of biophysical elements forming the riparian landscape (e.g., banks, channels, water, vegetation), design, and functional features (Garcia et al., 2020; Kaplan & Kaplan, 1989). Social-cultural factors encompass proximity and length of residence, socio-demographics, values, beliefs, emotions, behavioral tendencies, and place attachment (Garcia et al.,

2020; Wang et al., 2019b). In river restoration literature, dimensions like naturalness, risk, and safety, as well as stewardship and cleanliness, are most frequently analyzed to explore public preferences for river landscapes (Artmann et al., 2017; Garcia et al., 2020; Millard et al., 2022; Schrader, 1995).

Several variables and their interrelationships may influence urban river corridors. Therefore, it is necessary to investigate the factors influencing the usage and constraints of river corridors and the interactions among these factors. Involving the public in decision-making processes for river restoration can enhance their sense of ownership and pride in the local river environment (Eden & Tunstall, 2006). Perceiving the meanings attached to the river landscape helps to counteract feelings of detachment by fostering a connection between people and the restored river environment (Selman et al., 2010). Understanding the various factors that impact the public's use and constraints of urban river corridors may assist decision-makers in anticipating conflicts and outlining acceptable restoration management strategies, thereby contributing to the sustainable development of these projects.

1.3 Urban River Corridor in the Chinese Context

China is an increasingly urbanized continent. From 2010 to 2020, the urbanization rate in China rose from 49.7% to 63.9% (Zhai, 2021). The rapid economic development and population expansion, coupled with intense human activities such as extensive water infrastructure construction and the growth of agriculture and animal husbandry, have disrupted the balance of

natural river ecosystems (Chen et al., 2010; Jiang, 2009). Consequently, various ecological and environmental issues in rivers have emerged, encompassing river degradation, biodiversity reduction, and water bodies' eutrophication (Yu et al., 2015; He et al., 2022). Simultaneously, this multifaceted challenge severely threatens regional water security and socio-economic sustainability (Jiang, 2015). The decline in riverine ecosystems has consequently garnered escalating attention, prompting ecologists and scientific researchers to acknowledge the crucial significance of river corridors in this context.

Historically, rivers have been foundational to the development and sustenance of Chinese civilization (Xia et al., 2021). Early Chinese settlements were predominantly established along major rivers, such as the Yellow and Yangtze Rivers, which were critical for agriculture, transportation, and sustenance (Mostern, 2021; Wohlfart et al., 2016; Yasuda et al., 2004; Zhuang & Kidder, 2014). These rivers served as vital lifelines, supporting irrigation and acting as natural boundaries between regions, thereby shaping the socio-economic structure of early rural societies. As China transitioned from predominantly rural communities to urbanized centers, the function of rivers underwent significant transformation. During the urbanization process, rivers evolved from agricultural resources to integral components of urban planning and development (Bao & Fang, 2012). They not only dictated the spatial layout of cities but also facilitated economic and cultural exchanges, thus becoming central to the urban fabric (May, 2006; Castonguay & Evenden, 2012). However, the rapid pace of industrialization and modern urban development

has led to the degradation and alteration of many river corridors (Che et al., 2012). These changes have disrupted natural ecosystems and diminished the traditional roles that rivers once played in both rural and urban settings. As cities expanded, rivers increasingly intertwined with urban infrastructure, influencing city life's social and functional dynamics (Kondolf & Pinto, 2017). The historical evolution of these rivers from rural to urban contexts highlights their ongoing significance and the challenges they face in contemporary urban landscapes.

In response to these challenges, several national-level strategies have been implemented to restore and manage urban rivers by linking water quality improvements with ecosystem protection and urban development. Initiatives such as the "Dual Restoration" strategy and the "Technical Guidelines for the Protection and Restoration of River and Lake Ecological Buffer Zones" highlight the importance of restoring urban river corridors as critical elements of ecological sustainability (MEE, 2021; Li, 2021a). These strategies aim to enhance river water environments, protect aquatic ecosystems, and create harmonious urban spaces that balance human needs with environmental preservation.

Public perception of rivers has also evolved over the past two decades. Initially, rivers were heavily modified to improve flood control, often resulting in ecological degradation and loss of recreational value (Wantzen et al., 2016). However, there has been a growing awareness of the importance of river restoration, leading to the development of projects that seek to return rivers to

a more natural state and enhance their role as public spaces. Urban river corridors have thus become catalysts for sustainable urban development (Vollmer, 2009), offering benefits such as flood control (Lerner & Holt, 2012; Miguez et al., 2016), climate change adaptation (Rojas et al., 2013), recreational opportunities (Che, 2001), and enhanced biodiversity (Vermaat et al., 2016; Guimarães et al., 2021).

