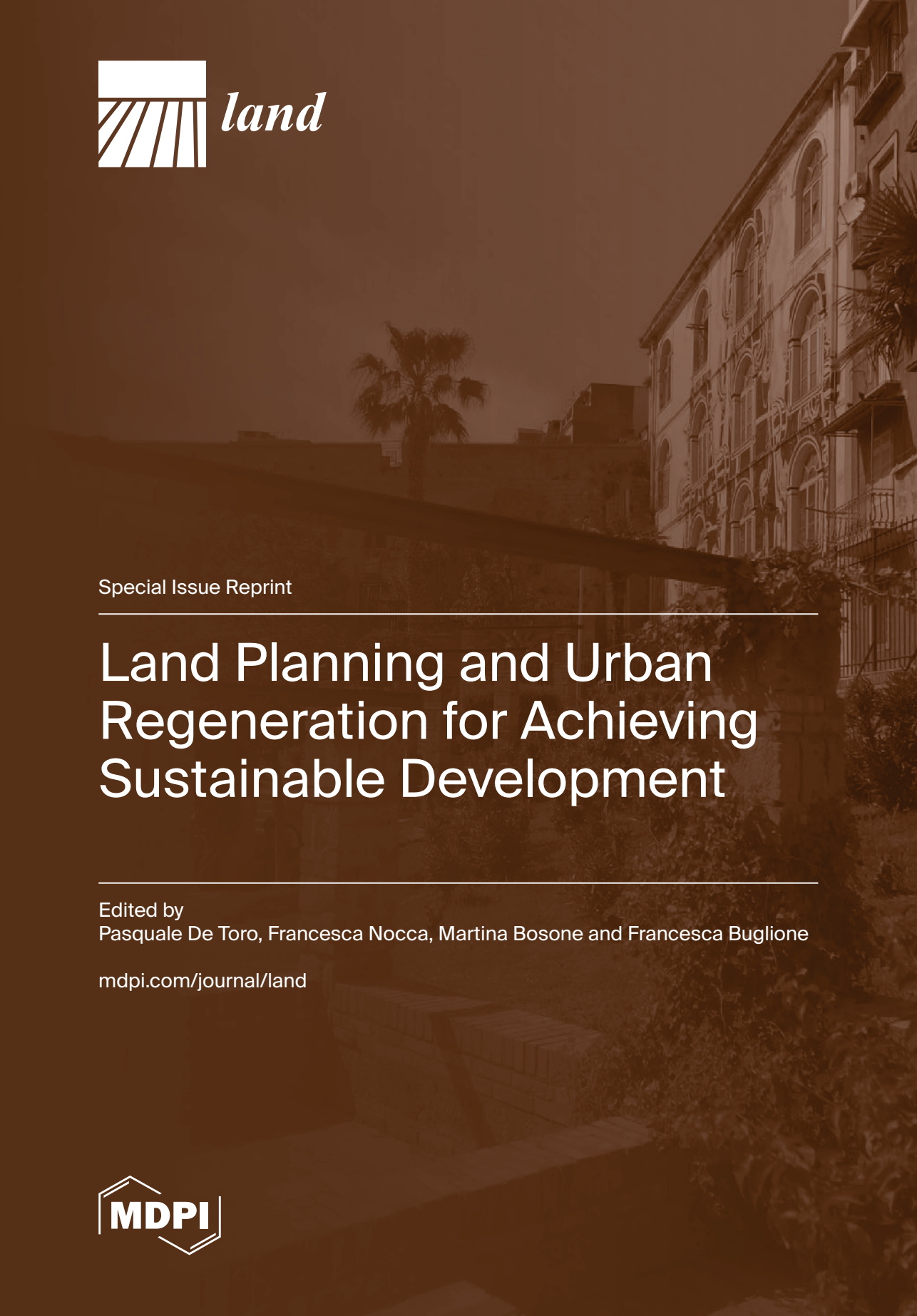


land

Special Issue Reprint

Land Planning and Urban Regeneration for Achieving Sustainable Development

Edited by
Pasquale De Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

mdpi.com/journal/land

MDPI

Land Planning and Urban Regeneration for Achieving Sustainable Development

Land Planning and Urban Regeneration for Achieving Sustainable Development

Editors

Pasquale De Toro
Francesca Nocca
Martina Bosone
Francesca Buglione

MDPI

Basel • Beijing • Wuhan • Barcelona • Belgrade • Novi Sad • Cluj • Manchester

Editors

Pasquale De Toro
University of Naples
Federico II
Naples
Italy

Francesca Nocca
University of Naples
Federico II
Naples
Italy

Martina Bosone
University of Naples
Federico II
Naples
Italy

Francesca Buglione
University of Naples
Federico II
Naples
Italy

Editorial Office
MDPI AG
Grosspeteranlage 5
4052 Basel, Switzerland

This is a reprint of articles from the Special Issue published online in the open access journal *Land* (ISSN 2073-445X) (available at: https://www.mdpi.com/journal/land/special_issues/urban_regeneration).

For citation purposes, cite each article independently as indicated on the article page online and as indicated below:

Lastname, A.A.; Lastname, B.B. Article Title. *Journal Name* **Year**, *Volume Number*, Page Range.

ISBN 978-3-7258-1609-5 (Hbk)
ISBN 978-3-7258-1610-1 (PDF)
doi.org/10.3390/books978-3-7258-1610-1

Cover image courtesy of Martina Bosone

Contents

About the Editors . . . . . **vii**

Preface . . . . . **ix**

Pasquale De Toro, Enrico Formato and Nicola Fierro
Sustainability Assessments of Peri-Urban Areas: An Evaluation Model for the Territorialization of the Sustainable Development Goals
Reprinted from: *Land* **2023**, *12*, 1415, doi:10.3390/land12071415 . . . . . **1**

Hamed Tavakoli, Massoomeh Hedayati Marzbali and Mohammad Javad Maghsoodi Tilaki
Spatial Liminality as a Framework for Revitalising Dilapidated Abandoned Buildings in Historic Cities: A Case Study
Reprinted from: *Land* **2023**, *12*, 931, doi:10.3390/land12040931 . . . . . **33**

Hanxuan Zhang, Xiangjuan Zhao, Jun Ren, Wenjing Hai, Jing Guo, Chengying Li and Yapei Gao
Research on the Slope Gradient Effect and Driving Factors of Construction Land in Urban Agglomerations in the Upper Yellow River: A Case Study of the Lanzhou–Xining Urban Agglomerations
Reprinted from: *Land* **2023**, *12*, 745, doi:10.3390/land12040745 . . . . . **50**

Maria Patrizia Vittoria, Stefania Ragozino and Gabriella Esposito De Vita
Urban Commons between Ostrom's and Neo-Materialist Approaches: The Case of Lido Pola in Naples, Southern Italy
Reprinted from: *Land* **2023**, *12*, 524, doi:10.3390/land12030524 . . . . . **81**

Lingling Li, Yansong He and Changjian Li
How Can the Risk of Misconduct in Land Expropriation for Tract Development Be Prevented and Mitigated: A Study of "Good Land Governance" Inspection in China
Reprinted from: *Land* **2022**, *11*, 2019, doi:10.3390/land11112019 . . . . . **100**

Tao Zhang, Yibo Yan, Qi Chen and Ze Liu
Evaluation Method of Composite Development Bus Terminal Using Multi-Source Data Processing
Reprinted from: *Land* **2022**, *11*, 1757, doi:10.3390/land11101757 . . . . . **123**

Yafei Liu
Space Reproduction in Urban China: Toward a Theoretical Framework of Urban Regeneration
Reprinted from: *Land* **2022**, *11*, 1704, doi:10.3390/land11101704 . . . . . **137**

Francesca Nocca and Mariarosaria Angrisano
The Multidimensional Evaluation of Cultural Heritage Regeneration Projects: A Proposal for Integrating Level(s) Tool—The Case Study of Villa Vannucchi in San Giorgio a Cremano (Italy)
Reprinted from: *Land* **2022**, *11*, 1568, doi:10.3390/land11091568 . . . . . **159**

Chaoyu Mo, Lin Wang and Fujie Rao
Typology, Preservation, and Regeneration of the Post-1949 Industrial Heritage in China: A Case Study of Shanghai
Reprinted from: *Land* **2022**, *11*, 1527, doi:10.3390/land11091527 . . . . . **186**

Jinliu Chen, Paola Pellegrini and Haoqi Wang
Comparative Residents' Satisfaction Evaluation for Socially Sustainable Regeneration—The Case of Two High-Density Communities in Suzhou
Reprinted from: *Land* **2022**, *11*, 1483, doi:10.3390/land11091483 . . . . . **202**

Xiaoxu Liang, Naisi Hua, John Martin, Elena Dellapiana, Cristina Coscia and Yu Zhang
Social Media as a Medium to Promote Local Perception Expression in China's World Heritage Sites
Reprinted from: *Land* **2022**, *11*, 841, doi:10.3390/land11060841 . . . . . **218**

About the Editors

Pasquale De Toro

Pasquale De Toro (Associate Professor) has a Ph.D. in 'Evaluation methods for the integrated conservation of architectural, urban and environmental heritage'. He is involved in research activities in the implementation of Decision Support Systems in the architectural, urban and environmental fields, particularly in the integration between economic and multi-criteria evaluation methods and tools. He also deals with the elaboration of integrated multidimensional evaluation approaches using Geographic Information Systems (GISs) to support decisions at urban and territorial scales (urban metabolism, real estate market, interaction between city and port areas, ecosystem services, etc.). He has been a member and/or principal investigator of research projects and a scientific coordinator of research agreements at national and international levels. He has been a member of the research groups of two Horizon 2020 Projects: CLIC - Circular models Leveraging Investments in Cultural heritage adaptive reuse and Be.CULTOUR - Beyond CULtural TOURism: human-centered innovations for sustainable and circular cultural tourism. Currently, he is working on the development of multidimensional evaluation methods and tools for assessing resilience in urban and metropolitan multi-risk contexts. He has been invited speaker at national and international conferences and a lecturer at Italian and foreign universities. He was the author or co-author of about 200 publications (in Italian or English) in scientific journals, books and meetings proceedings. He has been the Director of the Interdepartmental Research Centre in Urban Planning 'Alberto Calza Bini' of the University of Naples Federico II. He is a member of the International Council of Monuments and Sites (ICOMOS), member of the National Committee of Environmental Analysts Association and President of the Campania Regional Committee of the Italian Institute for Planning.

Francesca Nocca

Francesca Nocca (Researcher) is a Researcher in Evaluation at the Department of Architecture (DiARC) of the University of Naples Federico II. From April 2024, she has been conducting research period at the Department of Management in the Built Environment (MBE), Faculty of Architecture and the Built Environment Delft University of Technology – TU Delft. From 2018 to 2020, she was a post-doc researcher at DiARC. In 2017, she obtained her Ph.D. in Architecture (specific curriculum in Urban Planning and Evaluation), with a thesis titled 'Hybrid Assessment Tools for Operationalizing the UNESCO Historic Urban Landscape Approach'. Since 2014, she has been conducting research at the International Research Laboratory on the Creative and Sustainable City. From 2018 to 2020, she was a post-doc researcher at DiARC as part of the Italian National Project 'Metropolitan Cities: Economic-Territorial Strategies, Financial Constraints, and Circular Regeneration'. She has been invited as a speaker at Italian and international conferences, including Roskilde University (Denmark), Xiamen University (China), the National Coordination for Cultural Heritage Conservation - National Institute of Anthropology and History (CNCPC-INAH) (Mexico), and ICOMOS India. She is the author of numerous international scientific publications. Currently, she is a member of the International Council of Monuments and Sites (ICOMOS), the Italian Scientific Committee for the Economics of Conservation (ISCEC-ICOMOS), the Italian Society of Property Evaluation and Investment Decision, the Italian Association of Appraisers and Land Economists, and the Association of Environmental Analysts.

Martina Bosone

Martina Bosone (Researcher) is a Researcher in Evaluation at the Department of Architecture (DiARC) of the University of Naples Federico II and Ph.D. in 'Sustainable Technologies, Recovery and Representation of Architecture and Environment'. She is involved in research projects of national and European relevance, such as the National Italian Project 'Metropolitan cities: Economic Territorial Strategies, Financial Constraints and Circular Regeneration', the European Horizon 2020 research project 'CLIC - Circular models Leveraging Investments in Cultural heritage adaptive reuse' and the Horizon 2020 European research and innovation project 'Be.CULTOUR - Beyond CULtural TOURism: human-centered innovations for sustainable and circular cultural tourism'. In these projects she

developed innovative evaluation methods and tools for assessing the multidimensional impacts in the field of functional reuse and regeneration of cultural heritage and landscape in the perspective of circular economy, of sustainable cultural tourism and of shared management of cultural heritage as a common good. Since 2015, she was researcher at the International Research Laboratory on the Creative and Sustainable City. Currently, she is working with the Extended Partnership of National Recovery and Resilience Plan 'RETURN - multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate' for the development of multidimensional evaluation methods and tools for assessing resilience in urban and metropolitan multi-risk contexts. She is the author of numerous international scientific publications and she has been invited as a speaker at Italian and international conferences. Currently, she is a member of the International Council of Monuments and Sites (ICOMOS), the Italian Scientific Committee for the Economics of Conservation (ISCEC-ICOMOS), the Italian Association of Appraisers and Land Economists, the Association of Environmental Analysts, and the Italian Society of Architectural Technology.

Francesca Buglione

Francesca Buglione (Postdoctoral Researcher) currently works at the Department of Architecture (DiARC) of the University of Naples Federico II, Italy. She carried out research for European Horizon 2020 projects, focusing on multidimensional impacts of cultural heritage adaptive reuse through the circular economy model. In 2023, she obtained a Ph.D. in Architecture in 'Evaluation methods for the adaptive reuse of industrial heritage in the circular economy perspective'. From 2023 to 2024, she was a researcher at DiARC, focusing on circular cultural tourism within the 'Be.CULTOUR. Beyond CULtural TOURism: human-centered innovations for sustainable and circular cultural tourism' Horizon 2020 project. In 2021, she was involved in research activities of the CLIC 'Circular models Leveraging Investments in Cultural heritage adaptive reuse' Horizon 2020 project. In 2021, she pursued a Postgraduate Course in 'Adaptive reuse and integrated management of dismissed religious cultural heritage' at DiARC. In 2020, she was part of an interdisciplinary research group of the Italian National Project 'Metropolitan cities: economic-territorial strategies, financial constraints and circular regeneration'.

Preface

The structure and organization of the city are increasingly being investigated, especially considering the current challenges (i.e., climate change, COVID-19 pandemic, growing urbanization), highlighting the need to accelerate the transition towards a more sustainable development.

The debates on urbanization and culture are intertwined. Some international organizations (such as UNESCO and ICOMOS) and scientific studies emphasize the crucial role that culture can play in the achievement of sustainable development. Furthermore, the United Nations recognizes cultural heritage and landscape as important factors for urban sustainable development in many points of the 2030 Agenda and of the New Urban Agenda.

Although there are many theoretical studies regarding the role of cultural heritage and landscape in sustainable development, there are fewer studies that concretely demonstrate the multidimensional benefits (economic, socio-cultural and environmental) produced by their conservation and regeneration.

This special issue aims at exploring the contribution of cultural heritage and landscape to the achievement of sustainable development goals, also considering the current challenges that are changing the common vision about them (also in terms of use, accessibility, etc.). The urgency caused by these challenges has greatly accelerated the speed of transformational trends, allowing the identification of solutions that could be effective in the long term, regardless of the current health emergency.

In this context, evaluation tools, land planning, governance strategies, business and financial models play a fundamental role. Current evaluation approaches are mostly sectoral, mainly focusing on individual dimensions (economic, social, environmental) rather than their interrelationships.

Considering the multiplicity of values and stakeholders involved in the cultural heritage and landscape conservation and regeneration processes, the produced impacts require adequate evaluation tools, such as multicriteria evaluation methods. The complexity of cultural heritage and landscape conservation and regeneration processes implies an interpretation of evaluation as a dynamic process.

In particular, the topic addressed in this special issue are the following: urban regeneration and land planning; cultural heritage and landscape conservation and regeneration; multicriteria evaluation; sustainable cultural tourism; digitalization and innovative technologies for cultural heritage; participatory approaches.

Urban regeneration and land planning are fundamental in implementing sustainable urban environments. Urban regeneration entails revitalizing neglected or underutilized urban areas, transforming them into vibrant, functional spaces. This process not only enhances residents' quality of life but also promotes economic growth and environmental sustainability. Effective land planning ensures that urban regeneration projects are seamlessly integrated into broader urban development strategies, balancing the needs of communities, the environment, and economic interests.

Cultural heritage/landscape conservation and regeneration are important for maintaining the identity and historical continuity of communities while contributing to sustainable development. Conservation efforts safeguard valuable cultural and natural resources from degradation, whereas regeneration projects rejuvenate historical sites and landscapes, making them accessible and relevant to contemporary society. These activities bolster cultural awareness, support tourism, and foster community pride, all of which contribute to sustainable urban development.

Multicriteria evaluation represents an indispensable tool in assessing the impacts of urban regeneration and conservation projects. By evaluating a range of criteria – economic, social, environmental, and cultural – multicriteria evaluation methods provide a comprehensive analysis of the performances of different projects. This holistic approach enables stakeholders to make informed decisions that align with sustainable development goals, ensuring that projects deliver balanced and equitable outcomes.

Sustainable cultural tourism harnesses cultural heritage and landscapes to create tourism experiences that are economically viable and environmentally responsible. By promoting local culture and heritage, sustainable cultural tourism supports economic development while encouraging the preservation of cultural and natural resources. This form of tourism fosters greater cultural exchange

and understanding, enriching both visitors and host communities.

Digitization and innovative technologies for cultural heritage are revolutionizing the preservation and interaction with historical sites and artifacts. Digital tools such as 3D scanning, virtual reality, and Geographic Information Systems (GIS) facilitate detailed documentation and analysis of cultural heritage sites. These technologies not only enhance conservation efforts but also make cultural heritage more accessible to a global audience, enabling virtual tourism and educational initiatives.

Participatory approaches in urban regeneration and heritage conservation involve engaging local communities in the decision-making process. By involving stakeholders – residents, businesses, and local authorities – participatory approaches ensure that projects address the needs and values of the community. This inclusive process cultivates a sense of ownership and responsibility among community members, leading to more sustainable and successful outcomes.

The various research papers of this special issue face the aforementioned topics, providing fundamental scientific insights in the field of land planning and urban regeneration for achieving sustainable development.

De Toro et al. propose a sustainability assessment framework based on the 2030 Agenda's Sustainable Development Goals (SDGs) by territorializing and implementing these goals. The approach facilitates the creation of a Spatial Decision Support System (SDSS) that could integrate strategic environmental assessments in urban planning. They have used an assessment model, known as Spatial Sustainability Assessment Model (SSAM), which considers the environmental, social, and economic dimensions of sustainability. By using Geographic Information Systems (GIS) and Multi-Criteria Analysis (MCA), the SSAM aims to address economic development, social equity, and ecological integrity, which are the three core visions for rethinking peri-urban areas. Key indicators were selected based on their relevance to urban planning actions and their alignment with SDG 11a, which promotes positive economic, social, and environmental links among urban, peri-urban, and rural areas through strengthened development planning. These indicators represent sustainable planning processes in peri-urban areas. Recognizing the limitations of urban expansion, the study advocates for growth strategies emphasizing agri-environmental values, biodiversity reserves, new habitation models, and civic and collective uses. The methodology was tested on two urban plans in the Metropolitan City of Naples, each employing different strategies for peri-urban development. The results demonstrated that economic development, social equity, and ecological preservation could be integrated into decision-making processes to support sustainable development consistent with the SDGs. The study found that trade-offs among the three dimensions are identifiable and manageable. Environmental compromises necessary for peri-urban functions can be balanced by social benefits through collective land use and economic resource redistribution.

Tavakoli et al. introduce the concept of spatial liminality as a strategic approach for revitalizing disused urban areas in historic cities, particularly Middle Eastern cities. Spatial liminality refers to transitional or in-between spaces that historically fostered a strong sense of place and community among residents. By examining historic cities like Yazd and Kashan through a combination of questionnaire surveys and field studies, the paper demonstrates how these spaces played a crucial role in shaping social and cultural experiences in premodern times. The research begins with an interpretive historical study, which reveals that in earlier periods, spatial liminality was integral to the formation of a sense of place and citizenship. These transitional spaces, often located at the margins of urban environments, facilitated important social rituals and interactions, contributing to a cohesive community identity. On the quantitative side, the paper explores the relationship between Dilapidated and Abandoned Buildings (DABs) and the sense of place within local communities. The findings suggest that these neglected areas are linked to a diminished sense of community and place. Specifically, the absence of spatial liminality in these disused urban fabrics seems to undermine community connections and identity. The study argues that for historic cities, in order to regain their vibrant character and sense of community, it is essential to repurpose DABs while respecting their heritage values. By revitalizing these spaces and restoring their function as transitional zones, cities can reintroduce the spatial liminality that once helped define their social and cultural landscapes. In summary, this research contributes a theoretical framework that uses the concept of spatial liminality to enhance the understanding and management of historic urban areas. It offers practical guidelines for rejuvenating historic cities by emphasizing the importance of

preserving and reintegrating in-between spaces that historically nurtured community and identity.

Zhang et al. examine the scale and structural characteristics of construction land to optimize the spatial pattern of territorial planning. Utilizing the Google Earth Engine (GEE) platform, the research employs high-precision land-use cover data, DEM data, and socioeconomic data to construct the standard dominant comparative advantage index (NRCA) through geological mapping analysis. The analysis covers the Lanzhou–Xining urban agglomeration (LXUA) from 1990 to 2020 at various scales: urban agglomeration, provincial, city, and district. The study concludes that understanding different patterns and driving factors (as the scale, the period, the population, the GDP, etc.) is crucial for optimizing territorial planning and addressing the spatial dynamics of construction land in urban and rural areas.

The study by *Vittoria et al*. aims at exploring the performative implications of urban commons and their relational dynamics within an inclusive governance model and policy design context. It refers to two main theoretical approaches: Ostrom's sustainability framework and the hybrid neo-materialist perspectives developed by Metzger, Barad, and Latour. The research begins by establishing a theoretical foundation, including key concepts and frameworks. This foundation is then tested using a mixed-method approach applied to the case study of the Lido Pola Commons in Naples, Southern Italy. The empirical analysis is supported by extensive research experience and action-research processes focused on co-designing a living civic lab. The study's findings are discussed in terms of both internal and external validation of the case study results. It highlights how the results contribute to participatory policy design and emphasizes the importance of understanding social intra- and inter-actions within urban commons.