The restoration and revitalization of urban river corridors in China have become focal points for urban renewal efforts. By integrating green and blue spaces into urban design, cities aim to create a more connected and resilient ecological network (Vall-Casas et al., 2019). Despite the wealth of research on river corridors, differences in the use of river landscapes among various population groups have yet to be noticed. It has been proven that establishing effective collaboration among stakeholders with interests and impacts on urban river restoration is crucial (Hamdan et al., 2021). Achieving a balance in planning and implementing urban river restoration measures is imperative. Public consultation and engagement with local communities stand out as vital steps in the planning and implementing urban river restoration measures. Environmental planners and designers believe that landscape planning should meet the needs of users (Sreetheran, 2015). However, they often lack direct communication with the public before planning or designing river corridors. In the context of an evolving trend toward human-oriented design, a growing body of literature emphasizes that the design of landscapes attuned to public aesthetics and living needs is indispensable for achieving sustainability (Guo & Wang, 2022).

1.4 Rapid Development of Big Data Technology

With the advent of the big data era, data mining, analysis, and visualization technologies have witnessed remarkable advancements, making acquiring and utilizing large datasets less challenging. The explosive growth of internet users, epitomized by social media platforms, has transformed online networks into novel spaces where users can express opinions and emotions (Pak & Paroubek, 2010). Platforms like Facebook, Twitter, Flickr, Sina Weibo, WeChat, and Dianping boast substantial user bases, enabling individuals to voice their perspectives and discuss specific topics. Consequently, these platforms are evolving into crucial sources for collecting social perception data (van Zanten et al., 2016). The diverse and comprehensive data available on these social networks capture various dimensions of human activities and the dynamic characteristics of environmental elements.

Batty (2013) emphasized the need for urban planners to catch up with the big data era, adapt their thoughts, and explore big data applications within urban studies in his work "Big Data, Smart Cities and City Planning." In China, several social media platforms, such as Sina Weibo, Dianping, Baidu, Google, and numerous internet-based corporations, have, to a certain extent, facilitated targeted access to and management of data by offering Application Programming Interfaces (APIs). These platforms have increased data sharing across society (Zhu, 2020). The emergence of these open data organizations and websites has significantly altered and expanded the data foundation for urban research, which provides researchers with exceptional convenience and

a wealth of possibilities for conducting urban studies from various scales and perspectives (Mao, 2014). The utilization of social media data for precise analysis and design in urban contexts has gradually evolved into a consensus within urban planning and design (Wu et al., 2019b).

Compared to traditional data sources, social media data presents several advantages. These include lower data collection costs, large-scale data availability, the convenience of precise geographic information for each data point, reduced subjectivity and bias introduced by direct researcher-participant interactions, and the ability to capture voices often missing in conventional public participation (Chen et al., 2018a; Cheng et al., 2022; Daniel & Meitner, 2001; Pogačar & Žižek, 2020). Researchers can harness this data's vast, intricate, and rapidly evolving nature through mining and processing, enhancing the scientific rigor of their analyses and predictive capabilities. Consequently, social media is an additional resource complementing traditional methods across various research domains. Using social media as a platform, people can understand cities in a bottom-up manner and participate in the planning and optimization of urban space. This approach is conducive to creating livable environments that meet people's needs, ultimately increasing happiness and fostering harmonious and stable societies (Dwivedi, 2009; Li, 2021a; Zhao et al., 2016).

1.5 Problem Statement and Research Gap

In modern urbanized society, river corridors have become essential support systems for the development of cities (Xue & Wang, 2008). The increasing

urban population, influenced by rapid demographic changes and urban pressures, has prompted cities to prioritize the health and well-being of their residents (Paneerchelvam et al., 2020). Urban lifestyles and a lack of interaction with nature may result in stress and mental fatigue among urban dwellers (Velarde et al., 2007). Urban river corridors, as natural systems within cities, play a vital role in improving urban environmental conditions by mitigating surface temperatures, filtering pollutants, and preventing soil erosion (Apan et al., 2002; Fabos, 1995; Gunawardena et al., 2017; Hathway & Sharples, 2012; Kantartzis et al., 2006; Singh et al., 2021). Moreover, these corridors provide wildlife habitat, significantly enhancing urban biodiversity (Guimarães et al., 2021). Furthermore, urban river corridors offer residents opportunities to connect with natural environments and green spaces, providing venues for recreational activities and relaxation (Asakawa et al., 2004; Zainal Abidin, 2017). Research on healthy environments suggests that exposure to nature and restorative natural landscapes can reduce stress, alleviate negative emotional states, and promote psychological well-being (Grahm & Stigsdotter, 2003; Vaeztavakoli et al., 2018). Some studies also indicate that frequent contact with nature fosters social interaction and cohesion among neighbors (De Vries et al., 2013; Ekkel & de Vries, 2017; 'Yotti' Kingsley & Townsend, 2006). However, large green spaces are scarce in densely populated city centers, and the distance required to access these spaces often discourages frequent use (Woolley, 2003). Therefore, urban river corridors have emerged as ideal areas with water-oriented landscapes, providing citizens with extensive green spaces and connectivity (Chen et al., 2022).