Examining the China's ongoing land reform, *Li et al.* highlight new objectives aimed at improving the land expropriation process, including the following: narrowing the scope of land expropriation, standardizing the procedures involved, and creating a unified market for urban and rural construction land. The latest Land Management Law acknowledges land expropriation for tract development as a significant change in the land acquisition system. However, this new approach has encountered problems, primarily due to issues with how public interests are defined and protected. These issues pose a risk of misconduct and improper application of standards. To address these challenges, the article proposes the principles of Good Land Governance as a solution. It suggests that these problems can be managed through two main strategies. The first one is the "coordination of interests", by focusing on the principle of proportionality, i.e. the system can be improved by refining how public interests are assessed. This means adopting a more purposeful examination process to prevent the oversimplification or misrepresentation of public interests. The aim is to better implement and strengthen these interests. The second strategy refers to "synergistic shared governance", emphasizing the need for a shared approach to governance based on land justice principles. It involves the creation of a framework where public interests are equitably shared and replenished. Such a system would help prevent the erosion of public interests and ensure that they are maintained and reinforced. In summary the article argues that by implementing these strategies, China can address the structural risks associated with land expropriation and better protect public interests.

As highlighted by *Zhang et al*., as urbanization in China accelerates, there is a need for well-designed development plans to enhance the vitality and value of various areas. Their study addresses the lack of quantitative analysis for the composite development of bus terminals by proposing a method to evaluate the spatial relationships among facilities around these terminals. The approach combines urban points-of-interest data with street view images, focusing on two main aspects: the current development level and potential of bus terminals, as well as the quality of the surrounding pedestrian environment. The effectiveness of the proposed method was tested on five planned composite development bus terminals in Zhengzhou (China). The study's results provide strategic recommendations for improving terminal development. By integrating geographic information data and street view images, the research offers a novel way to assess both the spatial and visual characteristics of the built environment.

Furthermore, according to *Yafei Liu*, as China's urbanization advances into its middle and later stages, urban regeneration has become a key component of the national development strategy, aiming to drive high-quality urban growth. Despite its importance, urban regeneration involves a broad

range of disciplines, and there is a notable lack of systematic, comprehensive theories and frameworks to support both academic research and practical implementation. The research by Yafei Liu seeks to address this gap by developing a thorough theoretical framework for urban regeneration, focusing on space reproduction. It utilizes the theory of the production of space as a foundational element and integrates various related theories and research perspectives. The proposed framework centres around four core components: government, market, society, and space reproduction. The paper outlines roles and interactions of three main stakeholders – government, market, and society – in the urban regeneration process. It explores their specific interests, powers, and contributions within the reproduction mechanism and examines how these stakeholders collaborate in practice. Additionally, in alignment with sustainable development principles and a "people-oriented" approach, the paper underscores the significance of social factors and advocates for a multi-stakeholder co-governance model. This model involves the government, the market, and society, working together to effectively manage and guide urban regeneration efforts.

Nocca and Angrisano explore how cultural heritage can become a catalyst for the implementation of the circular city model. They highlight that urban areas face significant challenges in achieving sustainable development, making them critical sites for implementing effective strategies. The circular city model emerges as an innovative approach to urban organization, aiming to promote sustainability through circular processes. Their study focuses on the implementation tools needed to assess the effectiveness and efficiency of projects. The Level(s) tool, introduced by the European Commission in 2017, is the first assessment tool for circular economy practices in new buildings. The paper proposes to integrate the Level(s) tool's application to cultural heritage projects. Despite its utility, the Level(s) tool has limitations when used for evaluating cultural heritage regeneration projects. To address these gaps, the paper proposes a new evaluation framework, specifically designed for cultural heritage renovation and reuse projects. This framework integrates the Level(s) tool with additional criteria and indicators from other sources, such as the Green Building Council and the Heritage Impact Assessment. The proposed framework is applied to evaluate the renovation and reuse project of Villa Vannucchi, a historic building in San Giorgio a Cremano (Metropolitan City of Naples, Italy). The aim is to assess how effectively the framework is able to capture the economic, social, and environmental impacts of such projects, ultimately contributing to the broader goals of sustainable urban development.

Mo et al. explore the topic of industrial heritage, that is often neglected and can be at risk during urban redevelopment. In China, this issue is particularly pressing due to the rapid shift from an industrial to a post-industrial society. The country, once known as the "world's factory", now faces significant challenges in preserving its industrial heritage, although there has been some systematic research on this topic, especially for the period after 1949. *Their study* examines the situation in Shanghai, China's largest city and a key industrial centre. The study focuses on 83 accredited modern industrial heritage sites in the city and uses a combination of typological, statistical, and GIS spatial analyses to understand their characteristics and preservation status. Two main findings emerge from this research:

1) Diverse Industrial Heritage: the industrial heritage sites from the post-1949 period in China vary widely in terms of the industries they represent, their historical periods, and their spatial arrangements. The most common type of site is the "industrial block", where industrial development blends with the surrounding urban fabric.

2) Challenges in Suburban Areas: preserving and regenerating industrial heritage is notably more complicated and threatened in the suburbs compared to the inner city. This complexity reflects the broader challenges of managing these sites as urban areas evolve.

The study concludes with recommendations for improving the management and preservation of China's industrial heritage. It highlights the need for more focused strategies to address the distinct challenges faced by industrial heritage sites in both urban and suburban contexts.

As claimed by *Chen et al.*, China's 14th Five-Year Plan emphasizes people-oriented urban regeneration, particularly for residential communities built before 2000. Evaluating quality of life (QoL) and social sustainability is crucial in these regeneration efforts, as residents' satisfaction is a

key indicator of socially sustainable development. Chen et al. investigate how QoL is correlated to social sustainability by examining residents' perceptions in two high-density communities in Suzhou: Nanhuan, a high-rise, gated community from the 1980s expansion, and Daoqian, a multi-story, non-gated community in the old town. The study employs a mixed research approach, including field investigations, on-site interviews, and a survey with over 670 respondents. It also uses the Structural Equation Model (SEM) to analyse satisfaction evaluation factors. The findings reveal that in both communities improving environmental quality and facilities is expected to boost satisfaction. However, the study highlights that incorporating diverse spatial activities and increasing opportunities for social interaction are crucial for enhancing residents' satisfaction. The research provides valuable insights into socially sustainable community regeneration, guiding decision-making processes and design strategies to improve residents' quality of life.

Liang et al. investigate the assessment of public participation as crucial aspect for effective and sustainable cultural heritage management. Since early 2020, the COVID-19 pandemic has accelerated the shift to online platforms for stakeholder collaboration due to restrictions on in-person activities. This shift presents an opportunity to develop more comprehensive urban heritage protection strategies. However, there is limited research on how social media data can support people-centred heritage management and participatory evaluation. Their study addresses this gap by examining five World Cultural Heritage Sites in China and evaluating online participatory practices using Weibo, a popular Chinese social media platform. The research methodology involved analysing data from Weibo, focusing on three aspects: user information, text content, and images. The study concludes that leveraging social media to explore the interaction between digital and physical heritage conservation is practical and should be actively encouraged.

Pasquale De Toro, Francesca Nocca, Martina Bosone, and Francesca Buglione
Editors

land

MDPI

Article

Sustainability Assessments of Peri-Urban Areas: An Evaluation Model for the Territorialization of the Sustainable Development Goals

Pasquale De Toro *, Enrico Formato and Nicola Fierro

Department of Architecture, University of Naples Federico II, Via Toledo 402, I-80134 Naples, Italy; e.formato@unina.it (E.F.); nicola.fierro@unina.it (N.F.)
* Correspondence: pasquale.detoro@unina.it

Abstract: This research tests a sustainability assessment based on the 2030 Agenda's Sustainable Development Goals (SDGs) through a process of their territorialization and implementation. This process enables the development of a spatial decision support system (SDSS) that can be integrated with strategic environmental assessments in urban planning. The assessment takes place on the transversality of the sustainability concept, considering the three dimensions (environmental, social, and economic) in a single assessment through the spatial sustainability assessment model (SSAM) by integrating geographic information systems (GIS) and multicriteria analyses. Economic development, social equity, and ecological integrity represent the three common visions for rethinking peri-urban edges. The choice of key indicators is due to the possibilities for action of urban plans and the vision of SDG 11a, which aims to support 'positive economic, social, and environmental links among urban, peri-urban and rural areas by strengthening national and regional development planning'. In addition, they were selected to be representative of sustainable planning processes in the peri-urban area. In recognizing the limits of urban expansion processes, in the peri-urban area, it is necessary to promote a different growth based on agri-environmental values, the production of biodiversity reserves and corridors, new models of inhabiting open space, and the consolidation of civic and collective uses. The paper tests the assessment methodology in two urban plans of the Metropolitan City of Naples that address the development of the peri-urban area with different strategies. This provides insight into how to support decision-making processes so that economic development, social equity, and ecological integrity represent three common and integrated visions to enable development that is consistent with SDGs. The results show that it is possible to identify trade-offs among the three dimensions. In fact, where there are environmental subtractions necessary to accommodate peri-urban land-relation functions, these are offset by the social values of collective use and by the values of the current economy that aim to redistribute present resources.

Keywords: sustainability assessment; Sustainable Development Goals; 2030 Agenda; peri-urban fringe; multidimensional indicators; evaluation tools; sustainable development; spatial decision support system

Citation: De Toro, P.; Formato, E.; Fierro, N. Sustainability Assessments of Peri-Urban Areas: An Evaluation Model for the Territorialization of the Sustainable Development Goals. *Land* **2023**, *12*, 1415. https://doi.org/10.3390/land12071415

Academic Editor: Brian D. Fath

Received: 2 June 2023
Revised: 30 June 2023
Accepted: 10 July 2023
Published: 14 July 2023

1. Introduction

The experimentation carried out in this paper is aimed at territorializing the 2030 Agenda for Sustainable Development, which was adopted by all United Nations member states in 2015, to support planning processes in peri-urban areas.

Territorialization is a process of implementing the goals and targets of the 2030 Agenda. It is aimed at analyzing and spatially explicating the multiple values and relationships of the spatial context within the community and the linking social, economic, and environmental aspects. This process makes it possible to develop a spatial decision support system (SDSS) that operates, in the context of this research, as a sustainability assessment model,

as it enables the evaluation of urban planning forecasts in compliance with sustainable development goals (SDGs).

The sustainability assessment has been called the 'third generation' of impact assessment, following the environmental impact assessment (EIA) and strategic environmental assessment (SEA) [1,2]. It emerged simultaneously from different disciplinary fields, such as planning and natural resource management [3]. Although all environmental evaluation instruments have sustainable development issues as their underlying aim [4], the sustainability assessment has the specific purpose of orienting decision making toward the achievement of development goals in integrated dimensions [5]. In order to not make the assessment simply theoretical, it is necessary to build coherence between sustainability goals and the capacity for action or transformation of the instrument being assessed. By doing so, a direct relationship with the planning instrument is established, which makes it possible to identify key indicators for evaluation.

Sustainability is a cross-cutting concept that affects the environmental, economic, and social dimensions of a society. Today, a widely accepted definition of sustainable development is contained in *Our Common Future* (1987), better known as the *Brundtland Report*, of the World Commission on Environment and Development (WCED) of the United Nations Environment Program (UNEP). This paradigm constitutes the backbone of a debate that has been a priority since the 1970s with the *Limits to Growth* report of 1972 and had important continuations in *Carrying Capacity* by W.E. Rees (1992) or the *Millennium Ecosystem Assessment* (carried out between 2001 and 2005). The latter, assuming economic value as an impact gradient, described how ecological characteristics, functions, and processes, which directly or indirectly contribute to human wellbeing, have undergone such alterations that the world's economies are unable to compensate for the ecological debt. From the unraveling of a development model incapable of adapting to the scarcity of resources emerges the need for a notion of sustainability embedded in the link between the satisfaction of human needs and intergenerational responsibility that evolves with the analytical experimentation of tools and methods. This allows for continuous theoretical advances, guiding practices, experiments, or analytical models committed to repositioning society. It also guides the outcomes of generalized urbanization in new relationships of meaning that allow for an integrated development that does not consider nonhuman nature as external or the environment as a passive system of resources.

In this perspective, it is necessary to consider the city as an ecological process in which human and nonhuman entities mix and relate. This has led to the idea of 'urban assemblage' in the field of city studies; the city is no longer understood as a whole but as a multiplicity of components [6]. In particular, the notion of urban assemblage interprets space as a 'relational effect' rather than a 'structural context'; therefore, it is necessary to move from the space of the city to the multiple urban assemblages in which urban typologies are formed and reformed. The consequence of this is the redefinition of democracy toward participatory practices that could recognize and represent human and nonhuman entities as social actors [7], as well as the integration of 'expert knowledge' and 'common knowledge', which highlights different values and evaluation criteria in decision-making processes [8].

The operationalization of these concepts and the consequent territorialization of concrete actions take place within decision-making processes. From the urban assemblage perspective, the various actors involved in decision-making operate and decide under conditions of uncertainty, and the decisions themselves may be delayed due to various concomitant factors that are difficult to predict [9]. Multicriteria analyses turn out to be a useful approach to activate an effective decision-making process that is open to different forms of participation. Integration with geographical information systems (GISs) is particularly useful for sharing available information and using it in decision-making processes and to set objectives and evaluation criteria in advance. Therefore, the concept of sustainability, in its substantive meaning, persists in an unresolved tension in the perennial search for a balance between the prevalence of environmental needs and the demands of economic and social development. The debate has addressed the question of whether environmental

protection and development are separate from each other in order to ascertain whether environmental protection is ancillary to development or, conversely, development is instrumental to environmental protection [10]. By claiming the lexical priority of ecological rationality over economic, social or political rationality, ecological values deemed inferior can come into play for a full value [11]. By balancing the domains of development, it is possible, by means of place-based approaches, to bring sustainability back to a relationship to be conceived in terms of dialectical unity, which cannot be defined singularly or categorically but must be determined on a case-by-case basis due to differing contexts [1].

In the specific case of the peri-urban context, it is possible to imagine a novel proposal for sustainability because this space is dependent on both urban and rural culture [12]. The peri-urban area can represent the ideal space on which to build a debate and experiment a balance between the multidimensional divarication of sustainability. This opportunity is provided by the rethinking of linear/reductionist functioning based on a perpetual growth paradigm in favor of the implementation of a coherent local landscape with potential for collective use, comprising the social value of open space, as well as ecological and productive enhancement [13,14]. The renunciation of the local, in order to modernize the context, has led to extensive regionalization processes that have meant a rejection of the world that one claims to inhabit [15]. In the geosocial issue also highlighted by the 2030 Agenda, spatial justice is certainly a key. Recovering proximity represents an opportunity for an alternative economic development, which seeks to start again from the present resources of agriculture and the economies of open spaces engaged in the attempt to combine social and economic wellbeing with quality of life [13,14].

Therefore, the peri-urban landscape can represent the context where solutions matter significantly for both people and nature [16]. Its regional connections, as well as the wide availability of open and public spaces connected to operational landscapes, not only support biodiversity but also provide cities with the essential ecosystem services they need [17] through a redefinition of space according to the co-construction of community densities, shortening supply chains, and recycling.

The 2030 Agenda is the interpretive lens of the sustainability assessment model. On the model of *Agenda 21* (1992) and the *Millennium Development Goals* (2002), it implements the search for a balance by means of cooperative, quantifiable, and comparable tools, to be understood in the concrete network of relationships among the different dimensions: environmental, social and economic. It addresses geosocial and intergenerational issues that confront the contrasts that have characterized modernity (i.e., nature as an 'infinite bounty' and the economic system as the 'horn of plenty' [11]). The 2030 Agenda is structured to have both a global, qualitative view of development issues through the 17 goals (SDGs) and a local, quantitative view through the 169 targets and the 244 indicators. SDGs represent a valid framework for implementing the assessment, by means of representative, comparable, and relevant indices and indicators to assess and monitor transformations in multidimensional terms, setting targets in time and space that are necessary to achieve the desired sustainability conditions.

The 2030 Agenda's indications imply a regeneration of the peri-urban fringe in ecological terms in a dialectical relationship between different density gradients and functions, within planning and development processes understood in the sensitivity of the contextual limits of territories. In fact, SDGs place biodiversity and urbanization in the same frame of reference. The former, in Goal 15, stated that, by 2020, ecosystem and biodiversity values should be integrated into national and local planning and development processes. The latter, in Goal 11, states that positive economic, social, and environmental linkages should be sustained between urban, peri-urban and rural areas by strengthening national and regional development planning.

This paper highlights a spatially explicit methodology for assessing sustainability through the lens of the 2030 Agenda by integrating multicriteria techniques.

The difficulty of experimentation is due to two issues. The first concerns the statistical approach of the assessment of targets and indicators in the 2030 Agenda, which is not

always spatially explicit. The second difficulty is related to the need to identify indicators and values that can represent sustainability issues within the peculiarities of urban planning instruments and can thus answer 'How can I objectively know whether sustainability goals are being met or ignored?'

The main objective of the paper is to develop an assessment methodology that can help to make sustainability issues spatially explicit and quantified within environmental assessments aimed at peri-urban contexts, where there are strong pressures of urban sprawl. This is possible through the selection of key indicators that can both relate to the real possibilities of the actions of urban plans and summarize the complexity of SDGs. Moreover, the methodology and results are intended to contribute to the debate on the values for human activity to be compatible with the conditions for sustainable development. The methodology seeks to structure a replicable and implementable process. The results demonstrate the effectiveness of the implementation process between the 2030 Agenda and peri-urban territories, whereby greater expropriations of contextual values result in a greater distance from a condition of ideal sustainability. In fact, this condition is visible in the assessment in which the urban design includes a relational dimension of ecological and social values.

2. Materials and Methods

2.1. Study Area: The East Naples Peri-Urban Fringe

The peri-urban space appears as the dominant urban form and challenge of contemporary socio-spatial planning [18]. The focus on these areas is due to different levels of complexity transited by other disciplines and knowledge that have fertilized and flanked the urban question with the environmental question, as well as landscape integrity and ecological relations. Moreover, these areas represent landscapes in transition aimed to consolidate urban characteristics at the expense of agri-environmental values.

There are many definitions associated with the peri-urban context. The common characteristic of the many different types of space that are considered peri-urban is that they are transitional spaces with a certain mixture of urban and rural uses, resulting in a varied nature of the territory [19]. This degree of mixture is conditioned by the many overlapping and constantly changing variables (e.g., character, structure, thickness, prevalence of land use, way of occupying the space, and environmental processes), by the degree of belonging to the two reference sets (urban and rural), by the levels of gravitation (dependence/attraction) with respect to one or more centers, and by belonging to more or less structured metropolitan systems [20].

Nevertheless, there is a particularly strong difference between the peri-urban areas of developing countries and those of the developed nations of Europe. The former are characterized by poverty, environmental degradation, and informal settlements. The latter, to which this study refers, are characterized by low levels of mobility, economic performance, landscape integrity, and environmental quality [21].

This second typology of peri-urban areas highlights the result of the multipolar organization particularly evident in large metropolitan areas where the residual space is set as a frontier for greater competitiveness to the urban area that no longer holds a single center [22]. They are the product of processes of regionalization of the urban in which these new urbanization strategies determine an extended spatial configuration in which not everything is 'urban' but everything is 'urban-driven' [23]. In pockets of what used to be considered the countryside, a disjointed, additive, stratified and light patchwork extends a 'constitutive outside' [24] influenced by successive structural adjustment programs, land expropriations, agro-industrial consolidation and ecological plunder [23]. These are processes of spoiling that accumulate the resources (agrarian, environmental, and social) and then the expropriation of the capacity to reproduce them to make way for service infrastructures [25].

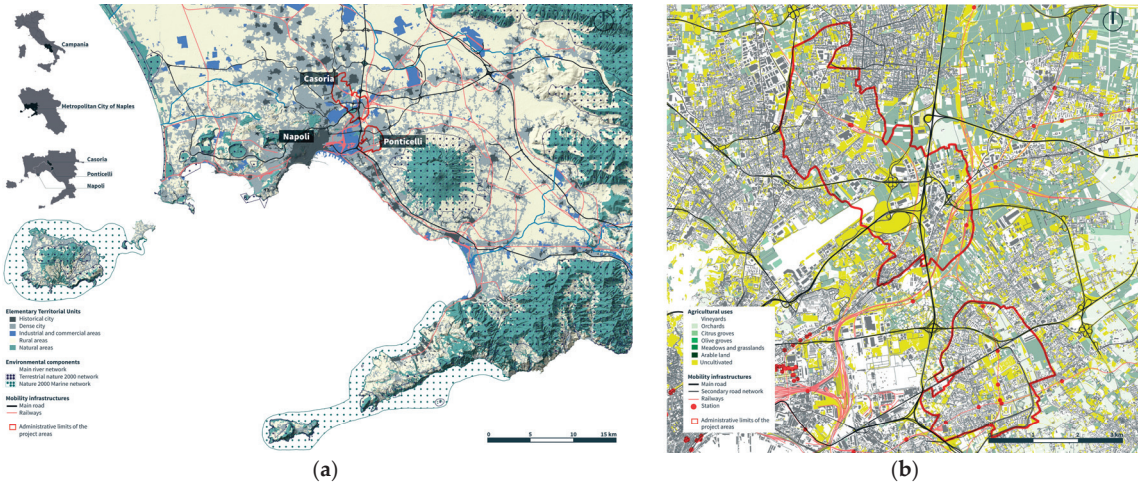
This 'third territory' of difficult delimitation is placed halfway between urbanity and rurality [26], plays the role of a 'bridge-space' between density and rarefaction [27],

and varies in size and nature according to the increase in urban pressures [28]. It is an indeterminate space, no longer considered nonurban, linked to dissipative logics or the functional decentralization of informality and waste of urban functioning.

The degradation of prime agricultural land, the deprivation of soil from tree density and the water pollution in peri-urban areas result from rapid urbanization which should be reread within the concept of ecological footprint [29] or planetary boundaries [30], aiming at recovering missed opportunities with respect to food self-sufficiency, shortening of supply chains, recycling of materials, soil consumption, and ecological connections of biodiversity corridors. The implications, therefore, call for 're-evaluating people–environment relationships' rather than focusing on resource extraction or land transitions.

The study area of the East Naples peri-urban fringe represents an urban–rural patchwork of mixed land uses in which a nonfunctioning agricultural matrix is still legible. Administrative boundaries, spaces and demarcations are no longer discrete, distinct or universal. It is an edge that develops at the fringe of the urban belt of the first ring consolidated around the cores of the historic city. It presents different functions and densities, and behaves as a transitional area in which the landscape is characterized by mobility infrastructure and its interstitial spaces, residential buildings, low-density settlements—planned and unplanned—and old rural cores interspersed with disused or declining production plates [13]. As the place where the urban expansion process unfolds, heterogeneous expectations and interests make urban planning processes complex. The controversies are amplified by the need to frame these processes in the paradigm of sustainable development. The agricultural palimpsest and the collective domain of related benefits (ecosystem, landscape, food, and economic services) are replaced by the accumulation and addition of uses necessary only for urban functioning through the strategic location of higher functions (e.g., landfills, shopping centers, logistics), or in the replication of unplanned settlements.