Identifying stakeholders' landscape values and preferences can help minimize potential conflicts and promote comprehensive planning and management of river corridors (Garcia et al., 2017). However, despite the favorable social and political context for increasing river landscape management and restoration to support community well-being in China, public participation remains limited, impeding major stakeholders' involvement, including owners, users, residents, visitors, and neighbors. This limited public involvement dramatically hinders the effective bridge of the "people-city-river" relationship (Garcia et al., 2017; Zainal & Lee, 2011). Research by Pouya and Baskaya (2018) shows that neglecting public participation in river restoration may lead to adverse outcomes, especially in urban river corridors. For instance, planting "wild grasses" and native plants in the riparian zone might be misconstrued as a lack of maintenance and management, whereas colorful ornamental grasses like *Miscanthus sinensis* may be more appealing to people. Additionally, involving the public in the decision-making process of river restoration plans can enhance their sense of belonging, ownership, and pride in the local river environment (Eden & Tunstall, 2006; Junker & Buchecker, 2008). Ultimately, public participation in river projects can increase the likelihood of successful implementation and support for restoration plans (Garcia et al., 2020; Nilsson et al., 2007).

Furthermore, understanding public usage and constraints is crucial in urban river corridor restoration (Garcia et al., 2020). Over the past few decades, urban river corridor projects have been ubiquitous in developed countries and increasingly promoted in developing countries. These projects propose

restoring rivers in urban environments through natural processes, ecological values, and socio-cultural functions (Bajc & Stokman, 2018; Blau & Panagopoulos, 2018; Delibas & Tezer, 2017). However, in densely populated cities, the social benefits of restoration may outweigh the potential ecological benefits. Residents are an inevitable part of urban river projects as rivers are intertwined with various economic, cultural, and social issues for the community (Chou, 2016; Pouya & Baskaya, 2018). Evidence suggests that residents interact with urban water bodies in diverse ways, and people from different cultural and racial backgrounds utilize river corridor spaces differently (Diep et al., 2022; Haeffner et al., 2017). Moreover, cultural influences significantly shape attitudes toward landscapes (Rohde & Kendle, 1994; Schaich, 2009; Zainal Abidin, 2017). Many rivers are closely linked to the identity and distinct characteristics of the cities they flow through (Bruttomesso, 2004). Thus, each river corridor requires unique planning and design approaches that suit its specific conditions as they vary in physical and ecological attributes (Zainal Abidin, 2017). Transferring restoration methods from a successfully applied city to another with different features often leads to failure when cultural diversity, public use, and constraints of the river corridor are not adequately considered. This phenomenon also presents significant challenges for Chinese urban design teams to improve the design process to cater to the needs and desires of multi-populated communities with diverse socio-economic backgrounds, especially regarding economic, health, and cultural well-being. Therefore, it is necessary to understand how different cultural groups utilize urban river corridor landscapes, providing valuable

insights to enhance the guidance of design and management strategies for these urban features (Johnston & Shimada, 2004).

Although online social media data is relatively easy to access and comes in large volumes, it has yet to receive full attention and effective utilization in urban river corridor research. A wealth of untapped information within social media data awaits further exploration and discovery. Some scholars in the field of the landscape have been experimenting with various methods to extract domain-relevant knowledge from social media data. For instance, recent studies have explored transforming information from spontaneously generated media data into structured landscape values (Chen et al., 2018b; Cheng et al., 2022). However, the reliability of these methods warrants further investigation and refinement. Compared to relatively more reliable and accurate traditional approaches such as surveys and interviews, social media data, as spontaneously generated data, contains highly subjective and personalized user comments, which may introduce additional biases (Chen et al., 2018b). Therefore, it is advisable to emphasize integrating social media data with conventional data sources in numerous landscape studies, enabling various types of data to cross-verify one another and helping to address urban challenges effectively.