The two case studies concern two experiences carried out in the Naples Metropolitan Area: the urban plan of the municipality of Casoria and the urban recovery program of the Ponticelli neighborhood in Naples. They differ in terms of project scale, type of urban planning instrument and purpose of the plan/program (Figure 1). The differences also concern the variability of the peri-urban context. This helps to clarify the results of the evaluation model, as well as its implementations and applications.



(**a**) (**b**)

Figure 1. (**a**) Location of the two case studies in the Metropolitan Area of Naples; (**b**) case study comparison.

The peri-urban landscape of Casoria is characterized by a widespread eco-systemic, particle, and topological fragmentation and a high density of mobility infrastructure. It

is subject to continuous pressure from unplanned settlements, expansions for production or logistics, and zones in which traditional agricultural management is put into crisis. Marginal agricultural areas are contrasted by numerous open spaces with dynamics of underuse and abandonment.

In Ponticelli, the condition of peri-urbanity is given by an edge condition between a dense urban system and the conurbation system of the coastal strip of the Metropolitan City of Naples, made up of interstices, residual agricultural uses, and large open spaces of public property, which are uncultivated and waiting new functions. The great residential areas of public housing policies have operated by leaving voids that are delimited by the infrastructural system. These voids are still potentially linked to a legible agricultural matrix (i.e., spaces with strong infrastructural pressures as well as uncertain spaces that have been left unrealized by the public housing policies that built this part of the city), with agricultural residues and numerous public properties.

2.1.1. The Municipal Urban Plan of Casoria

The municipality of Casoria is part of the first ring of municipalities that make up the Neapolitan urban fringe that stretches north and east of Naples. Table 1 shows the main demographic and spatial data obtained by the Municipality of Casoria and the Italian National Institute of Statistics (ISTAT).

Table 1. Territorial data for the municipality of Casoria.

Parameters	Data–Whole Municipality	Data–Peri-Urban Area (Case-Study)	Year	Source
Territorial area	12.1 km^2	3.7 km^2	2021	ISTAT
Population	74,394	1711	2021	ISTAT
Population density	6148.2/km^2	462.4/km^2	2021	ISTAT
Unemployment rate	29.4%	42.0%	2021	ISTAT
Sealed surface	7.8 km^2	2.3 km^2	2021	Municipality
Area sealed by mobility infrastructure	1.7 km^2	0.7 km^2	2021	Municipality
Public land area	1.0 km^2	0.6 km^2	2021	Municipality
Structural dependency index	51.2%	87.0%	2021	ISTAT
Private mobility index	5.2%	n/a	2021	ISTAT

The urban planning tool on which the evaluation model is tested is the municipal urban plan (MUP). This general urban planning tool is prepared by the municipal administration to outline strategic development choices, define public space management policies, identify structuring elements and territorial invariants, and protect the physical and environmental integrity of the territory by enhancing existing resources and their economic and social development. The choices made with these tools guarantee environmental quality and sustainability.

The guidelines dictated by the MUP, which are general in nature and of indefinite duration, are concretely implemented by operational planning. The programmatic operational plan (POP) envisaged by the MUP concerns the rural/peri-urban territorial unit characterized by the prevalence of rural territories with eco-systemic value, conditions of particle and topological fragmentation, low settlement density, phenomena of underutilization and abandonment, and the crossing of large network infrastructures. The MUP promotes the use of nonurbanized peri-urban contexts for social purposes, ecological reconnection, and environmental rebalancing. It aims to create public parks and public use with different naturalistic typologies, the possibility of enhancing agricultural production

for social, educational and training purposes, and an increase in the supply of social and public housing, with zero soil consumption.

The POP implements the provisions of the MUP through the definition of a vast peri-urban park. This park, covering approximately three square kilometers (one-quarter of the entire municipality), is included in the metropolitan ecological network and is aimed at the restoration of ecological continuity, the enhancement of agricultural use, the civic use of public areas, and new community densities. In particular, the POP envisages the creation of social settlements in the park and the construction of a sustainable road network (including a park road, a bicycle path, and an equipped pedestrian path) which connects the area with the urbanised context. A further provision is the identification of minimum project units (MPUs) in which three levels of land use are identified: equipped green, productive green/productive forest, and mitigation green. The latter extends on the edges of MPUs and beyond in the public interstitial areas of infrastructures.

The Casoria MUP was adopted in 2022. Plan strategies and actions in the peri-urban context have not yet been implemented. Strategies regarding public areas need to find specific funding. In private areas, the plan offers possibilities for development (reforestation programs, bicycle paths, civic uses of space, volumetric incentives for the development of agricultural economies or equipped green space, and the socioenvironmental rebalancing of illegal settlements) that are made explicit in the values of the ex-post evaluation, and aimed at reconstructing new relationships (environmental, economic, and social) between the dense city and the peri-urban crown. The analyses here presented are not part of the official assessment tools of the plan, but they are intended to build a debate on the necessity of sustainability assessments (particularly 'spatial assessments') within the strategic environmental assessment based on agendas shared by the scientific community and the settled community.

2.1.2. The Urban Recovery Program of the Ponticelli Neighborhood in Naples

Ponticelli is a district on the eastern outskirts of the municipality of Naples. The urban evolution of the neighborhood is linked to national public housing policies and to the contingency and acceleration measures that arise in response to natural disasters or to the high housing tension and social hardship in the suburbs. Table 2 shows the main demographic and spatial data of Ponticelli district.

Table 2. Territorial data for the Ponticelli district.

Parameters	Data–Municipality of Naples	Data–Ponticelli District	Data–Peri-Urban Area	Year	Source
Territorial area	117.27 km^2	6.1 km^2	0.6 km^2	2021	ISTAT
Population	921,142	53,058	2551	2021	ISTAT
Population density	7854.9/km^2	8698.0/km^2	4251.6/km^2	2021	ISTAT
Unemployment rate	27.8%	49.3%	54.6%	2021	ISTAT
Sealed surface	74.2 km^2	4.3 km^2	0.3 km^2	2021	Municipality
Area sealed by mobility infrastructure	14.0 km^2	1.2 km^2	0.1 km^2	2021	Municipality
Public land area	n/a	2.1 km^2	0.5 km^2	2021	Municipality
Structural dependency index	54.7%	64.0%	39.7%	2021	ISTAT
Private mobility index	53.2%	n/a	n/a	2021	ISTAT

The urban planning instrument on which the evaluation model is tested is the urban recovery program (URP). It is a program with the status of an implementing urban plan, and its approval and public financing have the following basic requirements: (a) the

building and urban redevelopment of public housing settlements, also in accordance with the urban planning instruments in force, (b) a systematic set of interventions organized on the basis of a unitary proposal, with different types of intervention (redevelopment and new construction) and the integrative characteristics of the functions (residential, public housing services, and production of goods and services)and (c) co-participation of public and private implementers and the related economic and organizational resources, with a minimum threshold of 25% private financing for ensuring the public financing of the project.

The Ponticelli URP has been designed to rethink the parts left unfinished by the rational design imposed by previous public housing programs. In fact, in the 1950s, the first public housing estates were grafted into Ponticelli as an expansion of the historic center of the city. The URP reinterprets the design of the suburbs in a contemporary key, confronting it with the rigid constraining system of the volcanic risk of Vesuvius (which, in some dangerous areas known as 'red zones', does not provide for residential development) and with the superordinate forecasts of the sustainable urban mobility plan (which envisages the passage of a bus rapid transit connecting with the city center). The URP envisages the construction of new social housing, areas of private residential expansion to balance the social mix, numerous public facilities, and a forest running through the central 'spine' of the neighborhood.

The Ponticelli URP is still in its preliminary stage. Its implementation depends on 75% public funding, as it acts on public land. Therefore, the assessment here proposed can represent a real decision support system for planners and public decision makers to use in the next stages for the real implementation of the plan.

2.2. Data Sources and Approach

For the comparison of the indicators, the evaluation was processed in a GIS environment on a hexagonal grid with 50 × 50 m spacing.

The use of regular polygons proves to be effective for representing the spatial variousness of the phenomena under investigation and is a suitable method for data generalisations, statistical mapping, and spatial evaluations [31]. Another peculiarity of regular-meshed grids is also inherent in the possibility of combining mapping units into new cells at a more detailed resolution, allowing the cumulative effects of state changes to be studied [32].

The analyses presented in this paper represent an instrument aimed at monitoring the implementation of strategies and actions and assessing how they achieve the goals of the two municipalities. The ex-ante evaluation represents the current state, while the ex-post scenario represents the maximum degree of achievement of the strategies and actions included in the two urban plans. Thus, the ex-post evaluation expresses in values and graphically (or spatially) the distance to the sustainability goals in a specific area of the territory.

For the assessment of the sustainability of the transformations, the indicators are built on the dual pre/post-plan scenario, which allows for a cognitive picture of the state of the environment and an assessment scenario of the achievement of targets.

In general, carrying out two different evaluations on dual pre/post-plan scenarios allows for a knowledge framework of the state of the environment and a scenario for monitoring the target achievement over time. In fact, the ex-ante scenario is intended as a tool for reconstructing the state of the environment to support decision making [33]. It addresses the issue of asset mapping, which indicates the process of documenting the tangible and intangible resources of a community, considering the assets that must be preserved and enhanced [34]. It allows the construction of a knowledge project capable of initiating a conscious and creative reflection aimed at overcoming the concepts acquired within the interpretative models of modern thought based on a paradigm of perpetual growth and a linear/reductionist functioning of decontextualization and resource extraction. Furthermore, it allows the urban design project to orientate its choices toward forms of sustainability and resilience inscribed within the urgencies of 2030 Agenda. These are

understood not only as the capacity to adapt to the pushes of urban transformation and the degenerative forces of land rent, but above all as the injection of elasticity into urban policies to connect resources, actors, identities, and tensions in a nonrigid manner to reactivate functional chains, and to reanimate urban metabolisms.

Ex-post evaluation allows the identification of the impacts of transformations by determining the identification of criticality thresholds through the recognition of contextual limits, and by integrating the multidimensional aspects necessary to look at open and multifunctional margins in which different forms of life interact and develop sociality. The objectives of using multidimensional criteria and specific indicators are different from the mapping and evaluation of context attributes and values in ex-ante evaluations, as ex-post evaluation focuses on the actual impacts generated [35]. In particular, ex-post evaluation is used to verify that established objectives have been achieved, to determine whether there are intended or unintended consequences, and to evaluate the effectiveness of alternative approaches in the meantime [35,36].

The place-based approach makes it possible to support researchers and practitioners facing complex multidimensional issues with methodologies that can be replicated and implemented in the relevant case study variables. This approach is focused on addressing a problem on a local scale, meeting the needs of a particular context by tapping into local communities and resources [37,38], and enabling work on a nonabstract concept of sustainability. This approach also support the theoretical and practical framework, considering the unique characteristics of a given complex socioecological system by aiming to generate locally relevant knowledge and context-specific solutions to address sustainability problems [39,40].

2.3. First Phase: Identification of Evaluation Indicators

Sustainability cannot be measured directly [41] but through a process of implementation that considers the transversality of the concept (economic development, social equity, and ecological integrity) [42] and through metrics or indicators [43] as a composite of several directly measurable variables that enable the quantification of such multidimensional and complex phenomena [41,44].

Indicators and indices, which are derived from values (we measure what we care about) and which create values (we care about what we measure) [45], assume instrumental value not only with respect to the type of territory (place-based approach) but above all with respect to the type of urban planning instrument being evaluated. Their main characteristic is their ability to summarize, focus, and condense the enormous complexity of our dynamic environment into a manageable amount of meaningful information [46]. Furthermore, 'composite indicators' can be easier to interpret than trying to find a trend in many separate variables [47,48]. Therefore, in order to visualize phenomena, highlight trends, and simplify, quantify, analyze, and communicate the otherwise complex and complicated information related to sustainability, it is necessary to identify coherence between the goals and targets of the 2030 Agenda and the possibility that the urban plan will have an impact. This coherence gives rise to a relationship of direct or indirect dependence that helps the spatial dimension of the spatial assessment to select the most significant indicators for the peri-urban for the integration of the three dimensions and the explicit rendering of impacts.

The SDGs through which the urban planning project in the peri-urban area was proven to correspond to the sustainability assessment are 2, 8, 12, 11, 15 and 17. The targets of the SDGs were analyzed, and indicators were identified (Table 3). The indicators of the 2030 Agenda were not always 'spatializable'. Thus, in some cases, an adaptation was developed to express the theme of sustainability. The indicators that fully correspond to the global indicators proposed by the 2030 Agenda are illegal building rate, forest area index, soil sealing, and fragmentation of natural and agricultural territory.

Table 3. SDGs, targets and indicators.

Dimension of Sustainability	SDGs	Targets	Indicators
Social	11. Sustainable cities and communities	11.1 By 2030, ensure access for all to adequate, safe, and affordable housing and basic services, and upgrade slums	Social housing
		11.2 By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	Sustainable mobility
		11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	Civic use of public properties
		11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage	Illegal building rate
	11. Sustainable cities and communities 17. Partnerships for the goals	11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities 17.17 Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships	Civic cornerstones
Environmental	15. Life on land data	15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	Forest area index
		15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	Soil sealing Ecosystem fragmentation
Economic	2. Zero hunger	2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality	Agri-environmental productions
	8. Decent work and economic growth	8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small-, and medium-sized enterprises, including through access to financial services	
	12. Responsible consumption and production	12.2 By 2030, achieve the sustainable management and efficient use of natural resources	
	8. Decent work and economic growth	8.4 Improve progressively, through 2030, global resource efficiency in consumption and production, and endeavor to decouple economic growth from environmental degradation, in accordance with the 10 year framework of programs on sustainable consumption and production, with developed countries taking the lead	Green equipped economies

2.4. Second Phase: Spatial Sustainability Assessment

All the evaluations were performed using the spatial sustainability assessment model (SSAM) [49,50], that was developed by the Regional Environmental Protection Agency of Umbria (an Italian Region) and the Environmental Laboratory, a research group within the Applied Economy Unit of the Department of Agricultural, Food, and Environmental Sciences (DSA3) of the University of Perugia (Italy). The SSAM is specifically developed for integrated spatial multicriteria analysis and combines multicriteria decision analysis (MCDA) with GIS, analyzing each sustainability dimension by means of the technique for order of preference by similarity to ideal solution (TOPSIS), and returning a global sustainability index by means of a weighted summation. The use of the geo-TOPSIS algorithm has already been successfully tested in other spatial classification contexts [51,52], as has the integration of GIS and multicriteria evaluation systems and methods.

MCDAs are part of decision support systems (DSSs); in their most general formulation, they can be considered as a set of systematic procedures that serve to generate, evaluate, and select alternative decisions on the basis of convergent criteria, which cannot be commensurate in a traditional way, and allow the combination of individual criteria into an overall assessment [53]. The multidimensionality of decision-making criteria, which must be considered in sustainability assessments, can be optimally handled by multicriteria procedures, through the peculiar introduction of different weighting systems, which vary according to the objectives and structure of the decision problem, and which basically serve to determine priorities of choice or action at various levels of complexity even in multidisciplinary approaches [54].

A GIS enables the construction of an interpretative knowledge framework of reality through spatial analysis models. It is part of geographic information science (GISci), which is the information that science has oriented toward the collection, modelling, management, visualization, and interpretation of geographic information, consolidated in the reflections on spatial dynamics and the need to read relationships and place measurable and shareable information in space [55]. Being an integrative disciplinary field, it combines multidisciplinary concepts, theories and techniques, enabling innovative synergies for a greater understanding of territories [56]. In particular, QGIS (version 3.16.14), an open-source software flexible to experimental implementations of academic research through the integration of specific plug-ins or tools, was used for the entire project.

The TOPSIS is an MCDA method [57–59] and uses, as a basic concept, that the preferred option should have—in Euclidean space—the 'shortest distance' to the 'ideal solution' and the 'greatest distance' to the 'nonideal solution'. The Euclidean distance criterion is then used to assess the relative closeness of the different alternative proposals to the final solution, and the final order of option preferences is obtained by confronting these relative distances [60]. This method is particularly useful for research as it can be used to verify the achievement of the 2030 Agenda's targets.

MCDAs integrated with GIS enable the development of spatial decision support systems (SDSSs) by combining geographical data with contextual statistical measures analyzed by means of preferences and value judgements. This allows both the effective communication of assessment results to planners and decision makers, and the construction of spatial assessments necessary to understand the impacts of urban planning on the territory.

In the SSAM, the MCDA model is activated within the GIS software (QGIS 3.16.14) and, therefore, uses the same interface and database. The interface of the SSAM provides a series of successive screens, in which the user is guided through the initial data input, and subsequently through the execution of the multicriteria analyses [49]. The final product of the processing is represented by numerical and tabular outputs, as well as graphical and cartographical outputs. These outputs represent the indices of environmental (*EnvIdeal*), economic (*EcoIdeal*) and social (*SocIdeal*) sustainability. The indicators of each dimension are aggregated by applying the TOPSIS, while the different dimensions are then aggregated by using the weighted summation to derive the overall sustainability index (*SustIdeal*) [46].

Furthermore, in addition to the separate calculation of the economic, environmental, and social indices, the SSAM presents a procedure that can retrace the steps that led to the final result, revealing which indicators and/or procedural steps had the greatest influence on the results obtained [49,50]. Figure 2 summarizes the methodological approach proposed in this research.

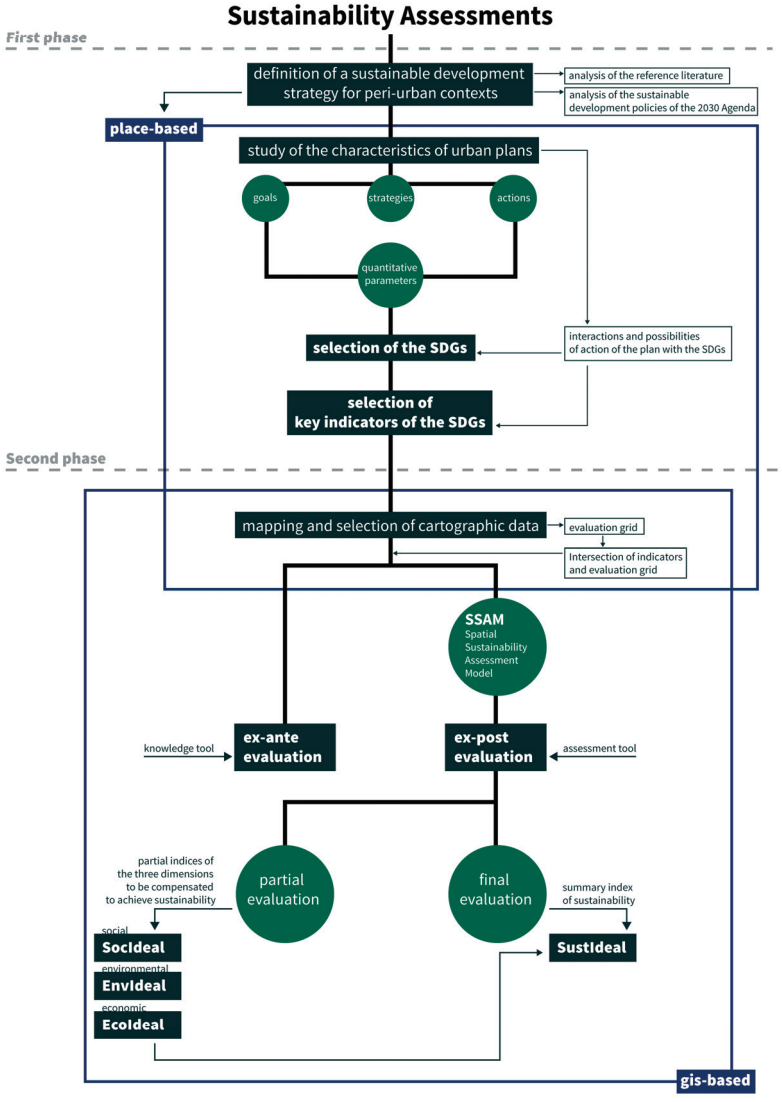


Figure 2. The proposed methodological approach.

3. Results

3.1. Results of the First Phase: Construction of Evaluation Indicators

3.1.1. Social Dimension

The social dimension was assessed in SDGs 11 and 17. The indicators used in the social assessment were as follows:

- social housing;
- sustainable mobility;

- civic use of public properties;
- illegal building rate;
- civic cornerstones.

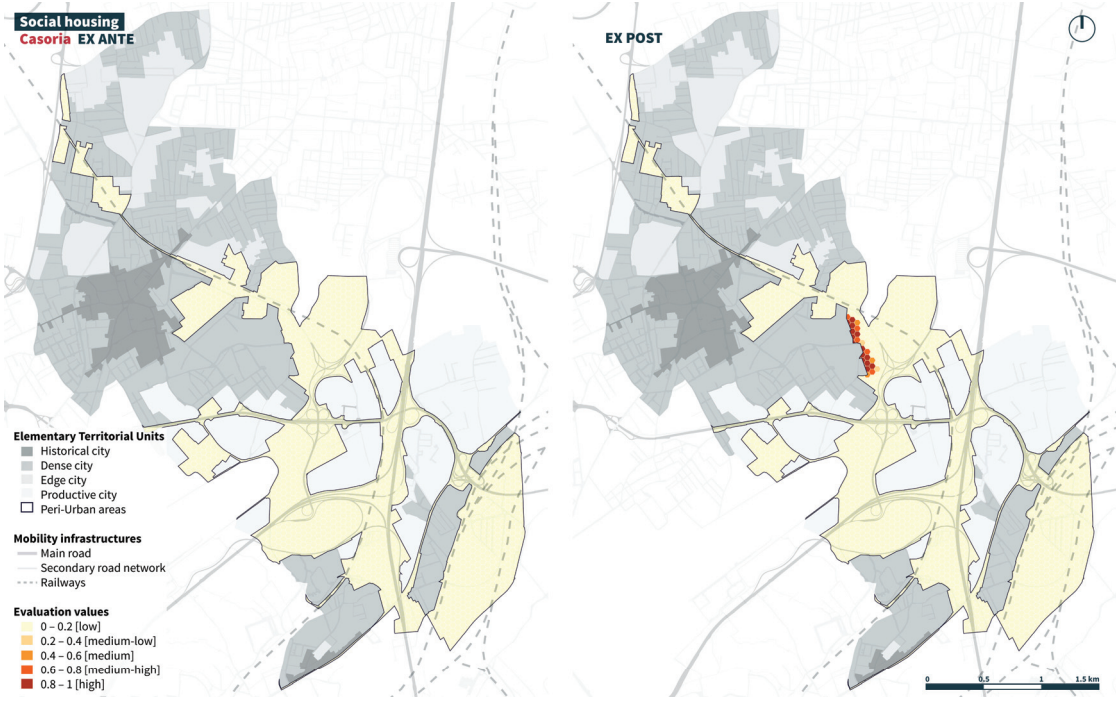
Social settlements constitute a part of the new community developments in the peri-urban context. These measures identify various criteria, but the key indicator summarizing this condition of housing hardship is the ratio of evictions to resident households. The municipalities of Naples and Casoria have the highest indices among the Metropolitan Area, and this condition is also given by a high housing density.