In China, previous literature mainly focused on the ecological functions of river corridors, such as flood control, erosion reduction, ecological benefits of regulating microclimates in natural riparian zones, and biodiversity of riverside vegetation (Ji et al., 2012; Zhang et al., 2022a). In recent years, researchers

have started to pay attention to the interactions between the physical features of river corridors and the "human dimension." However, these studies have some limitations as they primarily concentrate on post-usage evaluations, satisfaction, and vitality of urban river corridors, with little consideration for individual differences (Chen et al., 2022; Cheng et al., 2022; Fan et al., 2021; Liu et al., 2021; Niu et al., 2021; Shi et al., 2023; Zhang et al., 2022b). For those involved in designing and managing urban river corridors, it is essential to understand diverse perspectives, preferences, and experiences to avoid perpetuating the dominance of certain groups. Furthermore, previous research has mainly employed single indicators, such as familiarity or accessibility, with limited consideration of various aspects of urban river corridor use and their determining factors (Xie et al., 2023). Thus, there is still a lack of a comprehensive approach to gaining a deeper understanding of the intricate interactions among various factors influencing the utilization of these spaces, which contributes to providing valuable guidance for urban planners and policymakers to create sustainable and people-centric urban environments.

In Shijiazhuang, the design and maintenance of the Hutuo River Corridor are the responsibility of public administrative departments, while budget constraints hinder their action capacity. Extensive use of cultivated vegetation, with intensive and long-term exemplary management and maintenance through horticultural activities like pruning, irrigation, fertilization, and weed control, often leads to a decline in plant community species diversity, imbalanced species relationships, and loss of animal habitats, resulting in high construction and maintenance costs (Bormann et al., 2001; Ignatieva et al.,

2011; Jabbar & Mohd Yusoff, 2022; Kristoffersen et al., 2008; Pickett et al., 2001; Sudha & Ravindranath, 2000; Skaller, 1981). The economic burden of traditional management practices is becoming increasingly evident. Furthermore, the landscape design process for the Hutuo River Corridor often lacks originality and fails to capture the region's distinctive historical and cultural identity. Designers frequently replicate designs from other cities, applying standardized elements without adequately considering the local context. For instance, the repeated use of windmill motifs and uninspired signage has led to monotonous landscape features and repetitive visual effects, which strip the corridor of its vibrancy and obscure its potential to showcase local cultural assets. Moreover, the Hutuo River Corridor is subject to dual management by the Water Conservancy Bureau and the Landscape Bureau, a critical issue in the landscape design and management process is the lack of coordination between the two departments, each of which has different management objectives. For example, The Water Conservancy Bureau prioritizes river flood control and water management, while the Landscape Bureau focuses on ecological and aesthetic aspects from a landscape perspective. This dual management structure often leads to conflicting priorities and objectives, with little consideration given to the perspectives of the actual users of the river corridor. Since the Hutuo River Corridor Revitalization Project was implemented in 2007, its planning has been predominantly driven by governmental authorities and designers, with limited public consultation. This top-down approach risks misaligning the design outcomes with the public's expectations and demands, revealing a critical gap in the process where user participation is insufficiently integrated. Addressing

this disconnect is crucial to realizing the corridor's potential to enhance human well-being and improve the quality of life for the residents of Shijiazhuang.

1.6 Research Aim and Specific Objectives

This study aims to explore the connection between urban river corridors and social-ecological perspectives, which are frequently overlooked in the implementation of urban river projects. Therefore, this research seeks to examine current usage patterns and constraints of urban river corridors from a regional standpoint while also delivering dependable data concerning their effectiveness. By developing a conceptual framework that merges these aspects, the study intends to enhance the existing landscape design process and offer innovative strategies for developing and improving urban river corridors, particularly in the context of well-developed river cities in China. The overall goal will be achieved through the following four specific objectives:

- (a) To systematically review the current usage status and associated constraints of urban river corridors from the perspective of existing literature.
- (b) To identify the usage patterns of the Hutuo River Corridor in Shijiazhuang.
- (c) To determine the constraints encountered in the utilization of the Hutuo River Corridor in Shijiazhuang.
- (d) To propose a conceptual framework for the use and associated constraints of the Hutuo River Corridor in Shijiazhuang.

1.7 Research Questions

The main research questions in this study are:

- RQ1. How have the usage and associated constraints of urban river corridors been studied in the literature globally?
- RQ2. What are the usage patterns of the Hutuo River Corridor in Shijiazhuang?
- RQ3. What constraints are encountered in the utilization of the Hutuo River Corridor in Shijiazhuang?
- RQ4. Which influencing factors promote and limit the usage of the Hutuo River Corridor in Shijiazhuang?