The 'social housing' indicator used in the evaluation is calculated as the land area covered by social public housing developments that have been conventionally built or subsidized by public funding (Figure 3).

Sustainable connections are the main device for building an open, shared city. They aim to ensure that transport systems meet the economic, social, and environmental needs of society while minimizing their negative repercussions on the economy, society and environment. In Italy, a strong criticality stems from road transport, which contributes 23% to total greenhouse gas emissions (of which about 60% is attributable to passenger cars), about 50% to nitrogen oxide emissions, and about 13% to particulate emissions [61]. It is also a precondition for people, regardless of economic capacity, to be able to travel across the territory and establish social relationships. Although the public transport sector is of undisputed value in this issue, urban planning generally has no direct bearing on the transport sector. Therefore, the assessment is primarily intended as a redesign of the relationship between infrastructures and urban/peri-urban spaces to encourage the spread of alternative mobility and minimize environmental impacts. The sustainable mobility index is calculated as the surface area covered by traversability elements (e.g., pavements, bicycle lanes, and equipped paths) or by devices for environmental–climatic comfort (e.g., planting of trees along streets). In the ex-ante evaluation, only existing devices were assessed, while project devices were also added in the ex-post evaluation. In particular, devices aggregating various forms of traversability or environmental comfort were given an aggregate weight. For example, 'parkways' were given the highest weight, as they comprise all elements (Figure 4).

The indicator 'civic use of public properties' identifies public facilities or facilities for public use in the territory. In target 17.17, private equipment for public use is also included in the evaluation in order to promote effective partnerships among public, public–private, and civil society actors. The indicator is calculated as the surface area covered by public equipment that is categorized into education, common interest, and equipped public spaces or private equipment for public use (Figure 5).

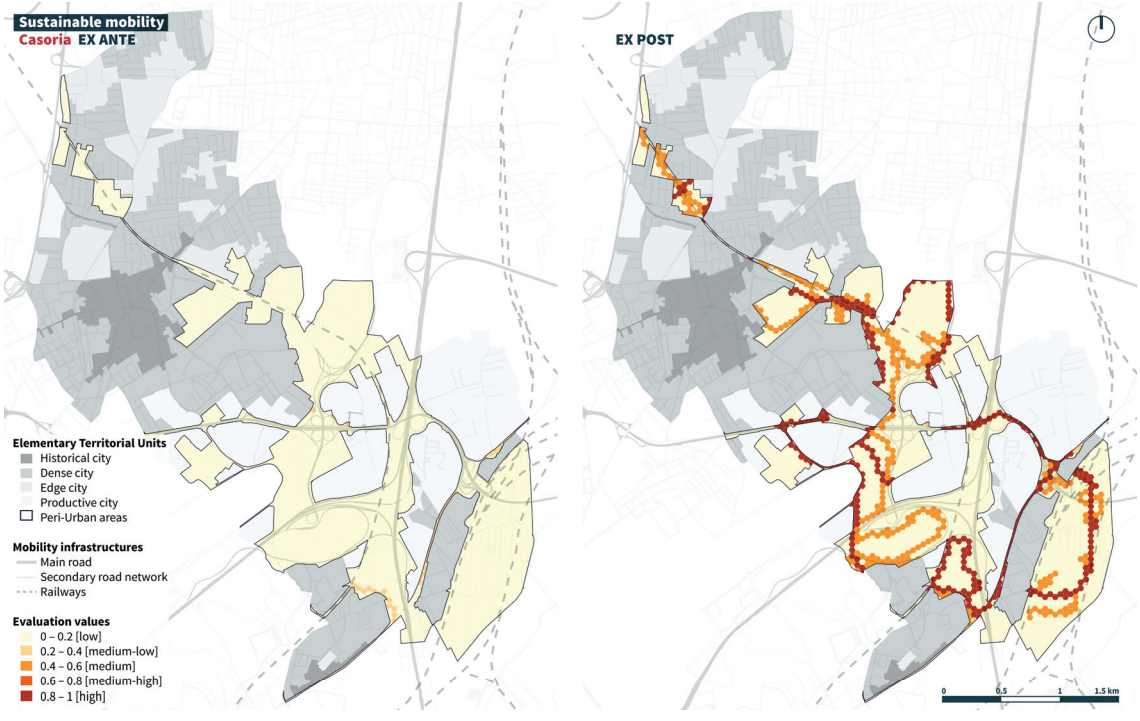
The 'illegal building rate' indicator concerns unplanned settlements, which represent land-use practices operated illegally and without a real right. The indicator is calculated in the ex-ante evaluation as the area covered by illegal settlements. In the ex-post evaluation, the capacity to accommodate tree density or public facilities is calculated. In the former case, the area free of infrastructures for mobility and buildings was identified by selecting the cells free of these two elements. A tree density ratio of one tree per 30 m^2 was then used. In the second case, only cells free of infrastructure, buildings, and appurtenances were selected and this area was used as an index. Both ratios were normalized on a 0–1 scale and their average was evaluated and subtracted from the ex-ante evaluation index. This makes it possible to assess the capacity of land to serve social purposes in such settlements. These parameters were used because the Casoria MUP envisages for the urban redevelopment of these areas the planting of at least 50% of the appurtenances and the identification of areas able to accommodate public facilities (Figure 6).



(**a**)

(**b**)

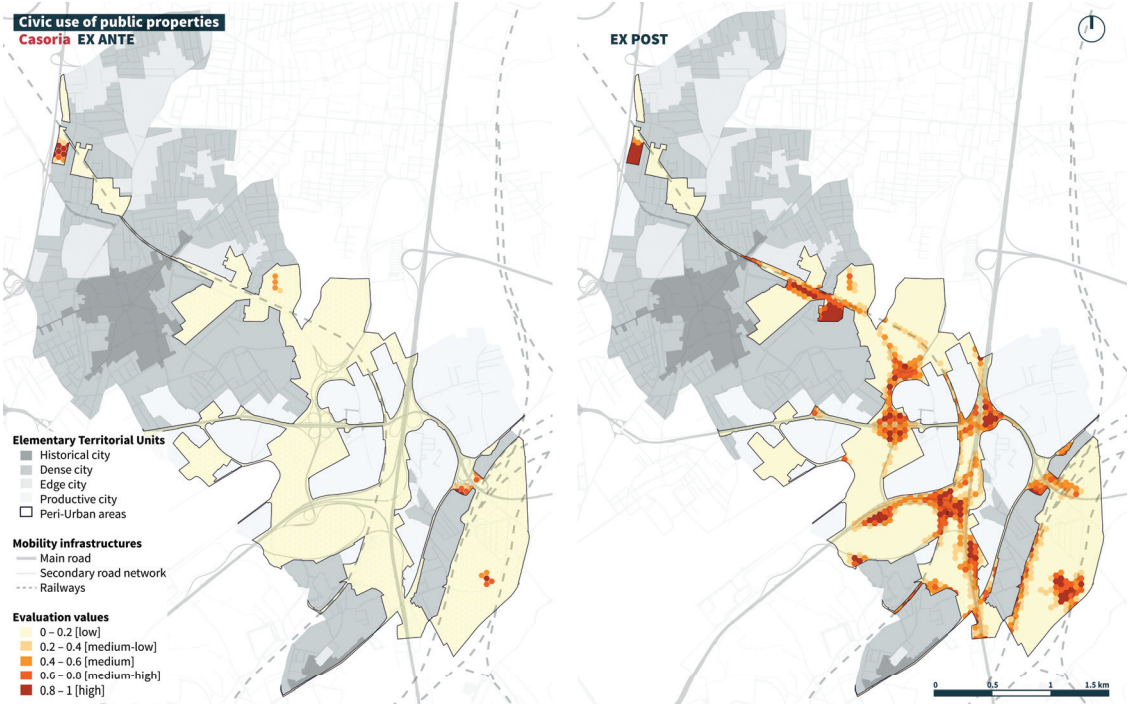
Figure 3. Social housing: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.



(**a**)

(**b**)

Figure 4. Sustainable mobility: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.



(**a**)

(**b**)

Figure 5. Civic use of public properties: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.

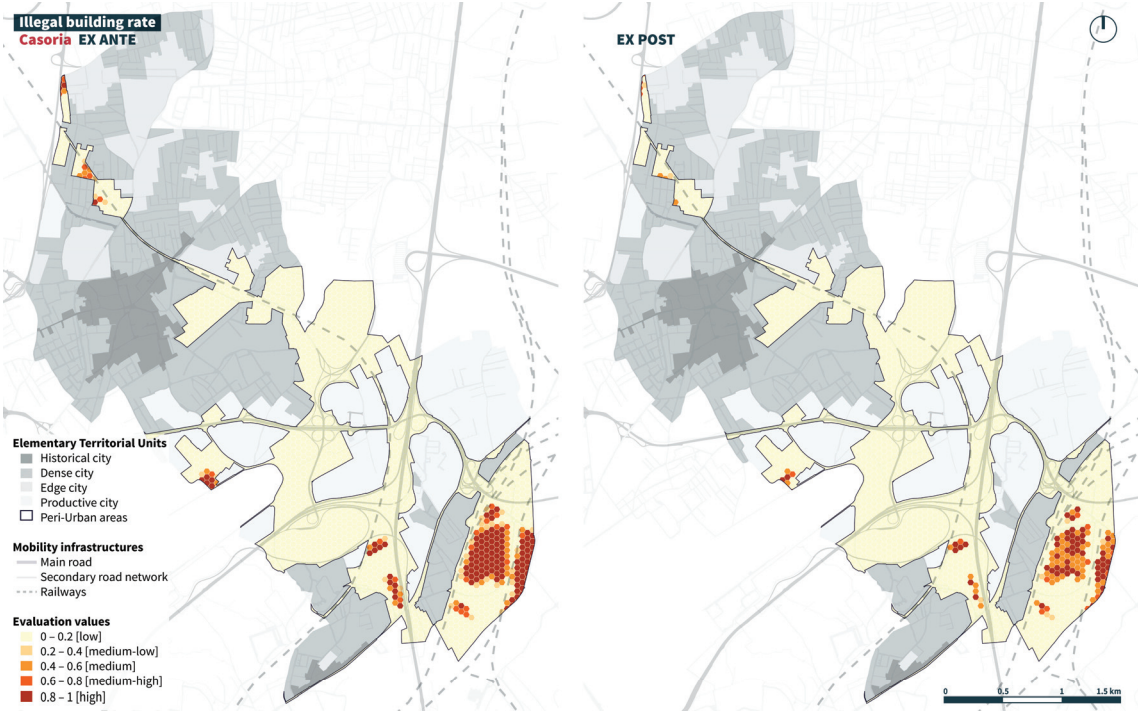
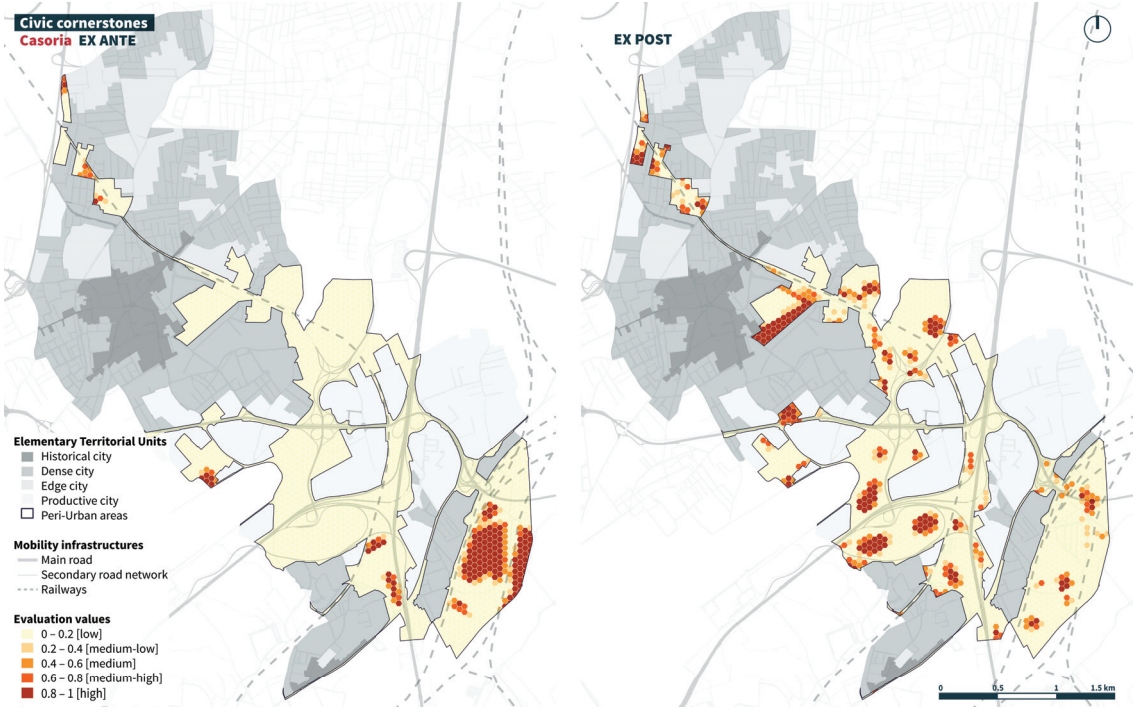


Figure 6. Illegal building rate: Casoria ex-ante and ex-post evaluation.

The last indicator of the social dimension is 'civic cornerstones'. This indicator represents a sustainable practice in land management as peri-urban areas are deregulated by large spaces and numerous uncultivated public properties with no real use. Their reactivation represents a practice of active territorialism in terms of care and management of uncultivated or unused and, therefore, inaccessible land. The experiences mapped in the ex-ante evaluation show how bottom-up regeneration practices have created multifunctional open spaces capable of combining the dimensions of utility and environmental quality [62]. These practices show the need for urban spaces not tied to the logic of consumption or profit and for a renewed right to the city. They also favor the ecological connectivity of the territory or public connection between parts of the territory. The indicator refers to the practices of the commons of a collaborative type and aimed at general interest objectives that go beyond even the most directly involved actors and transcend a logic of ownership [63]. The indicator is calculated as the public surface area covered by land use affected by social regenerative practices for public (public or public-use facilities and social agriculture) or ecological (forest) purposes. In the specific case of the Casoria plan, the mitigation green, productive green, and equipped green envisaged in the operational plan of the peri-urban park were evaluated ex-post on public properties (Figure 7).



(**a**)

(**b**)

Figure 7. Civic cornerstones: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.

3.1.2. Environmental Dimension

The environmental dimension was assessed according to SDGs 11 and 15. All indicators refer to the needs expressed in target 15.9 of the 2030 Agenda, which aims to integrate ecosystem and biodiversity values into national and local planning and development processes. The indicators and indices used in the assessment of the environmental dimension were as follows:

- soil sealing;
- forest area index;
- ecosystem fragmentation.

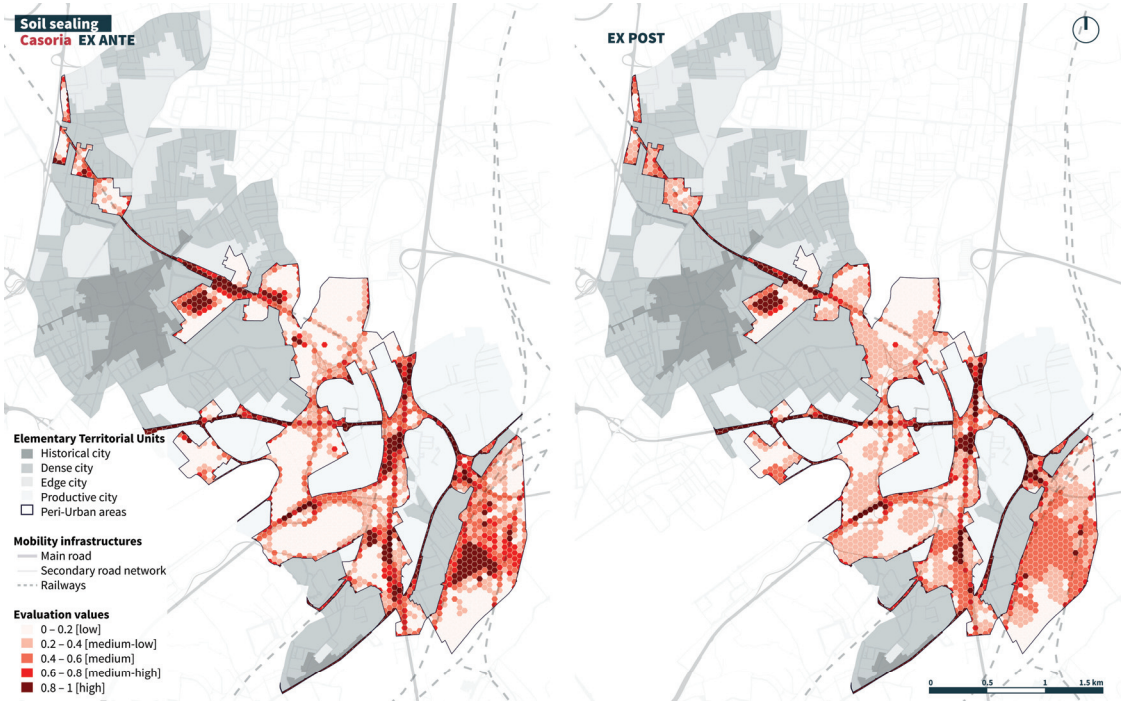
The indicator 'soil sealing' identifies the proportion of land area that is artificially covered by buildings, infrastructures and other permanent structures, which make the underlying soil totally or partially impervious to water, thereby preventing it from performing its vital functions. In particular, in the MUP/POP of Casoria, the ex-post assessment of the indicator is calculated on the basis of the plan's forecasts, which envisage the following de-impermeabilizations: in squatter settlements, 50% of the appurtenant areas are to be de-paved and planted with trees. All the mobility infrastructures in the peri-urban area are reclassified as agricultural service roads and made permeable, with the exception of ribbon infrastructures (e.g., motorways). Therefore, these de-impermeabilizations are subtracted. The plan provides for de-impermeabilizations concerning ecological islands and equipped green areas within the MPUs. For the latter, a maximum sealing of 30% of the area concerned was foreseen. This area was, therefore, added to the budget within the cell (Figure 8).

The 'forest area index' represents the proportion of land covered by forests and other wooded land, and describes the variations of the forest coverage over time. It is calculated on the basis of the reports of the National Inventory of Forests and Forest Carbon Sinks [64], which estimates an average tree density of forested areas in Italy of 1/20 m^2. In the ex-ante evaluation, the trees were then mapped in a GIS environment and counted for each grid cell. In the ex-post evaluation in all the grid cells falling within the areas identified by the plan as 'mitigation green', the maximum woodiness coefficient was associated according to the tree density ratio of 1/20 m^2, which equates to approximately 108 trees per cell.

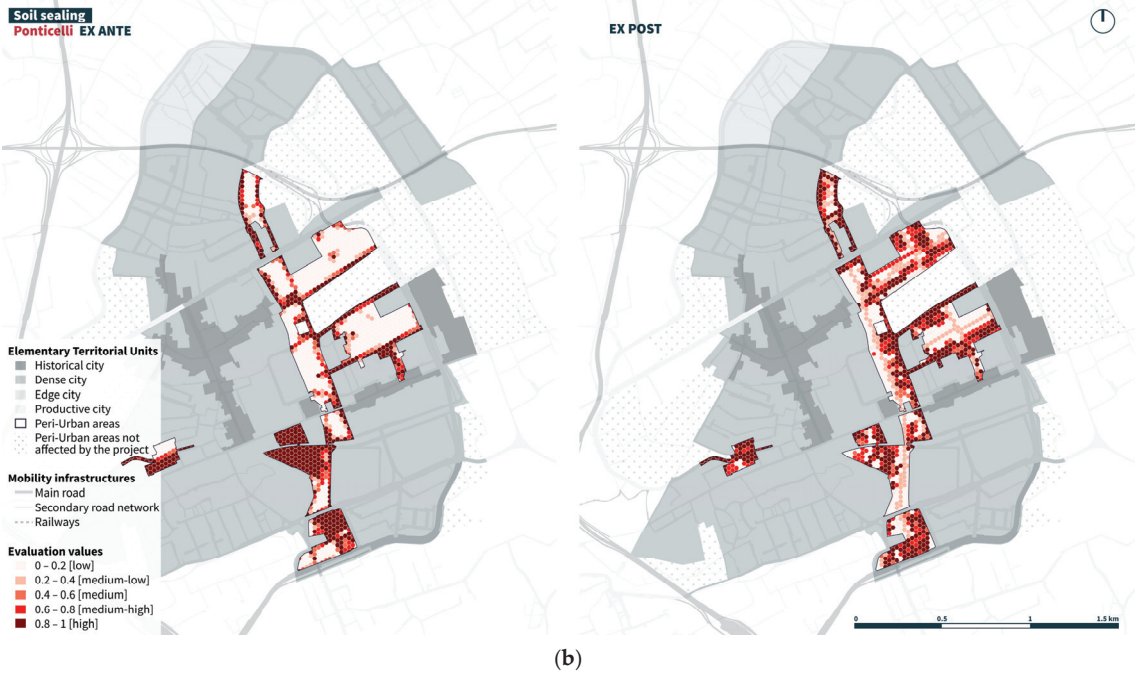
The 'soil sealing' indicator index was subtracted from this density. In addition, the areas potentially free of infrastructure or construction identified by the soil sealing indicator index were also subject to the ex-post evaluation since the plan provides for 50% planting in these areas. Agrarian tree formations (citrus groves) were not taken into account in the ex-ante and ex-post evaluations because their contribution to regulating ecosystem services is unknown, whereas they make a real contribution to supplying ecosystem services [65] (Figure 9).