1.8 Significance of Study

Previous studies have explored the advantages and significant roles of urban river corridors within a country, providing positive social-cultural experiences for residents. In addition, numerous studies have examined how the diversity of plant life in river corridors can contribute to urban ecosystem sustainability. From the perspective of previous researchers, the ideas and strategies investigated can serve as references for enhancing landscape design and management in urban river corridors. Environmental, historical, and cultural constraints significantly influence the landscape characteristics of urban river corridors. While abundant literature exists on the use and constraints of urban landscapes or green spaces, limited research is explicitly conducted within urban river corridors. Hence, there is an urgent need for holistic design approaches strongly influenced by ecological methods and robust community participation to improve the current landscape design process and achieve

exceptional sustainable outcomes for the future development of urban river corridors in China. Therefore, this research fills the gap in the lack of design strategies for urban river corridors, which is particularly vital in China, given its diverse population and multi-ethnic environment. Consequently, the resulting conceptual framework can be implemented to design urban river corridors. The findings of this study will provide evidence for planners, designers, and policymakers to strengthen urban river corridors. They will enhance the design and management standards of urban river corridors, positively impacting the well-being of Chinese communities and the overall quality of urban life.

Furthermore, apart from traditional survey methods, this study also employed social media data to enhance the generalization and accuracy of the research results. In this way, the shortcomings of traditional research methods, such as small data sample sizes, limited content categories, and insufficient collection time, are avoided (Cheng et al., 2022). Currently, there are few studies on urban river corridors using media data, and they are still in their nascent stage, primarily focusing on utilizing check-in data to reflect people's spatiotemporal behavior patterns and satisfaction (Cheng et al., 2022; Wu et al., 2019a, b, c). By harnessing the advantages of big data information mining, this study explored the characteristics of user recreational experiences. This approach facilitates a thorough and rapid understanding of user demands and constraints associated with various factors in urban river corridors, employing a bottom-up methodology. The integration of big data information mining offers a practical way to assess the value of qualitative ecology in future research.

1.9 Research Scope and Limitation

The scope of this study is to explore the usage patterns and constraints of urban river corridors, focusing on the Hutuo River Corridor in Shijiazhuang, Hebei Province, China. This region was selected as it exemplifies urban river corridors in northern inland cities of China, providing insights that are anticipated to extend to similar socio-cultural and environmental contexts across other Chinese cities. Central to this research is the development of a conceptual framework that integrates social and ecological dimensions. This framework is designed to investigate the intricate interactions among the physical attributes, ecological functions, and human usage patterns of urban river corridors. Special attention is given to how individuals from diverse cultural and socio-economic backgrounds engage with these corridors, aiming to lay a foundation for sustainable urban landscape design and management. The study employs a mixed-methods approach, combining traditional survey techniques with social media data analysis to comprehensively understand user behavior and its constraints. The significance of this research lies in its formulation of a conceptual framework that not only provides actionable recommendations for the design and management of urban river corridors in China but also addresses specific needs and constraints identified within the Hutuo River Corridor. It offers valuable theoretical and practical insights for the development of urban river corridors in China's rapidly urbanizing areas. This research aims to support urban planners, landscape designers, and policymakers with evidence-based strategies for enhancing the functionality and sustainability of urban river corridors.

This study also has some limitations. Firstly, the study could cover up to one sample area due to time and resource constraints. This empirical study on the usage and constraints of urban river corridors specifically focused on the Hutuo River Corridor in Shijiazhuang, Hebei Province, China. Therefore, the applicability of the findings to other cities requires further validation. Secondly, we observed a construction zone within the scenic area of the Hutuo River Corridor in Shijiazhuang, which generated noise, dust, or debris that might hinder people's visits. Lastly, the investigators did not conduct surveys during unfavorable weather or periods like rainy days or flood seasons, assuming visitors rarely use the Hutuo River Corridor during adverse weather or restricted access periods. However, it cannot be ruled out that some individuals may choose to explore the corridor even during rainy conditions. For example, Li (2009) published an article about climbing Mount Tai and enjoying the fun of waterfalls in the rain.

1.10 Definition of Terms

The definition of terms below provides an overview of the research's working definitions, which helps the reader better understand (Table 1.1).

Table 1.1: Terms and definitions in the context of this study

Terms	Definition
River corridor	A river corridor is a zone of vegetation distributed along a river and differs from the surrounding substrate (Forman, 1995). It comprises the river channel, riparian zones, floodplains, and the transitional upland fringe (FISRWG, 1998). However, the width and presence of these regions can vary depending on the topography and the extent of urban development (Vian et al., 2021).
Urban waterfront	Moretti (2008) describes urban waterfront as "the urban zone in direct proximity to water." This term is analogous to different words such as riverside, riverfront, river edge, water edge, harbourfront, and city port (Timur, 2013). It serves as an "interface area" or a "transition zone" that connects urban development and water bodies from an ecological perspective (Brighenti & Mattiucci, 2012; Samant & Brears, 2017; Yassin et al., 2010).
Urban riverfront	In urban areas located near water bodies, the interface between residents and water occurs along the "waterfront" (Vian et al., 2021), with water bodies including rivers, lakes, oceans, bays, creeks, or canals (Breen et al., 1994). Therefore, in urban areas near rivers, it constitutes the urban riverfront, serving as a transition area (Vian et al., 2021).
Urban blue-green space	Urban blue-green space refers to integrated areas within urban environments that harmoniously combine blue spaces, including water bodies such as rivers, lakes, ponds, and artificial water features, with green spaces comprising natural or planted areas with vegetation such as parks, gardens, and green corridors (Kumar & Shekhar, 2021; Pan et al., 2023; Sunita et al., 2023). This concept emphasizes the seamless integration of water and vegetation in urban planning to create sustainable and resilient urban environments (Sunita et al., 2023).
User	The term "user" refers to an individual or group of individuals who interact with or utilize a particular product, service, system, or platform in a specific context (Berni & Borgianni, 2021).
Social media data	Social media data refers to the information and content users generate, share, and exchange on various social media platforms (Fang, 2019). It encompasses a wide range of digital content, including text-based posts, comments, messages, images, videos, likes, shares, and other interactions that users engage in using social networking sites (Fang, 2019; Li, 2021c).
Socio-ecological framework	The socio-ecological model, derived from Urie Bronfenbrenner's ecological system theory, is a conceptual framework that explores the intricate interactions between social, cultural, economic, and political elements, along with the natural environment. It aims to understand the influences on human behavior and decision-making, recognizing the impact of various levels of influence, from individual to societal contexts. This model emphasizes the reciprocal relationship between human activities and the environment, highlighting how environmental factors impact human well-being (Paneerchelvam, 2020).

1.11 Thesis Structure

This thesis consists of five chapters. Each chapter is described in the flow chart in Figure 1.2.