The 'ecosystem fragmentation' index represents the share of natural and agricultural land with high/very high fragmentation. Land fragmentation is the process of reducing the continuity of ecosystems, habitats and landscape units as a result of phenomena such as urban sprawl and the development of the infrastructure network, which lead to the transformation of patches (unconsumed areas without significant artificial elements that fragment them by interrupting their continuity) of large territories into smaller and more isolated parts of land.

The index on peri-urban territory was constructed through an adaptation of the index 'effective mesh density' (Seff) [66]. The index represents the density of the territorial patches (no. of meshes per 1000 km^2) calculated according to the method of the Seff index related to the probability that two points chosen at random in a given area are located in the same territorial particle. This method has been appropriately modified according to the 'cross-boundary connections procedure', which guarantees the continuity of territory beyond the limits of the reporting unit (1 km^2 cell). The Seff index measures the obstacle regarding movement starting from a point within the reporting unit due to the presence on the territory of so-called 'fragmenting elements' barriers. The choice of the most appropriate fragmenting elements is guided by the aims and objectives of the analysis.

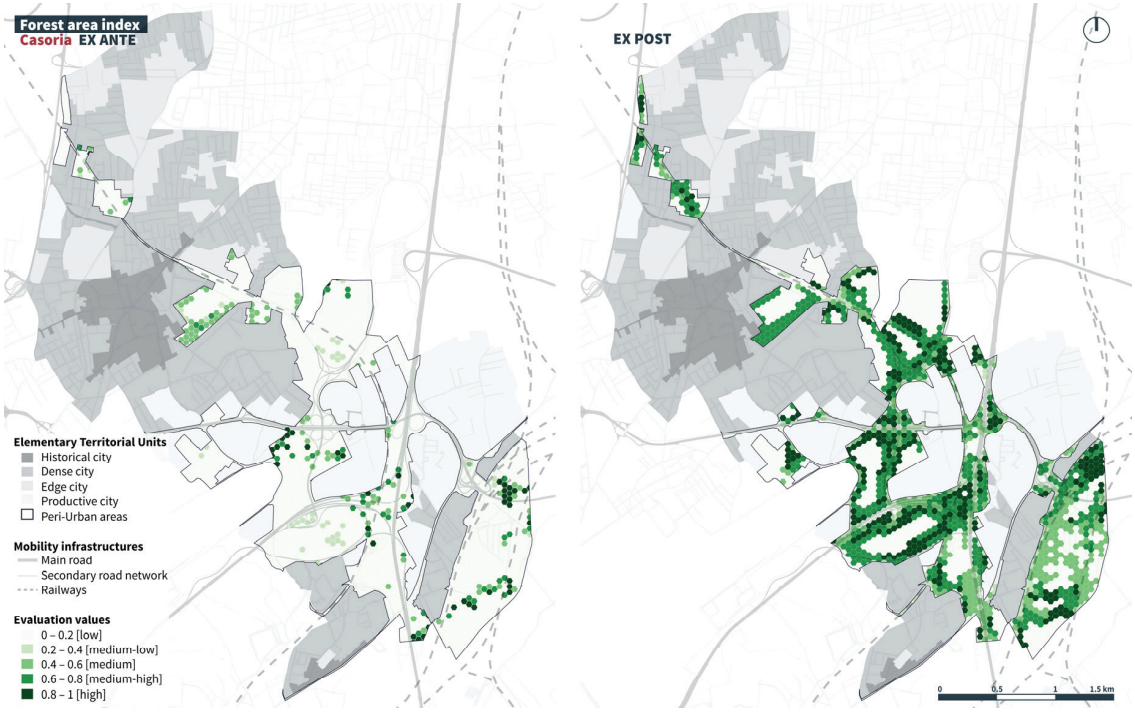


(**a**)

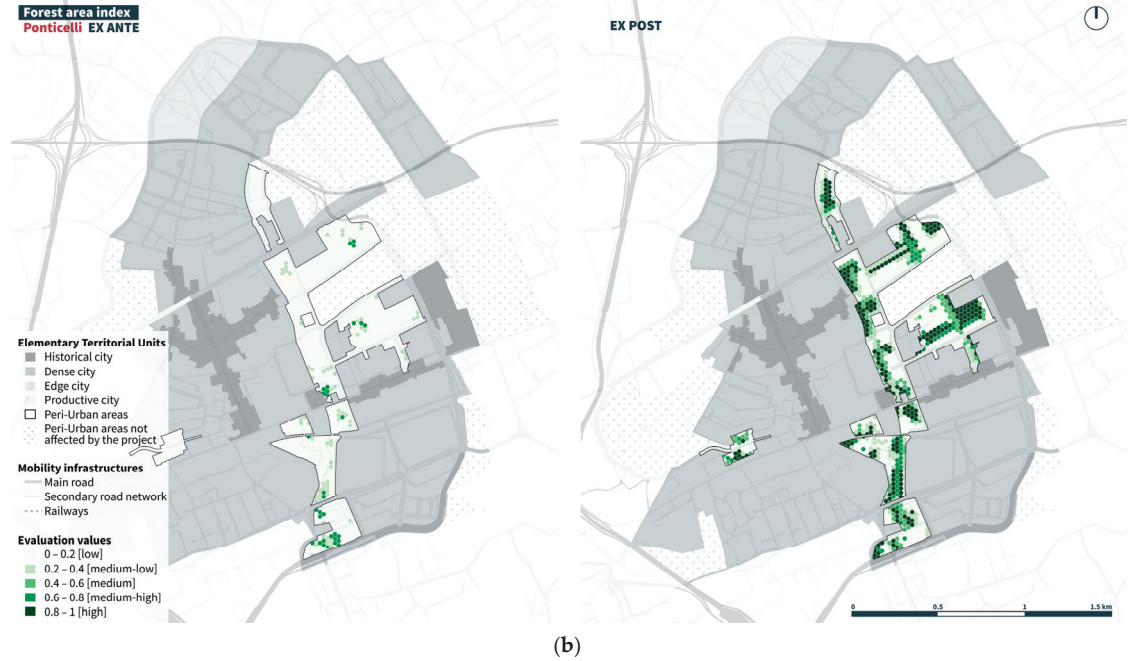


(**b**)

Figure 8. Soil sealing: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.



(**a**)



(**b**)

Figure 9. Forest area index: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.

The case study adaptation of the indicator of fragmentation was calculated with the open-source plug-in QGIS *FragScape* [67], developed by the National Research Institute for Agriculture, Food, and the Environment and the French Ministry of Ecological Transition. In the assessment, fragmenting elements are identified according to two criteria: spread of anthropogenic disturbance and constriction of parts. Diffusion of anthropogenic disturbance represents fragmentation caused by elements that do not allow connection between the parts, such as transport infrastructure. Constriction is represented by internal elements that do not allow movement, such as fences and overhead power grid infrastructures. In the ex-ante evaluation, the values were assessed for the determination of fragmentation buffers from the following thresholds:

- 15 m for urban roads;
- 7.5 m for the urban neighborhood road network;
- 5 m for fences and other infrastructure.

The ex-post evaluation assessed how well plan actions could mitigate fragmentation (Figure 10). The following measures were carried out according to the plan strategies:

- the cancellation of the buffer for fences, as both urban planning instruments provide that such works are not allowed in peri-urban areas;
- the cancellation of the buffer in areas where local roads are reclassified as agricultural service roads;
- the reduction in the buffer by 50% in areas characterized by public crossing routes;
- the reduction in the buffer by 50% in areas subject to mitigation through reforestation and, thus, ecological reconnection.

3.1.3. Economic Dimension

The economic dimension was assessed in SDGs 2, 8, and 12. The indicators of the economic dimension were as follows:

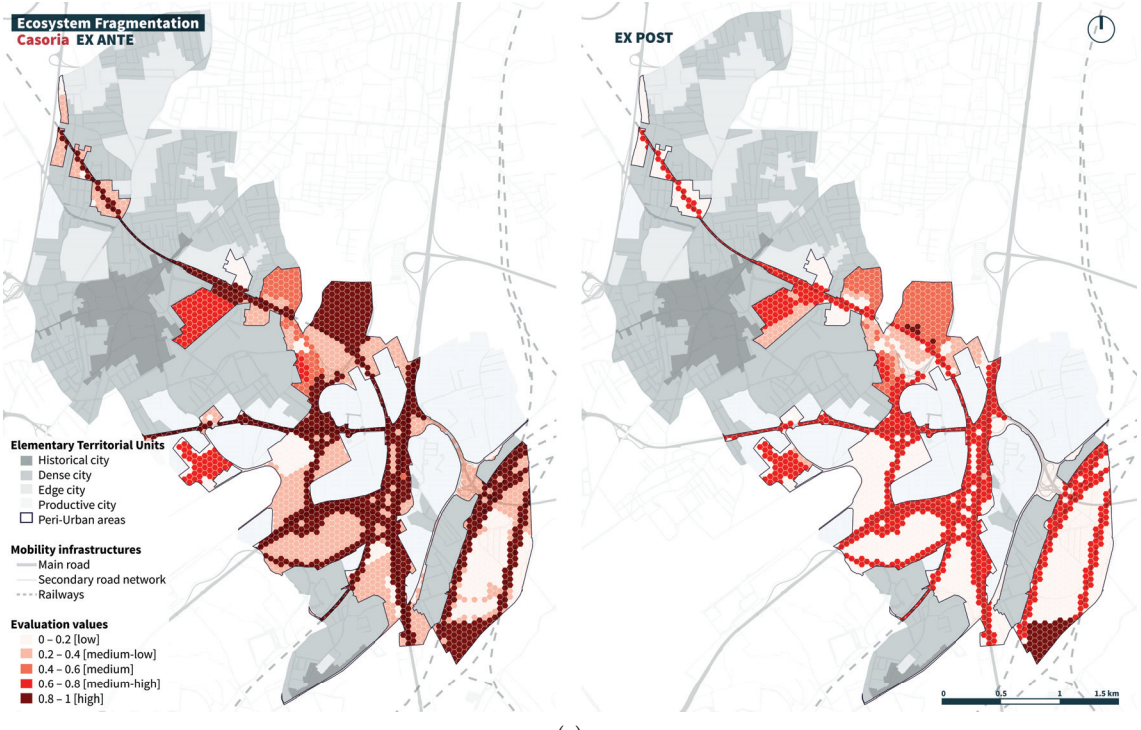
- agri-environmental productions;
- green-equipped economies.

The economic dimension is aimed at supporting the development of a coherent local landscape with the potential for collective use with a social value of open space (equipped green economies) and neighborhood economies (agri-environmental productions).

The ecological enhancement of the peri-urban area also passes through the recovery of agricultural productive capacity. In this perspective, proximity economies and short supply chains represent an opportunity for economic development based on existing resources and environmental sustainability, as well as the preservation of local agriculture and the agricultural landscape.

The 'agri-environmental productions' indicator is made up of the agricultural outlets provided in the MPUs of the Casoria MUP and the social gardens of the Ponticelli URP. In addition, these areas are able to offer woody forest products that support the ecosystem services category of supply. The index is calculated as the ratio of the area covered by the categories of productive green areas/productive forest (Figure 11).

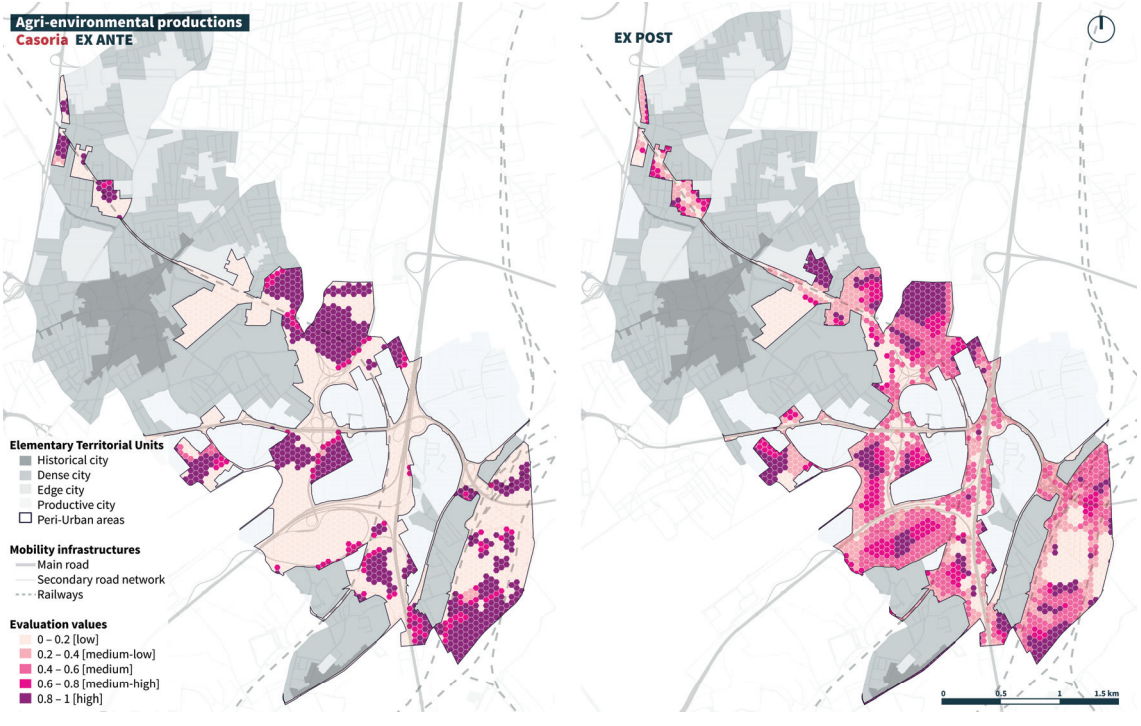
'Green equipped economies' are the areas designated for green-equipped zones. These areas can represent small economies of scale respecting the environmental criteria of rural areas with low building indices (0.3 m^3/m^2) (Figure 12).



(**a**)

(**b**)

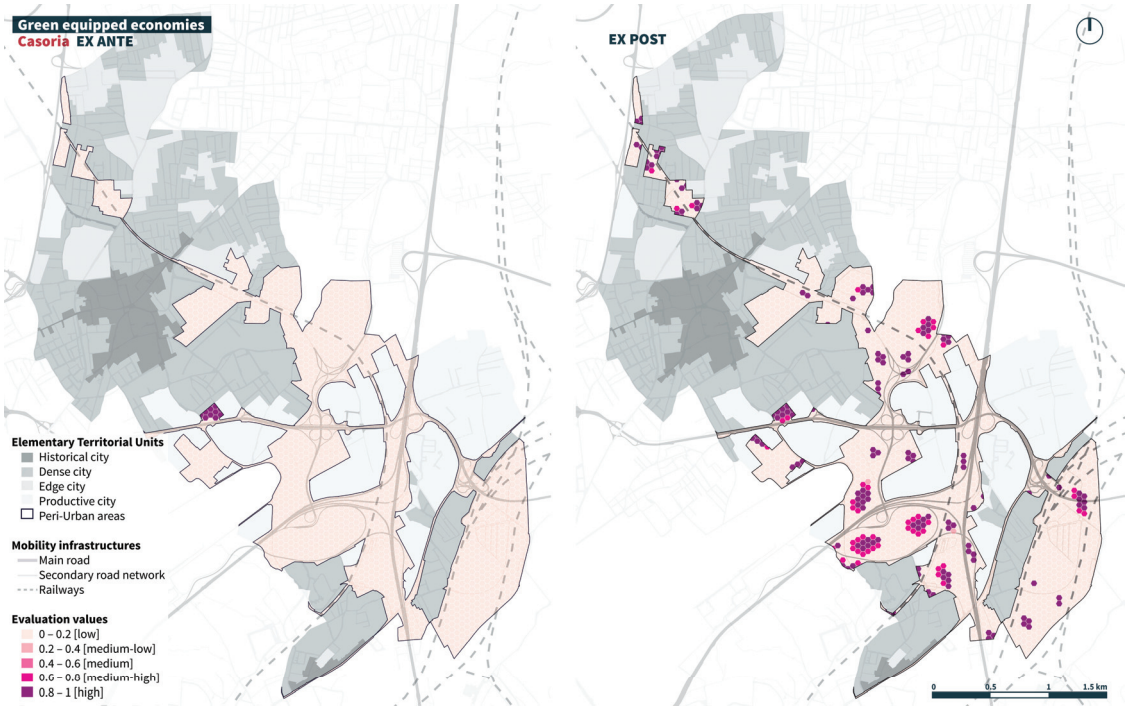
Figure 10. Ecosystem fragmentation: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.



(**a**)

(**b**)

Figure 11. Agri-environmental production: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.



(**a**)

(**b**)

Figure 12. Green equipped economies: (**a**) Casoria ex-ante and ex-post evaluation; (**b**) Ponticelli ex-ante and ex-post evaluation.

3.2. Results of the Second Phase: Dimension Assessment and Sustainability Index

All the assessments were conducted using the SSAM, a plugin developed within QGIS, which is a free and open-source GIS software, widely used in several fields and applications [49,50].

Due to the heterogeneity of the dimensions considered, it is not possible to achieve undifferentiated degrees of equilibrium. In addition to a synthetic spatial index, it is probably possible to consider thresholds for the peri-urban context and evaluate state changes. The analysis of the dimensions of the SDGs can be conducted using a spatial approach by means of the SSAM model, which enables the analysis of the relationships between the dimensions [49] (Figures 13 and 14).

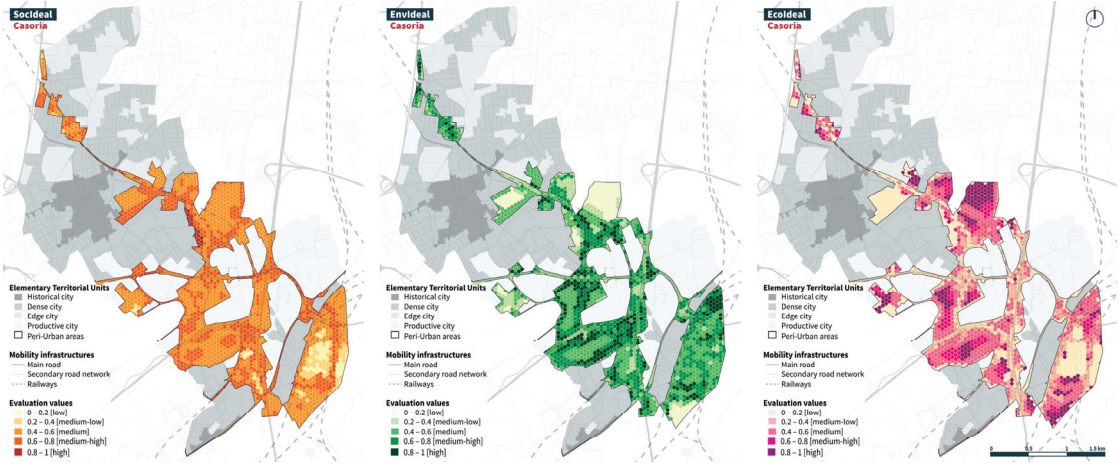


Figure 13. SSAM results for the Casoria municipal urban plan.

Figure 14. SSAM results for the Ponticelli urban recovery program.

The social dimension index shows a wide distribution of the average level of sustainability, with higher levels in public reactivation areas.

The environmental dimension index is the highest of the three. The plan actions are definitely sustainable from an environmental point of view as a large part of the grid shows medium–high levels. Despite identifying a high level of agricultural and

ecosystem fragmentation in the partial assessments, the index demonstrates high ecological connectivity in the peri-urban area.

The economic dimension is affected by the decisive importance of the reactivation of agricultural activities in the peri-urban area.

The ideal sustainability index shows a large distribution of values from medium to high, as well as the decisive importance of wooded areas along infrastructures, thus succeeding in linking, through a redefinition of the peri-urban space, the three dimensions defining the construction of community densities, the shortening of supply chains and the production of reserves and biodiversity corridors (Figure 15).

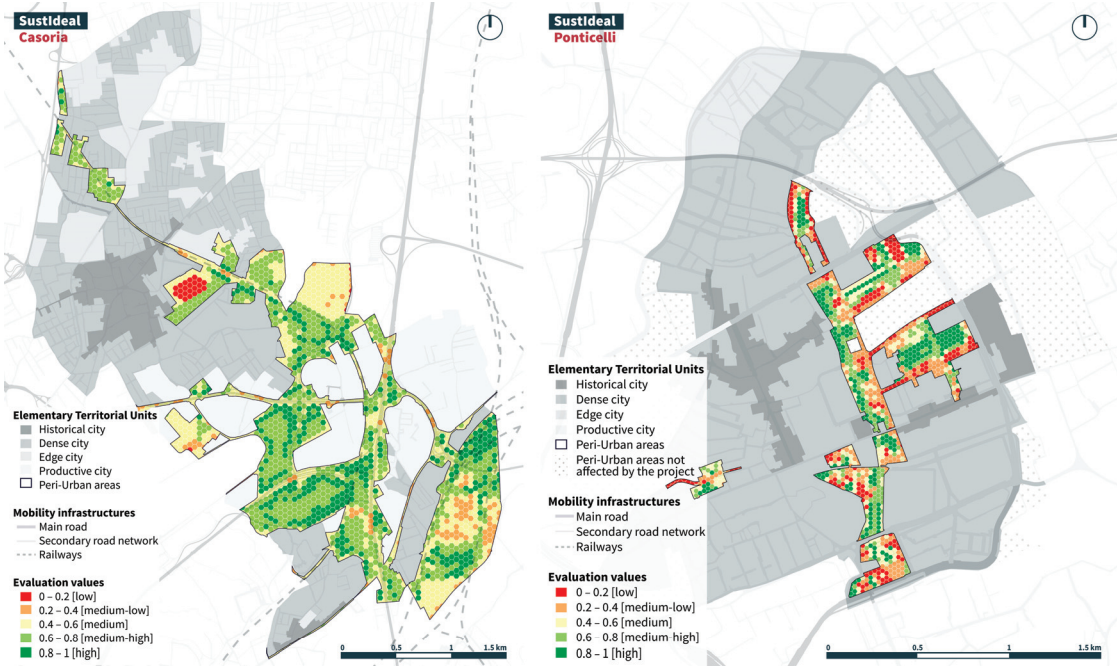


Figure 15. Ideal sustainability index for Casoria and Ponticelli.

The synthesis evaluation makes it possible to ascertain whether the multidimensional integration is balanced.

The development strategies of the two plans are heterogeneous. Comparing them helps to highlight sustainable planning strategies for the peri-urban territory.

In Casoria, the peri-urban strategy is aimed at reconstituting an agroforestry landscape as a compensatory component of the city. Spatially, it is directly accessible through a system of paths provided by the plan and collective use, and it is guaranteed by an economy of open space that needs to be nurtured by real people. The fragmentation is compensated for by a reclassification of roads, from urban to rural ones, as well as by the provision of a system of fences that allows for the movement of wildlife.