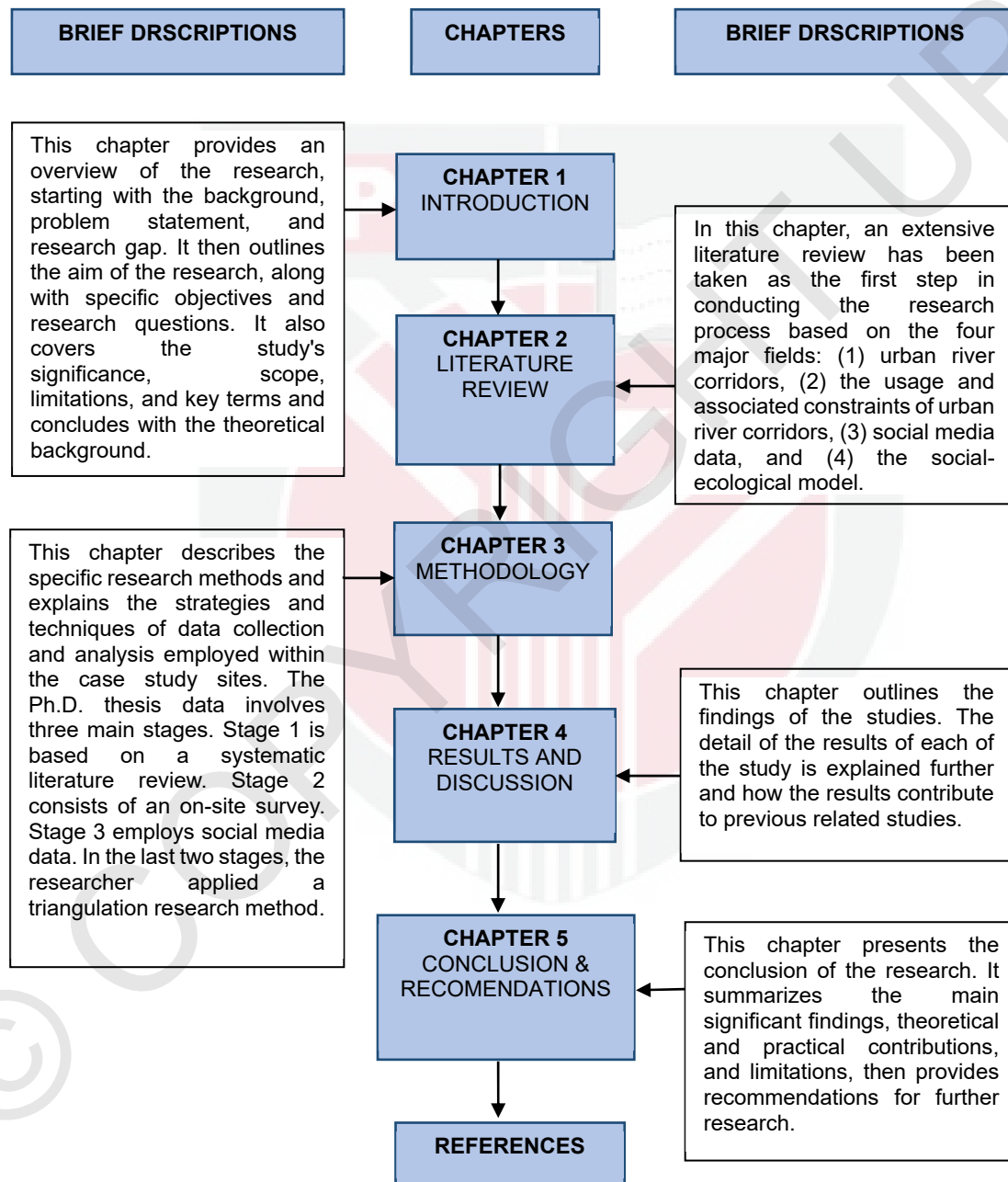


Figure 1.2: Flow chart presenting organization structure of the thesis

1.12 Theoretical Background

This study employs a social-ecological framework to explore the relationships between human behavior and the multi-level variables influencing usage patterns and constraints in urban river corridors. Drawing on social-ecological systems theory, this approach seeks to understand the interactions between human behavior and environmental factors (Bohnet & Smith, 2007; Liu, 2014). Guided by evolutionary theory, the social-ecological paradigm views social environments—such as families, institutions, groups, and communities—as forms of social ecosystems. It underscores the critical role of the ecological environment (the habitat for human existence) in analyzing and understanding human behavior, emphasizing the significant impact of the interactions between individuals and the various systems within their environment (Shi & Fan, 2005). From the perspective of environmental psychology, other assumptions are also related to this theory.

Inspired by Urie Bronfenbrenner's ecological systems theory (1977), the following socio-ecological framework was developed for this study, specifically highlighting how individual, social, and physical factors, and their interrelations, collectively shape the behaviors and constraints related to urban river corridors (Figure 1.3). This framework offers a robust theoretical foundation for analyzing the complex interactions between individuals and their social-ecological environments. Such an approach is crucial for comprehending the usage patterns and constraints within urban river corridors.