In Ponticelli, the strong urban and settlement pressure resulting from its partial urban infrastructure allows for a mitigating result of the pressures. The results show that, as more strategies and actions are dictated on the economic and social component, more trade-offs can be identified. Building economic, social, and environmental links among urban, peri-urban, and rural areas cannot be limited to just a narrative, but must be spatially transformed into indices, parameters, subsidies or facilities. Infrastructures and urbanization works must be rethought to consider multiple species and enable multispecies habitability. Moreover, the assessment process could be implemented by the goals that

address resources, energy, and consumption (SDGs 6, 7 and 12). This implementation would be necessary to verify whether new public settlements meet near-zero-energy building (NZEB) criteria and are aimed at urbanization that is not extractive of natural resources.

4. Conclusions

Environmental assessments, interpreted as instruments for the pursuit of sustainability, can support decision-making processes for peri-urban planning and programming.

Although the fringe represents significant critical issues, it can be seen as a key area for the regeneration of European cities by working on a different growth model from the one that generated them [13].

The territorialization of the 2030 Agenda in the peri-urban context brings out the need to rethink urbanization without postulating a constitutive outside [24] in which split spatiality is rethought to communicate the sense of an ecological and social relational dimension. The conflicting interests in these transitional landscapes must be supported by evaluations capable of opening a debate and questioning the hypertrophic city in order to imagine urbanizations not preordained to technological or economic laws but instead to collective political choices. In these political choices the form of urbanization should follow the differentiations of infrastructure solutions cultivated within holistic frames of territorial development through a balanced management of resources and attention to the ecological dimension [68]. The development of cities must be planned within its consolidated boundaries, considering that some areas are not sustainable options for relocating the waste of life support (e.g., landfills, logistics and production activities) because they are incompatible with the quality of the residential habitat or because the expansion models foresaw a sectionalization of space. Thinking of the margin as a constitutive exterior determines the construction of what Gilles Clément calls the 'backyards' that serve as another medium for displacement [69].

The use of GIS proved to be very useful for the territorialization of the 2030 Agenda and, thus, in the representation of sustainability indicators and indices. However, it must be considered that GIS, as well as multicriteria evaluation methods, must be used as a decision support system, and not as a tool capable of 'automatically' managing a large availability of spatial data. Therefore, the GIS must not be understood as a tool capable of providing 'automatic' solutions, but as support for public participation and decision-making processes, given the facility with which information and spatial analyses can be communicated.

In this perspective, the debate on 'critical GIS' fits in. It highlights the danger of an increasing role of expert knowledge within the decision-making processes with the advent of a sort of automation revolution that could have completely overhauled the geographical discipline. In fact, it has been pointed out that the risk of a 'hidden technocracy' [70] may be particularly evident when disposing tools capable of 'big' spatial information and analysis. In particular, Thatcher et al. pointed out that critical GIS 'can help us constructively engage not only mainstream GISci and the ever-proliferating intersections of computation with space and place, as well as critical human geography' [71].

Indeed, critical GIS can be understood as a tool to support social transformation by producing not only new cartographies but also new possibilities for change, taking into account the needs of the weaker, marginalized, or discriminated social classes [72]. Thus, a GIS can become a tool for analyzing spatial values, visualizing and proposing 'new spatialities' [73] in order to build fairer and more equitable cities, and reducing spatial inequalities within cities [74].

The use of a GIS in this research moves it in an important direction, with the development of indices and indicators based on the SDGs of the 2030 Agenda verifying the feasibility of these tools on a territorial level for the support of strategic environmental assessments, and therefore, stakeholder participation. These indices make the issues of the society of peri-urban territories spatially explicit. In addition, they attempt to overcome the growing criticality of aquiring data through replicable procedures. The choice of indicators

or indices is based on adaptations of measures proposed in the national monitoring of ISTAT, which largely uses indices equivalent to the global indicators of the 2030 Agenda. The adaptations that were necessary in this experiment are justified by the place-based approach that the 2030 Agenda, by its very nature, cannot consider except in terms of compensation or trade-offs on indicators that are worse than the status quo, enabling collective use with a social value of open space and proximity as an opportunity for alternative economic development. Proximity and the local characteristics are certainly in the focus of contemporary urban design, but they also need to be reworked in the evaluation processes.

In the economic dimension, the services provided by agroforestry economies, which the 2030 Agenda deals with in terms of utilized agricultural area, are integrated and the concrete case of the economies of green spaces is evaluated.

In the environmental dimension, the woodiness coefficient can be associated with regulating ecosystem services (CO_2 sequestration, air purification, protection against erosion or hydrogeological disruptions, and increase in habitats for biodiversity) or with indicators of ecological value used in the green infrastructure of spatial policies. It, therefore, represents a synthetic indicator capable of fulfilling several functions.

In the social dimension, the 2030 Agenda does not take into account the civic use of public property. It is not possible to imagine a sustainable development that does not consider instances of regeneration from below, even if only with a view to saving public expenditure. Even unintentional practices of a collaborative type, aimed at objectives of general interest that go beyond even the most directly involved subjects and transcend a logic of a proprietary type [63], persist in the territories, with different and unqualified purposes, resulting in a shared project based on new ways of planning and managing regeneration processes from a quantitative point of view. These instances of a social character need to be studied within the evaluation and planning processes to make them transparent within the community in order to bring out the social aims of bottom-up processes. Furthermore, given the in-depth scale of the experimentation, it was deemed necessary to adapt the sustainable mobility index to the spatial context, evaluating the actual devices capable of fostering sustainable mobility for all social groups, as a form of spatial justice.

The territorialized model makes it possible both to explicate a physical dimension of the transformations and to highlight the new economic, social and environmental relationships between urban and peri-urban contexts. Moreover, a parallelism with the broad scientific literature of ecosystem services is possible [75]. Indeed, the three dimensions can represent 'regulating services' for the environmental dimension, 'provisioning services' for the economic dimension, and 'cultural services' for the social dimension [76].

This evaluation model is developed to associate spatial values that peri-urban areas are capable of expressing even at a potential level. The nonachievement of ideal sustainability is due to two conditions. The first shows that the peri-urban space is used for value expropriation purposes (e.g., to reiterate an urban development that is no longer sustainable, as in the case of private residences that are, however, necessary for the financing of the URP project) and for the creation of 'social mixing'. The second issue concerns the state of the place. In fact, by its nature, the peri-urban space is made up of extensive infrastructures and settlements for which planning tools can imagine restraining or compensatory measures but are not able to cancel their impacts.

Author Contributions: Conceptualization, E.F. and P.D.T.; methodology, N.F. and E.F.; software, N.F.; validation, N.F., E.F. and P.D.T.; formal analysis, N.F. and P.D.T.; investigation, N.F. and E.F.; data curation, N.F.; writing—original draft preparation, E.F. and N.F.; writing—review and editing, P.D.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Acknowledgments: The research activities illustrated in the paper were developed by the authors, and they analyzed urban planning predictions developed under two collaboration agreements

between the Department of Architecture (DiARC) of the University of Naples Federico II and the Cities of Casoria and Naples.

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

References

1. Bond, A.; Morrison-Saunders, A.; Pope, J. Sustainability assessment: The state of the art. *Impact Assess. Proj. Apprais.* **2012**, *30*, 53–62. [CrossRef]
2. Sadler, B. A framework for environmental sustainability assessment and assurance. In *Handbook of Environmental Impact Assessment*; Petts, J., Ed.; Blackwell: Oxford, UK, 1999; Volume 2, pp. 12–32.
3. Gibson, R.B. *Sustainability Assessment: Criteria, Processes and Applications*; Earthscan: London, UK, 2005.
4. Sheate, W.R. The evolving nature of environmental assessment and management: Linking tools to help deliver sustainability—Tools, techniques & approaches for sustainability. In *Tools, Techniques and Approaches for Sustainability: Collected Writings in Environmental Assessment Policy and Management*; Sheate, W.R., Ed.; World Scientific: Singapore, 2009; pp. 1–29.
5. Hacking, T.; Guthrie, P. A framework for clarifying the meaning of triple bottom-line, integrated, and sustainability assessment. *Environ. Impact Assess. Rev.* **2008**, *28*, 73–89. [CrossRef]
6. Farías, I. The politics of urban assemblages. *City* **2011**, *15*, 365–374. [CrossRef]
7. Latour, B. *Politics of Nature: How to Bring the Sciences into Democracy*; Harvard University Press: Cambridge, MA, USA, 2004.
8. Callon, M.; Lascoumes, P.; Barthe, Y. *Acting in an Uncertain World. An Essay on Technical Democracy*; MIT Press: Cambridge, MA, USA; London, UK, 2009.
9. Simandan, D. Competition, contingency, and destabilization in urban assemblages and actor-networks. *Urban Geogr.* **2018**, *39*, 655–666. [CrossRef]
10. Buffoni, L. La "dottrina" dello sviluppo sostenibile e della solidarietà generazionale. *Il Giusto Proced. Di Normaz. Ambient.* **2007**, *8*, 1–21.
11. Low, N.; Gleeson, B. *Justice, Society and Nature. An Exploration of Political Ecology*, 2nd ed.; Routledge: London, UK, 1998; pp. 29–48.
12. Mininni, M. Abitare il territorio e costruire paesaggi. In *Campagne Urbane*, 2nd ed.; Donadie, P., Ed.; Donzelli Editore: Roma, Italy, 2013; pp. XIII–LV.
13. Attademo, A.; Formato, E. Ripartire dalle cinture urbane di transizione. In *Fringe Shifts*; Attademo, A., Formato, E., Eds.; LISt Lab: Trento, Italy, 2018; pp. 10–25.
14. Russo, M. Un urbanistica senza crescita? In *Urbanistica per Una Diversa Crescita*; Russo, M., Ed.; Donzelli Editore: Roma, Italy, 2014; pp. XV–XXX.
15. Latour, B. *Tracciare la Rotta*; Raffaello Cortina Editore: Milano, Italy, 2018; pp. 61–65.
16. Forman, T.T.R. In Conversation with Richard T. T. Forman. *LA+ Interdiscip. J. Landsc. Archit.* **2015**, *1*, 115–120.
17. Weller, R.; Drozdz, Z.; Padgett Kjaersgaard, S. Hotspot Cities: Identifying peri-urban conflict zones. *J. Landsc. Archit.* **2019**, *14*, 8–19. [CrossRef]
18. Ravetz, J.; Fertner, C.; Sick Nielsen, T. The Dynamics of Peri-Urbanization. In *Peri-Urban Futures: Scenarios and Models for Land Use Change in Europe*; Nilsson, K., Pauleit, S., Bell, S., Aalbers, C., Sick Nielsen, T., Eds.; Springer: London, UK, 2012; pp. 13–44.
19. Wandl, A.; Magoni, M. Sustainable Planning of Peri-Urban Areas: Introduction to the Special Issue. *Plan. Pract. Res.* **2017**, *32*, 1–3. [CrossRef]
20. Pareglio, S.; Pozzi, F. Analisi e caratterizzazione dei sistemi agricoli e territoriali della Lombardia. In *Analisi e Governo Dell'agricoltura Periurbana (AGAPU). Rapporto Finale di Ricerca*; Pareglio, S., Ed.; Fondazione Lombardia per l'Ambiente: Milano, Italy, 2013; pp. 24–60.
21. Forsyth, A. Defining suburbs. *J. Plan. Lit.* **2012**, *27*, 270–281.
22. Mininni, M. *Approssimazioni Alla Città*, 1st ed.; Donzelli Editore: Roma, Italy, 2012; pp. 13–62.
23. Brenner, N. Theses on Urbanization. *Public Cult.* **2013**, *25*, 85–144.
24. Brenner, N.; Schmid, C. Planetary urbanisation. In *Urban Constellations*; Gandy, M., Ed.; Jovis: Berlin, Germany, 2011; pp. 10–13.
25. Harvey, D. *The New Imperialism*; Oxford University Press: New York, NY, USA, 2003; pp. 137–182.
26. Mininni, M. Né città, né campagna. Un terzo territorio per una società paesaggista. *Urbanistica* **2005**, *128*, 7–14.
27. Ferretto, M.; Caiani, G.; Mugnano, S. Classificazione dei comuni lombardi sulla base della morfologia sociale e delle funzioni: 4 possibili scenari interpretativi del territorio. In *Analisi e Governo Dell'agricoltura Periurbana (AGAPU). Rapporto Finale di Riceerca*; Pareglio, S., Ed.; Fondazione Lombardia per l'Ambiente: Milano, Italy, 2013; pp. 116–153.
28. Simon, D.; McGregor, D.; Thompson, D. Contemporary Perspectives on the Peri-Urban Zones of Cities in Developing Areas. In *The Peri-Urban Interface: Approches to Sustainable Natural and Human Resource Use*; Simon, D., McGregor, D., Thompson, D., Eds.; Earthscan: London, UK, 2006; pp. 3–17.
29. Allen, A. Understanding Environmental Change in the Contest of Rural-Urban Interaction. In *The Peri-Urban Interface: Approches to Sustainable Natural and Human Resource Use*; Simon, D., McGregor, D., Thompson, D., Eds.; Earthscan: London, UK, 2006; pp. 30–43.

30. Rockström, J.; Steffen, W.; Noone, K.; Persson, Å.; Chapin, F.S., III; Lambin, E.; Lenton, T.M.; Scheffer, M.; Folke, C.; Schellnhuber, H.; et al. Planetary boundaries: Exploring the safe operating space for humanity. *Ecol. Soc.* **2009**, *14*, 32. [CrossRef]
31. Cerreta, M.; Poli, G. Landscape Services Assessment: A Hybrid Multi-Criteria Spatial Decision Support System (MC-SDSS). *Sustainability* **2017**, *9*, 1311. [CrossRef]
32. Birch, C.P.; Oom, S.P.; Beecham, J.A. Rectangular and hexagonal grids used for observation, experiment and simulation in ecology. *Ecol. Model.* **2007**, *206*, 347–359.
33. Wang, J.; Maier, S.D.; Horn, R.; Holländer, R.; Aschemann, R. Development of an Ex-Ante Sustainability Assessment Methodology for Municipal Solid Waste Management Innovations. *Sustainability* **2018**, *10*, 3208. [CrossRef]
34. Panzarella, F.; Turcanu, C.; Abelshausen, B.; Cappuyns, V. Community capitals and (social) sustainability: Use and misuse of asset-based approaches in environmental management. *J. Environ. Manag.* **2023**, *329*, 117122.
35. Bosone, M.; De Toro, P.; Fusco Girard, L.; Gravagnuolo, A.; Iodice, S. Indicators for Ex-Post Evaluation of Cultural Heritage Adaptive Reuse Impacts in the Perspective of the Circular Economy. *Sustainability* **2021**, *13*, 4759. [CrossRef]
36. OECD. Better Regulation Practices across the European Union. Chapter 4. In *Ex-Post Review of Laws and Regulations across the European Union*; OECD: Paris, France, 2019.
37. Ayala-Orozco, B.; Rosell, J.A.; Merçon, J.; Bueno, I.; Alatorre-Frenk, G.; Langle-Flores, A.; Lobato, A. Challenges and Strategies in Place-Based Multi-Stakeholder Collaboration for Sustainability: Learning from Experiences in the Global South. *Sustainability* **2018**, *10*, 3217.
38. Bellefontaine, T.; Wisener, R. *The Evaluation of Place-Based Approaches. Questions for Further Research*; Policy Horizons Canada: Toronto, ON, Canada, 2011; p. 33.
39. Carpenter, S.R.; Folke, C.; Norström, A.; Olsson, O.; Schultz, L.; Agarwal, B.; Balvanera, P.; Campbell, B.; Castilla, J.C.; Cramer, W. Program on ecosystem change and society: An international research strategy for integrated social-ecological systems. *Curr. Opin. Environ. Sustain.* **2012**, *4*, 134–138. [CrossRef]
40. Balvanera, P.; Calderón-Contreras, R.; Castro, A.J.; Felipe-Lucia, M.R.; Geijzendorffer, I.R.; Jacobs, S.; Martín-López, B.; Arbieu, U.; Speranza, C.I.; Locatelli, B.; et al. Interconnected place-based social-ecological research can inform global sustainability. *Curr. Opin. Environ. Sustain.* **2017**, *29*, 1–7. [CrossRef]
41. Becker, W.; Saisana, M.; Paruolo, P.; Vandecasteele, I. Weights and importance in composite indicators: Closing the gap. *Ecol. Indic.* **2017**, *80*, 12–22. [CrossRef] [PubMed]
42. Serrat, O. The Sustainable Livelihoods Approach. In *Knowledge Solutions*; Serrat, O., Ed.; Springer: Singapore, 2017; pp. 21–26.
43. Dong, Y.; Hauschild, M.Z. Indicators for environmental sustainability. *Procedia CIRP* **2017**, *61*, 697–702. [CrossRef]
44. Coppinger, C.R.; Gorman, M.; Markey, A.; Stanley, D.A. Are indicators useful for measuring and supporting the sustainability of forest use? A Zambian case study. *For. Policy Econ.* **2023**, *149*, 102926. [CrossRef]
45. Meadows, D. Indicators and information systems for sustainable development. In *The Earthscan Reader in Sustainable Cities*, 1st ed.; Satterthwaite, D., Ed.; Routledge: London, UK, 1999; pp. 1–30.
46. Warhurst, A. Sustainability Indicators and Sustainability Performance Management. In *Report to the Project: Mining, Minerals and Sustainable Development (MMSD)*; International Institute for Environment and Development (IIED): Warwick, UK, 2022.
47. Singh, K.R.; Murty, H.R.; Gupta, S.K.; Dikshit, A.K. An overview of sustainability assessment methodologies. *Ecol. Indic.* **2012**, *15*, 281–299. [CrossRef]
48. Nardo, M.; Saisana, M.; Saltelli, A.; Tarantola, S. *Tools for Composite Indicators Building*; European Commission: Brussels, Belgium, 2005.
49. Rocchi, L.; Ricciolini, E.; Massei, G.; Paolotti, L.; Boggia, A. Towards the 2030 Agenda: Measuring the Progress of the European Union Countries through the SDGs Achievement Index. *Sustainability* **2022**, *14*, 3563. [CrossRef]
50. Boggia, A.; Massei, G.; Pace, E.; Rocchia, L.; Paolotti, L.; Attard, M. Spatial multicriteria analysis for sustainability assessment: A new model for decision making. *Land Use Policy* **2018**, *71*, 281–292. [CrossRef]
51. Carone, P.; De Toro, P.; Franciosa, A. Evaluation of urban processes on health in Historic Urban Landscape approach: Experimentation in the Metropolitan Area of Naples (Italy). *Qual. Innov. Prospery* **2016**, *21*, 202–222. [CrossRef]
52. Fusco Girard, L.; Cerreta, M.; De Toro, P. Towards a local comprehensive productive development strategy: A methodological proposal for the Metropolitan City of Naples. *Qual. Innov. Prospery* **2016**, *21*, 223–240. [CrossRef]
53. Malczewski, J.; Rinner, C. *Multicriteria Decision Analysis in Geographic Information Science*; Springer: Berlin, Germany, 2015.
54. Rodenburg, C.A.; Nijkamp, P. Multifunctional land use in the city: A typological overview. *Built Environ.* **2004**, *30*, 274–288. [CrossRef]
55. Peeters, D.; Thomas, I. Location of Public Services: From Theory to Application. In *Models in Spatial Analysis*; Sanders, L., Ed.; ISTE Ltd.: London, UK, 2007; pp. 73–96.
56. Kemp, K.K. Geographic Information Science and Spatial Analysis for the Humanitie. In *The Spatial Humanities: GIS and the Future Humanities Scholarship*; Bodenhamer, D.J., Corrigan, J., Harris, T.M., Eds.; Indiana University Press: Bloomington, MN, USA, 2010; pp. 31–57.
57. Olson, D.L. Comparison of weights in TOPSIS models. *Math. Comput. Model.* **2004**, *40*, 721–727. [CrossRef]
58. Huang, I.B.; Keisler, J.; Linkov, I. Multi-criteria decision analysis in environmental sciences: Ten years of applications and trends. *Sci. Total Environ.* **2011**, *409*, 3578–3594. [CrossRef] [PubMed]

59. Ananda, J.; Herath, A. A critical review of multi-criteria decision making methods with special reference to forest management and planning. *Ecol. Econ.* **2009**, *68*, 2535–2548.
60. D'Auria, A.; De Toro, P.; Fierro, N.; Montone, E. Integration between GIS and Multi-Criteria Analysis for Ecosystem Services Assessment: A Methodological Proposal for the National Park of Cilento, Vallo di Diano and Alburni (Italy). *Sustainability* **2018**, *10*, 3329. [CrossRef]
61. ISPRA. *XIII Rapporto "Qualità dell'Ambiente Urbano"*; ISPRA: Rome, Italy, 2017.
62. Magnaghi, A. *Il Principio Territoriale*; Bollati Boringhieri: Torino, Italy, 2020.
63. Cellamare, C. *Città Fai-Da-Te*; Donzelli Editore: Roma, Italy, 2019.
64. INFC—Inventario Nazionale delle Foreste e dei Serbatoi Forestali di Carbonio (2005–2015). Available online: https://www.sian.it (accessed on 14 June 2022).
65. Schirpke, U.; Scolozzi, R.; De Marco, C. *Modello Dimostrativo di Valutazione Qualitativa e Quantitativa dei Servizi Ecosistemici Nei Siti Pilota; Parte1: Metodi di Valutazione*; Report del Progetto Making Good Natura (LIFE+11 ENV/IT/000168); EURAC Research: Bolzano, Italy, 2022.
66. Jaeger, J.A.G. Landscape division, splitting index, and effective mesh size: New measures of landscape fragmentation. *Landsc. Ecol.* **2000**, *15*, 115–130. [CrossRef]
67. Chailloux, M.; Amsallem, J.; Chéry, J.P. *FragScape v1.0. INRAE*; Ministère de la Transition Ecologique et Solidaire: Paris, France, 2019.
68. Brenner, N. The Hinterland, Urbanized? *AD/Archit. Des.* **2016**, *86*, 118–127.
69. Dryzek, J.S. *Rational Ecology: Environment and Political Economy*; Blackwell: New York, NY, USA, 1987.
70. Obermeyer, N.J. The hidden GIS technocracy. *Cartogr. Geogr. Inf. Syst.* **1995**, *22*, 78–83. [CrossRef]
71. Thatcher, J.; Bergmann, L.; Ricker, B.; Rose-Redwood, R.; O'Sullivan, D.; Barnes, T.J.; Barnesmoore, L.R.; Beltz Imaoka, L.; Burns, R.; Cinnamon, J.; et al. Revisiting critical GIS. *Environ. Plan. A* **2016**, *48*, 815–824. [CrossRef]
72. Pavlovskaya, M. Critical GIS as a tool for social transformation. *Can. Geogr./Le Géographe Can.* **2018**, *62*, 40–54. [CrossRef]
73. Bergmann, L. Towards economic geographies beyond the nature-society divide. *Geoforum* **2017**, *85*, 324–335. [CrossRef]
74. Pavlovskaya, M. Theorizing with GIS: A tool for critical geographies? *Environ. Plan. A* **2006**, *38*, 2003–2020. [CrossRef]
75. Potschin, M.; Haines-Young, R. Landscapes, sustainability and the place-based analysis of ecosystem services. *Landsc. Ecol.* **2013**, *28*, 1053–1065. [CrossRef]
76. De Toro, P.; Formato, E.; Fierro, N. Territorializzare l'Agenda 2030. Un esperimento nel periurbano napoletano. In *Planning-Evaluation. Le Valutazioni nel Processo di Pianificazione e Progettazione*; Cerreta, M., Russo, M., Eds.; Planum Publisher e Società Italiana degli Urbanisti: Roma-Milano, Italy, 2023; pp. 62–69.

land

MDPI

Article

Spatial Liminality as a Framework for Revitalising Dilapidated Abandoned Buildings in Historic Cities: A Case Study

Hamed Tavakoli [1], Massoomeh Hedayati Marzbali [2,*] and Mohammad Javad Maghsoodi Tilaki [3]

[1] Australian Institute of Landscape Architects, Level 1/18 National Circuit, Barton, ACT 2600, Australia; hamed.tavakoli@mail.com
[2] School of Housing, Building & Planning, Universiti Sains Malaysia, Minden, Penang 11800, Malaysia
[3] School of Humanities, Universiti Sains Malaysia, Minden, Penang 11800, Malaysia; maghsoodi@usm.my
* Correspondence: hedayati@usm.my

Abstract: This paper develops the theory of liminality as a guideline for revitalising disused urban fabrics in historic cities. Since Middle Eastern historic cities exist as a transitional phenomenon, spatial liminality is identified as an epistemological tool for their investigation. This paper sets up a mixed-method approach based on questionnaire surveys and field studies in twelve urban blocks in historic Yazd and Kashan. Using an interpretive historical study, it is verified that, during the premodern eras, spatial liminality has been synonymous with the formation of sense of place/citizenship, mainly generated as a result of the existence of in-between spaces in historic cities, which, in turn, could have facilitated the rites of passage for residents. In a quantitative layer, the correlation between dilapidated abandoned buildings (DABs) (i.e., disused urban fabrics) and sense of place/citizenship is investigated in case studies, which unfolds associations that lack of sense of place amongst local communities could convey to the meaning of spatial liminality. The analysis demonstrates DABs are associated with lack of spatial liminality, contributing to the breakdown of sense of community identification/place. Therefore, DABs need to be reutilized while maintaining their heritage values. The discourse identifies in-between spaces that once facilitated spatial liminality and demonstrates a guideline for revitalising historic cities. This study put forward a theoretical contribution that enables the use of spatial liminality to guide the understanding and management of historic cities.

Keywords: dilapidated abandoned buildings (DABs); spatial liminality; territorial interdependence; revitalization; historic city

Citation: Tavakoli, H.; Hedayati Marzbali, M.; Maghsoodi Tilaki, M.J. Spatial Liminality as a Framework for Revitalising Dilapidated Abandoned Buildings in Historic Cities: A Case Study. *Land* **2023**, *12*, 931. https://doi.org/10.3390/land12040931

Academic Editors: Pasquale de Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 22 March 2023
Revised: 15 April 2023
Accepted: 18 April 2023
Published: 21 April 2023

1. Introduction

The transformation of Middle Eastern cities was initiated during the 19th century, where Islamic preindustrial cities started to transform into modern cities. From the 1970s onwards, the proportion of people living in urban areas in the Middle East, particularly in Iran, has risen rapidly. Consequently, historic Middle Eastern cities have become subject to an exogenous phenomenon [1]. Ever since, the historic cores inside a lot of (major or minor) contemporary cities have mainly been subject to gradual decay, with an exodus of population and abandonment of buildings for more than half a century [2]. As a result, today, large areas of historic areas can be considered as dilapidated abandoned buildings (DABs) [3–5]. Today, due to such a vast proportion of DABs, historic cities in the Middle East have been transformed into disaggregated and fragmentary areas that have remained unattended or have been filled by new developments that have inharmonious relationships with surrounding environs. Therefore, DABs and their relevant redevelopment regulations are conceptually challenging, and have been largely neglected within the socio-spatial planning context of historic cities [6,7].

In Iranian historic urban areas, similar to other historic cities in the Middle East, several factors contribute to a lack of sense of belonging to place and citizenship among residents,

which makes original inhabitants leave historic areas [8]. Such lack of sense of place could occur as a result of lack of neighbourhood satisfaction, which may be generated as a result of the rapid growth of poor households, the deterioration of physical structures, the existence of DABs [9,10], or lack of infrastructure and social capital [11]. Moreover, inefficient planning models along with such socio-spatial problems encourage mass emigration of original residents to city fringe developments and generate larger extents of DABs in Iranian historic cities. Consequently, the contemporary correlations between the extent of DABs and the emigration of original residents need to be considered a serious issue [12]. Here, DABs have become a tangible-dependent variable suspended between past and present, which arguably accelerates the formation of socio-spatial vulnerability by creating physical dilapidation and dissatisfaction on the part of residents [9].

Despite great efforts, several factors have caused further segregated and underutilised heritage areas in Iran. First, the revitalisation of historic cities in Iran is not seen as a priority among relevant government agencies, either because of the obsolete image of historic areas among the public or lack of technical and institutional capability to come to grips with such a complex mix of physical and social problems [13]. Second, decision-makers are rarely provided with technical approaches and institutional tools that could demonstrate the viability of alternative, more appropriate models of intervention. This has hastened the development of cities far beyond the historic areas and contributed to an unreasonable urban sprawl [3]. Third, revitalisation programs in historic Iranian cities have been limited to document heritage contexts, providing building regulations, and defining heritage buffer zones. Plans have concentrated on pedestrianisation, place-making, and façade restoration [14]. Fourth, there has been an underlying emphasis on physical linear renewal and delivery of flagship projects as a prevalent approach, mainly employed by the central government [15]. However, various moves toward redevelopment have undermined historic Iranian cities.

Therefore, the broad aim of this research is to provide an innovative method for understanding such socio-spatial vulnerability associated with DABs that can facilitate strategies for revitalising historic cities. This study aims to determine the extent to which liminality can inform revitalisation projects and processes against the formation of DABs. Accordingly, this article focuses on studying the correlation between lack of sense of belonging to the place/citizenship and the extent of DABs, which can be exclusively associated with the transitory–liminal situations related to the emigration of residents.

2. Literature Review

2.1. Theoretical Backgrounds: Socio-Spatial Revitalisation of Historic Cities

Since the 18th century, several global schools of thought have reiterated a need for the revitalisation of heritage sites and cultural properties [11]. The methods of urban revitalisation in historic cities may include several approaches, from mere preservation to physical intervention or a combination of both [16]. Cultural heritage values should direct levels of intervention for the revitalisation of historic cities, and any intervention that would lessen or compromise such values is objectionable and should not occur [17]. It is crucial to understand that the preservation of cultural heritage sites and objects is underpinned by values projected by the public onto essentially inanimate objects that are not static but possess mutable qualities on an intergenerational scale [18].

Since the 1970s, historic cities in the Middle East have undergone a reassessment of their importance [3]. In the 21st century, historic revitalisation is largely associated with city planning and development. Advocates promote preservation as a key driver of urban revitalisation; however, there is a shortage of empirical research that addresses this connection, especially in an Iranian setting [3]. In this respect, the progressive development of regeneration programs created awareness of the impossibility of separating historic centres (either in analytical or in planning terms) from their municipal, territorial, and social contexts, which are linked by mutual, deep relationships [18]. Nonetheless, today, identity generation and empowerment of local communities have become an indispensable

part of any regeneration program, especially in the case of old city centres or other historic environments at risk of abandonment [2].

2.2. Liminality as a Theoretical Tool in Historic Cities

As discussed earlier, the transformation of historic Middle Eastern cities was the result of social-spatial changes caused by the industrial age, despite changes in architectural fabrics occurring naturally and organically during previous centuries [15]. Such socio-spatial disruptions generated an ever-widening chasm between past and future, pulled the present of historic cities apart, and emptied it of many of its essential qualities. Historic areas in Middle Eastern cities can thus be assumed to be entities suspended in-between the premodern and contemporary epochs [9], neither entirely losing their traditional properties (e.g., unique structures/land grains/narrow roads), nor capable of adapting themselves to the surrounding modern built environment. Liminality can thus draw new insights into understanding spatial and temporal transitions between heritage fabrics and spaces of everyday life [6,19]. As a result, liminality is a suitable tool for understanding socio-spatial vulnerability in the context of urban regeneration in historic Iranian/Middle Eastern cities, whereby DABs can meaningfully reflect the liminal qualities of life. Here, a gap in the relevant scholarship is the relationship between the extent of DABs and the formation of socio-spatial vulnerability, which can be examined using spatial liminality [19].

In anthropology, liminality is used as a measure for understanding the vulnerability of individuals or social groups, living in limbo, among (and in interaction with) other human beings [20]. Arnold Van Gennep [21] first coined liminality, upon which he distinguished rites that mark the passage of an individual or social group from one status to another. Following van Gennep, by coining spatial liminality, Thomassen [22] indicated the third dimension of liminality as place, moving beyond the dichotomy of time and event as the foundations of liminality. Thomassen noted van Gennep's specification that liminality is essentially a spatial concept, demonstrating that, perhaps, the physical passage of a threshold somehow preceded the rites that demarcate a symbolic or spiritual passage.

By elaborating on "spatial liminality", Thomassen advanced Karl Jaspers' theory of axial ages, demonstrating that there are substantial grounds to believe that Jaspers' axial age theory could be comprehended using liminality [22], suggesting that in-between spatial positioning could be the primary cause for the simultaneous generation of rites of transition among neighbouring societies.

In addition, Stavrides suggested that in-betweenness can indeed become activated by the unblocking of the paralysed potentialities of a threshold space [23]. He further described how a threshold space can generate socio-spatial conditions in which people undergo the transition from one social identity to another, and suggested that societies explicitly control these transitional periods by regulating rites of passage to ensure that liminal people pass to a different social role without threatening social reproduction [23]. Stavrides believes that such threshold spaces could be marked by experiences of social liminality in which in-between spaces do not merely circumscribe a defined area of use, but instead offer a passage from one social status to another [24].

Thus, in-between places are spaces with the power to institute comparisons and encourage new relations/communications between different people. Here, a threshold space connects and separates individuals at the same time [25]. Thus, thresholds as prearranged structures enable societies symbolically construct their experience of negotiation and, simultaneously, material artefacts that allow negotiations and generational changes to take place [23].

Threshold spaces can thus offer areas for conciliation and encounters with otherness, which may be created between permeable and evolving identities. In this sense, distinctive cultures can infuse/diffuse across borders and among adjacent interdependent communities [26]. Consequently, porous in-between spaces can arguably be seen to be specifically relevant to the formation of spatial liminality by generating socio-spatial interdependence that, in the past, brought meaning to space in Middle Eastern medieval cities/neighbourhoods, and thus be productive of place formation [6].

2.3. The Formation of Liminal Middle Eastern States

In contrast to the condition of modern territorial states, territorialities of medieval states in the Middle East can be clearly described by spatial liminality, characterised by osmotic borders and territorial interdependence that together facilitate rites of passage amongst neighbouring states. In addition, rites of passage are here, as opposed to the physical crossing of borders, including a real-life transition. Therefore, in a historic city, it seems that liminality operates at different scales: civic/communal (e.g., religious groups and subgroups), as well as national and transnational [6].

Generally, in Middle Eastern historic cities, the social interconnections between heterogeneous communities were established by private, blind alleys, or semi-private spaces, such as lanes. Cul-de-sacs were regarded strictly as an extension of the household's private space and could be a place for social interaction between local women and children [27]. As citizens moved from blind alleys to lanes, social relations increased from extended families (or several related families) in blind alleys to more diverse families in semi-private lanes (Figure 1). As residents bypassed these lanes and passages, they became concentrated in small squares that caused even more collisions and formed subsequent social relations amongst diverse neighbourhoods [28].

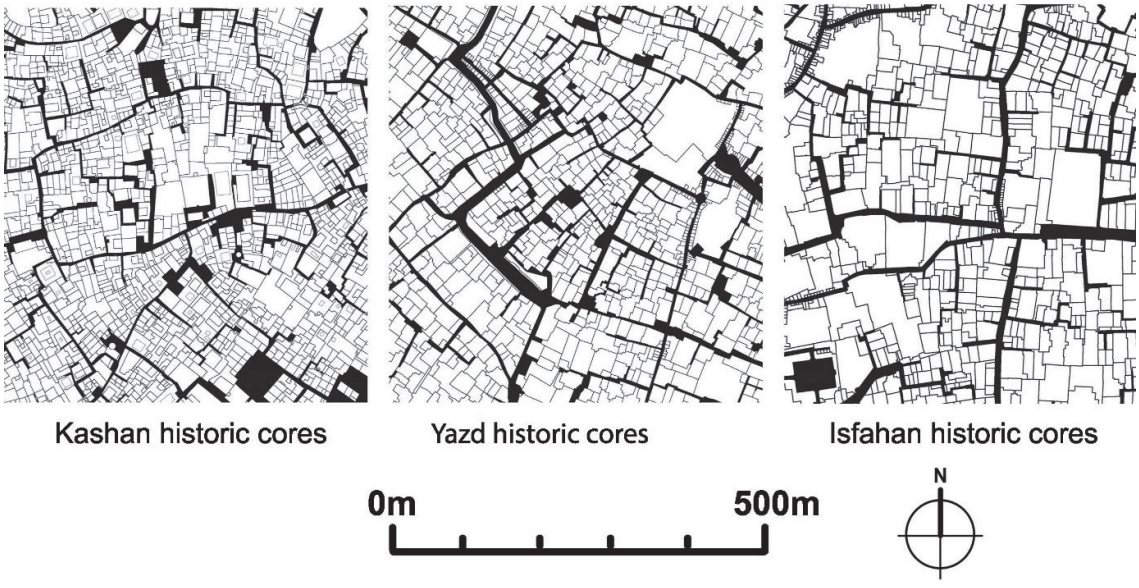


Figure 1. The cul-de-sac worked as a semi-private space in historic Iranian cities, while tiny squares provided access to dwellings and generated social groupings. Maps show the somehow untouched condition of these cities in 2018 [6].

Therefore, public and semi-public roads could accommodate interneighbourhood interactions, thanks to adjacent shops, mosques, caravanserai, schools, and other public spaces, which made such small communities/neighbourhoods interdependent [29]. As a result, most urban traffic used major thoroughfares, roads, and in-between spaces to link important areas for commercial or religious purposes, while neighbourhoods were accessible only by immediate cohorts in a distinct community (Figure 2) [30]. Consequently, diverse communities could establish intergroup negotiations and have access to communal spaces, namely public squares, neighbourhood centres, bazaars, mosques, and schools, using connecting roads [27].

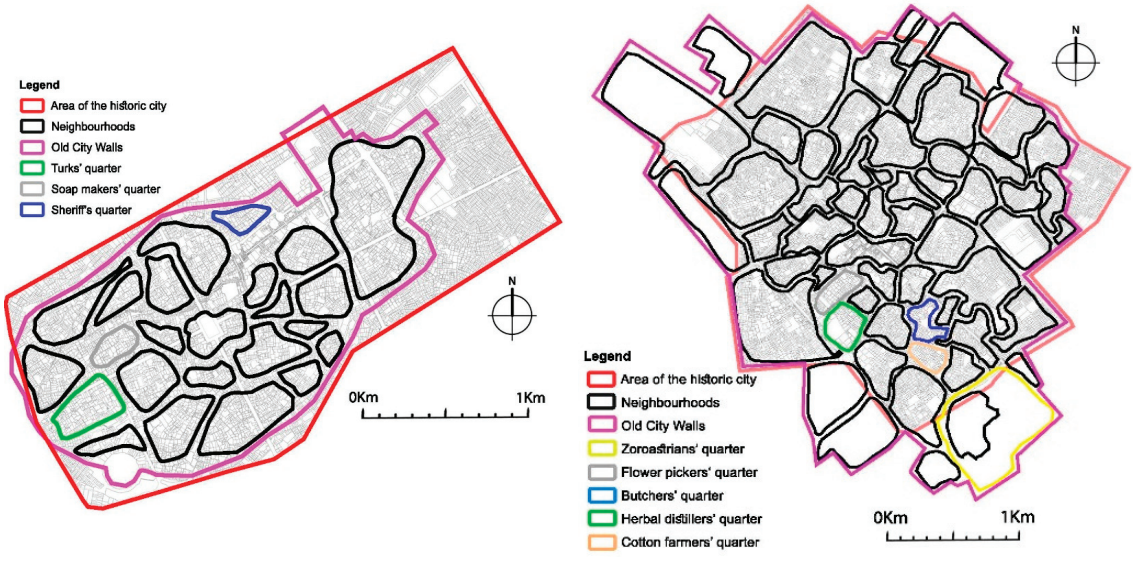


Figure 2. Heterogeneous neighbourhoods in the medieval city of Yazd (**right**) and Kashan (**left**) were formed as a result of the accumulation of people with mutual religious identities or similar types of occupations in one place [31].

From a road network system perspective, in historic cities, three types of roads are identifiable: firstly, public roads that connected major neighbourhoods and could be extended as traditional bazaars or stretched to a city gate; secondly, semi-public roads that interconnected public roads and facilitated access to neighbourhoods, including local shops, which also served as a neighbourhood centre for social interaction, a playground for children, and/or a stage for jugglers or street vendors; and thirdly, dead-end alleyways, or semi-private roads branched out from semi-public roads, that provided access to a cluster of private houses [14]. Not unlike roads, the territorial implication of open spaces in historic cities is apparent in the functionality of in-between spaces (e.g., courtyards) and across scales, containing private, semi-private, and public areas in historic cities [32]. In a historic Middle Eastern city, courtyards facilitated multipurpose spaces for communal relations, group games, social entertainment, religious rituals, commercial activities and trades, ceremonial events, and interneighbourhood collaborations/negotiations. A courtyard could have facilitated socio-ethical arrangements for extended families (or smaller social groups) to live mutually around a semi-private threshold space. Here, in-between spaces tend to generate complex borders among neighbourhoods, while in most cases, these boundaries are not accurate [31]. Within a traditional neighbourhood, small courtyards in cul-de-sacs functioned as semi-private spaces, used by all the inhabitants of surrounding dwellings for social and recreational activities. These tiny squares, surrounded by and providing access to dwellings/buildings in old cities, generated social values by enhancing socio-spatial associations between residents (Figure 3) [27].

Therefore, those hierarchical divisions arguably reflect that in-between spaces somehow facilitated spatial liminality inside neighbourhoods within historic cities during the medieval era and became porous membranes that led to the facilitation of the rites of passage among social groups (Figure 4) [31].

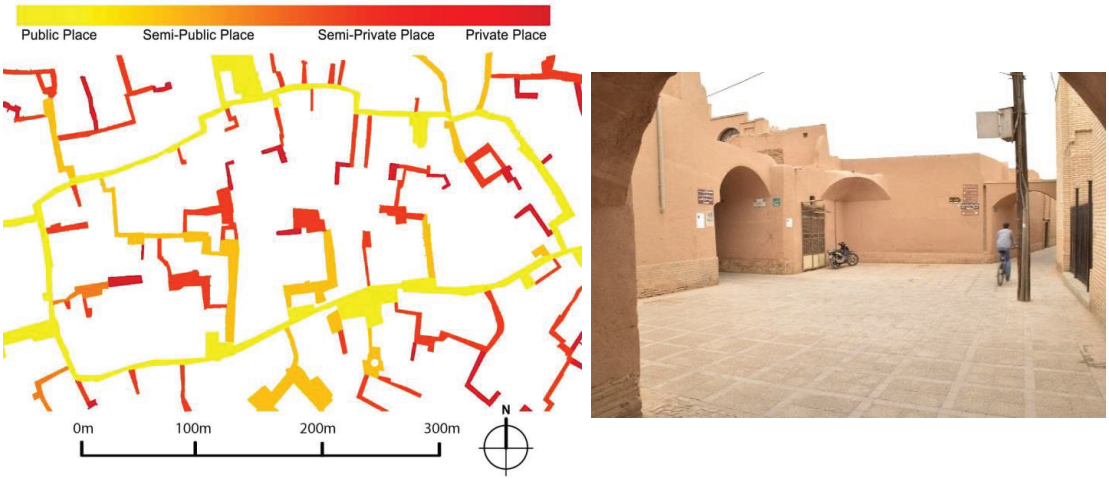


Figure 3. Hierarchical in-between spaces and the formation of spatial liminality in historic Kashan [31].

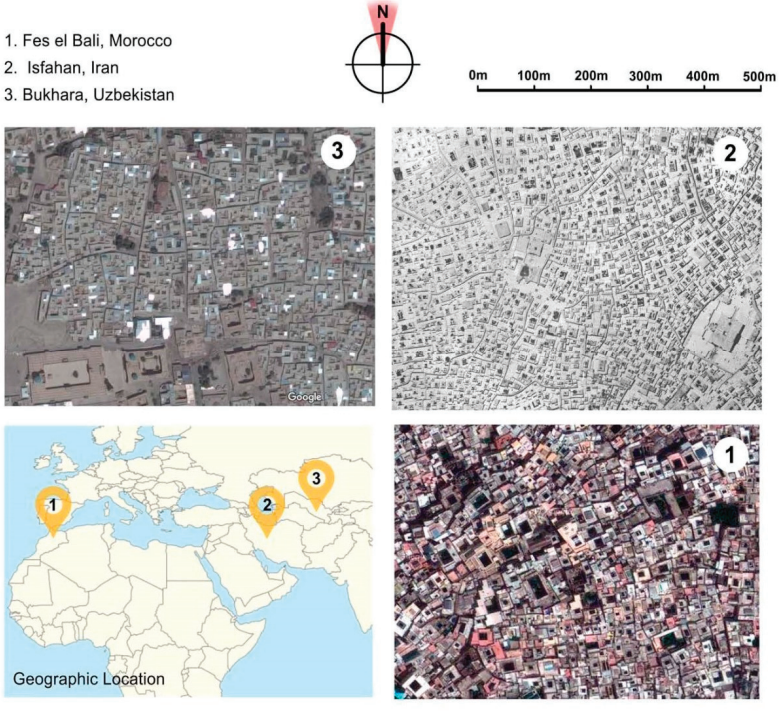


Figure 4. The morphology of courtyard structures in Middle Eastern and North African cities [31].