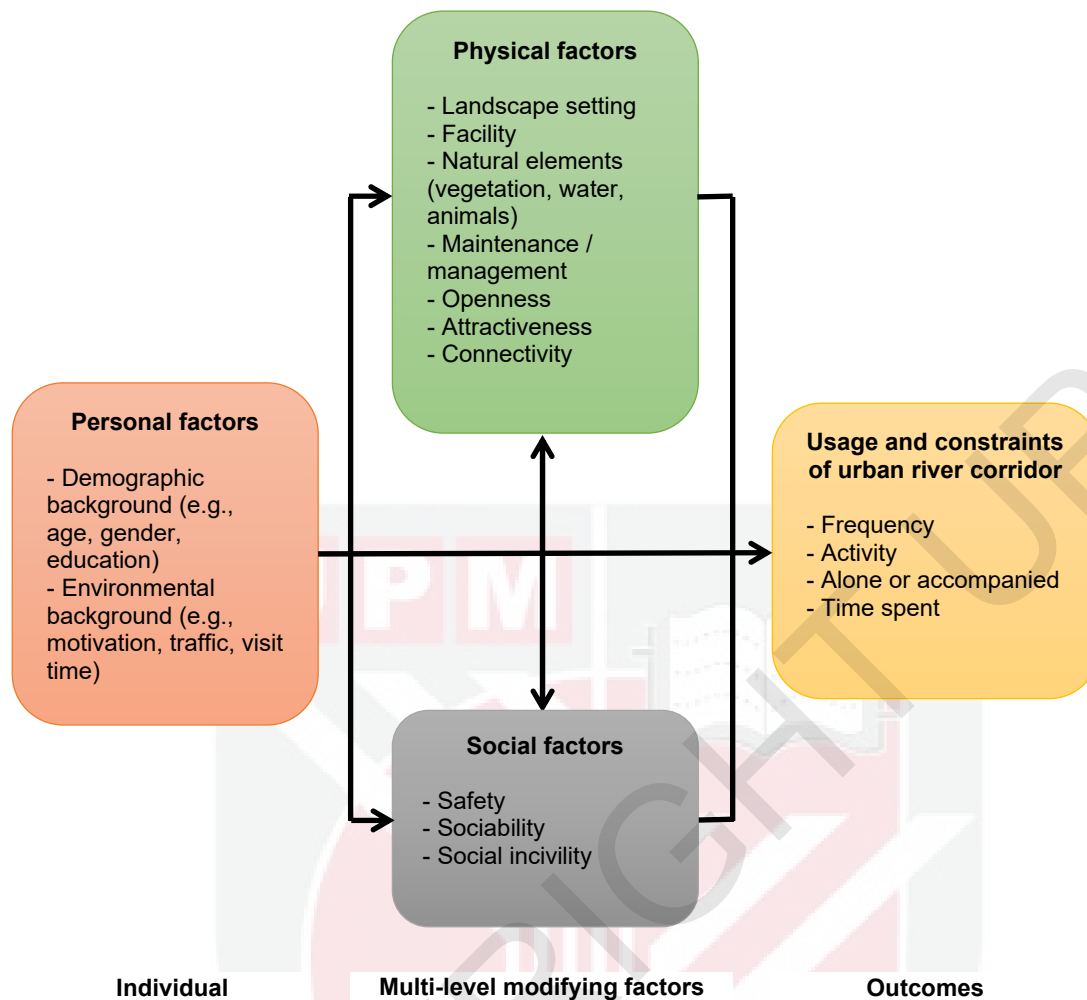


Figure 1.3: Conceptual framework of the research: personal, social and physical factors of urban river corridor usage and constraints

1.12.1 Personal Factors

Individuals are at the center of social-ecological theory. Personal attributes broadly include all the characteristics of an individual (Chenyang et al., 2022).

The personal attributes include 1) Demographic background, such as age, gender, and other physiological characteristics, as well as personal attributes, such as occupation, education level, residence, marital status, ethnic/race, and living environment during childhood; 2) Environmental background factors,

which cover motivation, traffic, accessibility, frequency of visits, visit time, length of stay, and activity.

1.12.2 Social Factors

Social attributes refer to social psychological processes when people connect with others, society, and nature in social practice activities (Chenyang et al., 2022; Sreetheran & Bosch, 2014). The literature found that the social factors affecting the usage and restriction of urban river corridors include three factors: safety, sociality, and social incivility (Che et al., 2012; Eid et al., 2021; Vert et al., 2019; Vierikko & Yli-Pelkonen, 2019; Wu et al., 2019a; Xie et al., 2023). Safety is a critical concern of visitors to the urban river corridor, especially children and women. Social connections such as companionship, encouragement, and helping friends/family members influence the public's behavioral preferences (Kerishnan & Maruthaveeran, 2021). One study reported that other people's presence may increase feelings of safety (Staats & Hartig, 2004). A strong sense of neighborhood social cohesion is likely to foster increased social interactions among neighbors, ultimately promoting the utilization of urban river corridors.

1.12.3 Physical Factors

Physical factors can significantly influence individual usage, resulting in either positive or negative experiences. For instance, people may be drawn to pleasant natural settings, while chaotic environments might evoke aversion. In

a narrow sense, physical attributes primarily refer to the tangible characteristics and spatial elements of objects (Wang et al., 2019b). These include landscape settings, facilities, natural elements (such as vegetation, water, and animals), and aspects of maintenance and management. In addition to these tangible aspects, the perceived environment—the perceptual attributes of the physical environment where individuals live, work, and engage in leisure activities—also influences human behavior (Appleyard, 1979; Gärling & Golledge, 1989). Perceptions of environmental attributes, shaped by individual experiences and expectations, can encompass various aspects such as hydraulicity, comfort, openness, naturalness, attractiveness, coherence, legibility, complexity, harmony, rhythm, order, messiness, mystique, seclusion, and distinctiveness (Jorgensen et al., 2002; Hashim et al., 2016; Hoyle et al., 2017; Kaplan, 1992; Lamb & Purcell, 1990; Lis et al., 2022; Pardela et al., 2022; Sang et al., 2016; Suppakittpaisarn et al., 2020; Wojnowska-Heciak, 2019; Yilmaz et al., 2018). These perceptual elements are integral to how people experience and interact with their environments, and they play a crucial role in determining the usage and constraints associated with urban river corridors.

1.12.4 Relationship Between Factors

The social-ecological framework pays attention to the individual and the interaction between people and the environment at multiple levels (Liu, 2014). The social environment and physical environment will affect the behavior of individuals, and the behavior of individuals, groups, and organizations will also

affect the social environment and physical environment (Liu, 2014). The environment can control or limit a person's behavior, and changing the environment can induce changes in certain behaviors. Therefore, only targeted interventions based on different human-environment interaction situations can produce better results.



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