2.4. Social Aspects of Spatial Liminality

Spatial aspects of liminality as a substructure for social interaction involve widespread social ramifications that emerge once people cross a threshold [33]. In this respect, social aspects of liminality in historic cities had been relevant to the formation of sense of place, engendered by socio-spatial exchanges, that may occur within in-between spaces.

The design of those cities thus reinforced the sense of citizenship by implementing special zoning practices, including building semi-private quarters or blocks allocated to cohorts according to their ethnic/citizenship origin. Accordingly, such neighbourhood zoning became socially ideal, as each social group was accustomed to maintaining strong ties between its members, preferring to live in a territory close to each other. However, the implication of such communitarian design practices, e.g., neighbourhood zoning (that generated the territoriality of social groups), and the consequent intergroup negotiations/relations (via in-between spaces) fostered multiple communities in historic cities to live together, which culminated in medieval diversity [34].

Based on the above discussion on liminality, it could be assumed that rites of passage (generated via spatial liminality) for communities, as described by Thomassen [33], had occurred as a consequence of socio-spatial intergroup relationships within threshold spaces, which occurred amongst social groups (made up of individual citizens) separated by spatial territorialities. Here, Thomassen's [33] discussion regarding in-between spatial positioning, in-between spaces, and the formation of interacting/liminal societies as signifying territorial interdependence, is not dissimilar to what Stavrides [35] described as "heterotopia", by which he refers to interdependent places that maintain osmotic boundaries/territorialities while generating porous urban spaces, suitable for "acts of encounter" between communities. Stavrides refers to Foucault's assertion that "heterotopias always presuppose a system of opening and closing that isolates them and makes them penetrable at one and the same time": those "other places", therefore, are simultaneously connected to and separated from the places from which they differ [35]. Here, such resemblances between descriptions of the two thinkers of liminality (Thomassen and Stavrides) verify that rites of passage in both cases could represent spatial liminality as specified in this article, must have at least five intrinsic qualities: Firstly, within heterotopia, medieval Middle Eastern states/neighbourhoods and centres of axial ages, several unique social groups need to coexist. Secondly, individuals within such distinct social groups receive a special membership in terms of being a right-bearing citizen of the community. Thirdly, such heterogeneous communities should be bounded by specific territorialities that make certain places different from other places [5]. Fourthly, for the survival of such social groups, different socio-spatial interactions need to be established. Fifthly, (and most importantly in our discussion) the existence of threshold and osmotic (in-between) spaces becomes necessary for the improvisation of such socio-spatial interactions. Such qualities clearly show the relational status of spatial liminality in heterotopia, medieval Middle Eastern states/cities and identity societies of an axial age (Table 1).

Table 1. Five essential elements of spatial liminality, as developed in this paper.

Components of Spatial Liminality	Heterotopia	Axial Ages	Middle Eastern States	Neighbourhoods in Middle Eastern Cities
Citizenship/membership	Membership of the heterotopia as opposed to the surrounding spaces of normality.	Membership of a specific civilization or religion	Membership of a specific state	Membership of a specific neighbourhood/community
Formation of interdependent social/identity groups	Social groups in neighbourhoods	Larger societies, nationalities	Interdependent states	Interdependent neighbourhoods/communities
Formation of territoriality	Physical areas inside the boundaries of neighbourhoods	Continents, countries or larger geographic–ethnic regions	Countries and States	Physical areas inside the boundaries of neighbourhoods
Formation of socio-spatial interactions	Interneighbourhood relationships (e.g., trades, negotiations, games, etc.)	International discourses, large-scale wars, trades, and religious debates	Interstate discourses, regional wars, trades, and religious debates	Interneighbourhood relationships (e.g., trades, negotiations, games, etc.)
In-between/threshold spaces as places of negotiation/interactions	In-between public spaces among neighbourhoods	Thresholds in-between countries (e.g., Mesopotamia)	In between boundary zones	In-between public spaces among neighbourhoods (e.g., roads and courtyards)

3. Materials and Methods

The current research aims to analyse complex issues within the boundaries of historic cities; therefore, a mixed methodology is proposed. Initially, following the approach of Creswell (2003), the current inquiry includes characteristics of interpretive historical research by making use of multiple historic sources of evidence covering spatial liminality. Here, case study research can also be used as an empirical inquiry that inspects a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident [36]. The research questions were addressed using street surveys and field observation to reveal the associations that lack of sense of belonging to a place could convey to the meaning of spatial liminality in Yazd and Kashan. For measuring sense of belonging to place/citizenship associated with DABs, several quantifiable tools are proposed in this inquiry, including the percentage of areas occupied by local residents, the percentage of DABs (i.e., independent variables), as well as questionnaires measuring levels of sense of place satisfaction amongst local residents (as dependent variables) in all case studies.

3.1. Case Study Selection

The case study selection procedure in this research aims to cover a wide range of population densities in historic Iranian cities. Thus, historic Kashan and Yazd were selected as larger case studies that accommodate lower and mid-range populations, respectively, while possessing the largest areas of urban heritage areas in Iran (Figure 5).

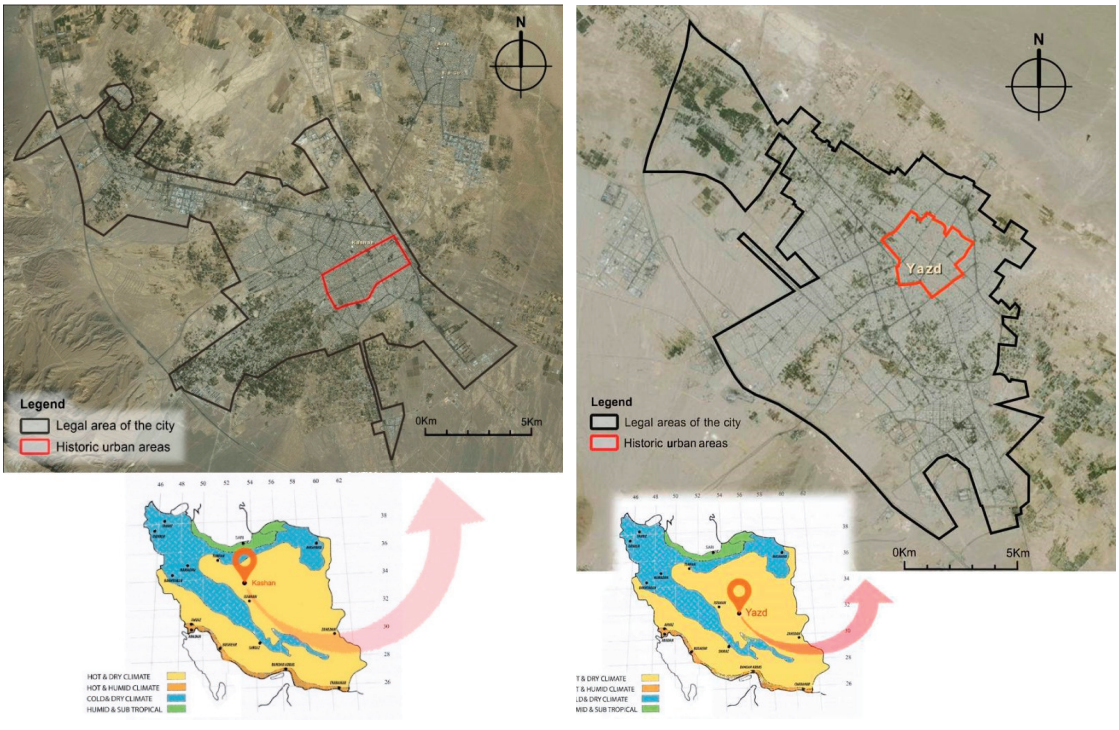


Figure 5. Historic urban areas within the contemporary city of Kashan (**left**) and Yazd (**right**) [31].

At the next level, the selection procedure aims to capture the maximum variation of DABs in historic cities, thus singling out urban tissues with higher, medium, and lower percentages of DABs in Yazd and Kashan. Accordingly, Darb-i-Isfahan, Mohtasham, and

Posht-i-Mashhad-i-paeen are selected as urban tissues that, respectively, developed higher (27%), medium (15%), and lower (4%) percentages of DABs in Kashan as previously measured by Mirmiran [12]. Godal-i-Mosalla, Dolat-Abad, and Gonbad-i-Sabz were also selected as urban tissues that, respectively, developed higher (25%), medium (17%), and lower (10%) percentages of DABs in Yazd, as calculated by Behzadfar [11].

After selecting a variety of urban tissues (that characterise a broad range of DABs), smaller urban elements need to be investigated as tangible case studies. In Middle Eastern historic cities, an urban block could be conceived as a group of several dwellings including semi-private and in-between spaces [27]. Such clusters thus best represent the smallest identifiable urban component that forms traditional neighbourhoods, known as urban blocks [37].

Consequently, two urban blocks were nominated in each selected tissue, which should have developed a higher and lower percentage of DABs per urban block, to capture the maximum variation of disused areas. The selection criteria were based on two logical aspects: (1) the reliable size of urban blocks (should have areas between 15,000 to 60,000 m^2) and (2) the intaction quality of roads and physical structures, which can indicate public segregation, as a result of lack of vehicular accessibility. Consequently, twelve sample blocks were chosen for further investigation. Among all selected cases, six blocks are positioned in Kashan (B-1 and B-2 in Darb-i-Isfahan, B-15 and B-16 in Mohtasham, B-3 and B-5 Posht-i-Mashhad-i-paeen urban tissues), as calculated by Mirmiran [12] (Figure 6 (left)). Another six blocks are located in Yazd including Godal-i-Mosalla (B-30 and B-43), Dolat-Abad (B-9 and B-28), and Gonbad-i-sabz (B-8 and B-47) urban tissues, as measured by Behzadfar [11] (Figure 6 (right)).

Figure 6. The seven urban tissues of historic Kashan as surveyed by Mirmiran (2011) (**left**) and the eight urban tissues of historic Yazd based on Behzadfar [11] (**right**).

3.2. Data Collection

Two primary methods of data collection were implemented, namely questionnaire surveys and field observations. Consequently, two categories of data were gathered, namely spatial and attitudinal. Spatial data were collected using field studies along with the observation of nonparticipant behaviours, aimed at exploring the extent of local Iranian settlements against the proportion of DABs in selected urban blocks. Attitudinal items ask for the respondent's attitudes and perceptions on sense of belonging to the place/citizenship. In Iranian historic areas, residents can be classified into two major groups: (a) refugees or

non-Iranian disadvantaged communities, and (b) local Iranian-born residents [6]. To avoid complications, in this article, the second group is recognised thus as the subject of spatial liminality in historic cities, although in many circumstances, non-Iranian residents could also be liminal.

Data were gathered based on five questions and in line with what Behzadfar [11], Mirmiran [12], and Tavassoli [38] suggested—previous definitions that can measure spatial liminality:

- "Why did you move to historic areas?" highlights lesser levels of sense of belonging to place amongst residents by identifying people who have settled in purely for occupying cheaper housing opportunities.
- "What are the most chronic problems in historic areas?" and "what does make your neighbourhood unsafe?" represent residents' perceptions regarding the sense of place satisfaction.
- "What do you think about dilapidated abandoned buildings?" signifies the sense of place satisfaction amongst local residents regarding DABs that characterize a real or perceived lack of safety.
- "Do you swap house to reach an equal accommodation option outside historic areas?" reflects a sense of place identity among residents.

Since the average number of properties (i.e., statistical subject matter in this research) in each sample block can reach about 100, the overall statistical target population reached about 1200, wherein street surveys should be conducted. In a statistical target setting with a population of about 1200, the optimal sample size of about 120 properties (10% of the overall statistical population) seems reliable [39]. Thus, street surveys were conducted among residents of 141 properties including 61 residences in Kashan and 80 residences in Yazd. This research includes street surveys; therefore, ethical approval, from human participants was sought (see Appendix A).

4. Results

By making use of historical sources and nonquantifiable information, this research involves a detailed examination of the theory of spatial liminality and its relationship with in-between spaces and sense of place amongst residents in historic cities in Iran during the middle ages. Earlier in this article, using an interpretive historical study and literature review, it was demonstrated that spatial liminality is synonymous with the formation of sense of place/citizenship, mainly generated as a result of the existence of in-between spaces, such as courtyards and roads in traditional neighbourhoods. In the spatial layer, this article focused on the percentages of DABs and their correlation with sense of belonging to place citizenship among Iranian-born residents in each urban block. In a cluster analysis, the average percentage of areas occupied by local Iranian-born residents showed a reverse correlation with the extent of DABs in Yazd and Kashan. In all sample blocks, the average size of areas occupied by Iranian-born residents became higher when the percentage of DABs was reduced. Such quality demonstrates the deleterious effects of DABs, upon which sense of belonging was weakened, encouraging further emigration of residents and shrinking the size of areas occupied by local populations (Table 2).

Table 2. Analysing aspects of spatial liminality of DABs in 12 case studies.

Levels of DABs	The Average Percentage of Areas Occupied by Local Iranian Residents	Surveyed Blocks
Historic Kashan (average percentage of local settlements per urban block)		
High 44% < DABs	48% (Lowest)	(B-1 and B-15)
Medium 21% < DABs < 44%	58% (Medium)	(B-2 and B-3)
Low DABs < 21%	78% (Highest)	(B-16 and B-5)
Historic Yazd (average percentage of local settlements per urban block)		
High 39% < DABs	42% (Lowest)	(B-43 and B-8)
Medium 32% < DABs < 39%	62% (Medium)	(B-30 and B-28)
Low DABs < 32%	74% (Highest)	(B-9 and B-47)

In the attitudinal layer, the majority of respondents in Kashan (65.6%) reported that accessing cheaper housing opportunities was the major reason for their immigration to historic areas. On the contrary, less than half of the respondents in Yazd (43.7%) reported that the existence of cheaper housing opportunities was the main reason for their immigration to historic zones. The results from respondents in Kashan confirm previous studies, where Behzadfar [11], Mirmiran [12], and Tavakoli [31] suggested that the existence of cheaper housing opportunities is the major reason for the immigration of vulnerable refugees and disadvantaged communities to historic areas. A cluster analysis of the percentage of socio-spatial concerns (stated by participants) demonstrates that lack of sense of belonging to place (arguably generated as a result of lack of spatial liminality) can be a prevalent problem in historic urban areas, which is closely related to the larger extents of DABs (Tables 3 and 4). Here, a descriptive analysis indicates that a large proportion of residents in Kashan have moved to historical areas for accessing cheaper housing options that may have developed little or no sense of belonging to the place. The results outlined that levels of such lack of sense of place (arguably generated as a consequence of lack of spatial liminality) are strongly correlated to the proportion of DABs in Kashan. The analysis reiterates that levels of sense of place identity among local residents (which arguably equates to spatial liminality) in historic sample blocks of Yazd and Kashan are extremely low, and have become independent of DABs.

Table 3. Analysing aspects of spatial liminality in 12 urban blocks.

Historic Kashan (Local Residents' Concerns)								
Levels of DABs	Access cheaper housing options	Lack of public security	Existence of DABs	DABs must be reutilized	Pests and vermin	Foreign refugees	I Will leave my house	Surveyed blocks
High 44% < DABs	69% (High)	31% (High)	85% (High)	69% (High)	8% (High)	17% (High)	77% (High)	(B-1 and B-15)
Medium 21% < DABs < 44%	61% (Medium)	14% (Medium)	64% (Medium)	73% (Medium)	10% (Medium)	10% (Medium)	90% (High)	(B-2 and B-3)
Low DABs < 21%	49% (Low)	11% (Low)	69%	43% (Low)	0% (Low)	0% (Low)	73% (High)	(B-16 and B-5)

Table 4. Analysing aspects of spatial liminality in 12 urban blocks.

Historic Yazd (Local Residents' Concerns)									
Levels of DABs	Lack of public security	Existence of DABs	DABs must be reutilized	DABs are dangerous	Pests and vermin	Foreign refugees	Addicts or criminals	I Will leave my house	Surveyed blocks
High 39% < DABs	63% (High)	83% (High)	70% (High)	74% (High)	15% (High)	40% (High)	68% (High)	65% (High)	(B-43 and B-8)
Medium 32% < DABs < 39%	45% (Medium)	71% (Medium)	49% (Low)	54% (Medium)	13% (Medium)	20% (Medium)	42% (Medium)	57% (High)	(B-30 and B-28)
Low DABs < 32%	23% (Low)	74% (Medium)	49% (Low)	23% (Low)	0% (Low)	14% (Low)	34% (Low)	67% (High)	(B-9 and B-47)

A chi-square test of independence also suggested that the proportions of residents who have moved into historic areas to access cheaper housing options are significantly related to the extent of DABs in Kashan ($\chi^2(1, n = 61) = 11.100$, $p < 0.05$) but not in Yazd ($\chi^2(1, n = 80) = 10.439$, $p > 0.05$). The analysis reiterates that residents may have developed little or no sense of belonging to the place ($\chi^2(1, n = 141) = 6.621$, $p < 0.05$). However, the results show no significant relationship between the sense of belonging/attachment to the place (as indicated by residents wishing to emigrate from the historic areas) and the extent of DABs in historic cities ($\chi^2(1, n = 141) = 2.948$, $p > 0.05$). This, in turn, may be related to the unclear nature of this question requiring cautious and sometimes unreal answers to be proposed by vulnerable respondents. Additionally, in both Yazd and Kashan, there were no significant relationships identified between other reasons for immigrating to historical areas, such as closeness to work or friends and families ($\chi^2(1, n = 141) = 0.004$, $p > 0.05$), accessibility to other districts ($\chi^2(1, n = 141) = 3.167$, $p > 0.05$), and other factors

($\chi^2(1, n = 141) = 2.373$, $p > 0.05$). This, in turn, also reiterates the lack of sense of place (or perhaps lack of spatial liminality) amongst residents in the selected historic areas.

In all case studies, there are meaningful grounds upon which to believe that the percentage of residents' concerns regarding (a real or perceived) lack of public safety ($\chi^2(1, n = 141) = 12.537$, $p < 0.05$), the stated problems associated with DABs ($\chi^2(1, n = 141) = 4.128$, $p < 0.05$), and the presence of foreign refugees ($\chi^2(1, n = 141) = 13.103$, $p < 0.05$), as well as a local demand that DABs must be reutilized ($\chi^2(1, n = 141) = 5.138$, $p < 0.05$) are correlated to the extent of DABs. This, in turn, reconfirms the lack of sense of place/citizenship accompanied by the absence of spatial liminality amongst respondents in relevant historic areas. The results also show a significant relationship between (a perceived or real) lack of security and the proportion of DABs in Yazd ($\chi^2(1, n = 80) = 10.717$, $p < 0.05$), but not in Kashan ($\chi^2(1, n = 61) = 2.494$, $p > 0.05$). It is also evident that the percentage of concerned residents who believe DABs are dangerous (due to attracting antisocial behaviours) is closely related to the extent of DABs per urban block in Yazd ($\chi^2(1, n = 80) = 5.952$, $p < 0.05$).

The results along with the data triangulation and analysis suggest that today's lack of spatial liminality in targeted historic areas has contributed to a lack of sense of place, identity, and citizenship amongst residents, which, in many circumstances, are strongly related to the extent of DABs in historic areas. The results and analysis advocate the second assumption that the existence of DABs (as a tangible aspect) could be strongly related to the lack of spatial liminality within the studied urban blocks, the absence of which can further eradicate historic cities.

5. Discussion

Due to such a vast proportion of DABs in Iranian historical cities, this study aimed to determine the extent to which liminality can inform revitalisation projects and processes against the formation of DABs. The findings in this research contribute to exploring the role of place as the third dimension of liminality along with time and event, as proposed by van Gennep [21]. The discussion draws upon van Gennep's theory of liminality along with Thomassen's [33] spatial liminality and Stavrides' social liminality [35], positioning liminality as an emancipatory theoretical and analytical framework, to interpret the nature and meaningfulness of life in historic cities. The discourse investigates the vulnerability of citizens in real-life events, which (in line with Van Gennep's notion of liminality) develops a post-structuralist approach for analysing conditions of liminality that can be seen as empirical, lived reality in social science [20]. The theoretical contribution as proposed here brought about a perspective where spatial liminality can be utilised as a guideline for understanding and handling historic cities.

By comparing liminal structures of axial ages [33] with the concept of territorial interdependence [26,35], it was found that the socio-spatial trade-offs amongst social groups on a larger scale had arguably generated spatial liminality, indicating real-life transitions in medieval Iranian cities. In addition, the result revealed that, in Iranian historic cities, heterogeneous communities had recurrently become liminal and undergone their rites of passage in conjunction with their adjacent neighbouring communities.

Correspondingly, qualitative interpretive analysis suggested that the correlation between several aspects of spatial liminality (i.e., sense of place, citizenship, territoriality, and identity amongst residents) and the formation of in-between spaces was significant during premodern eras in Iranian historic cities. This result is in agreement with those of a number of previous studies [11,12,27]. The quantitative analysis demonstrated that the present-day correlation between the extent of DABs and lack of spatial liminality (i.e., the current lack of sense of belonging to place/citizenship) amongst residents is substantial too. This reveals multifaceted associations that a sense of belonging to place/citizenship, the disposition of in-between spaces, and the existence of DABs could convey to the existence of spatial liminality amongst residents in historic areas and within the larger context of contemporary Iranian and perhaps Middle Eastern cities (Figure 7).

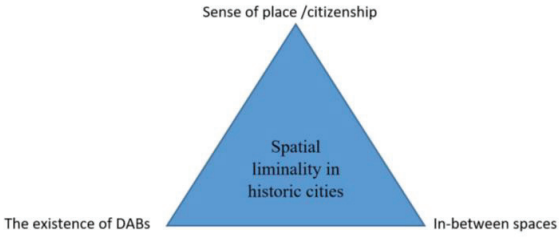


Figure 7. Current multifaceted associations could change levels of spatial liminality in historic cities.

Spatial liminality encouraged the formation of interdependent neighbourhoods, built security and sense of place/citizenship in the district, and effectively promoted communal participation, which generated self-growing public institutions. Regarding the theoretical implications of this study, the research reiterates a theory that emigration from historical neighbourhoods has arguably destabilised and displaced such pre-existing socio-spatial ecosystems by weakening present day spatial liminality. As spatial liminality discloses socio-spatial mechanisms, its formation can enhance social life and encouraging residents to meet personal needs through collective life [40]. Therefore, the formation of social groups in such neighbourhoods has been observed as a progressive aspect in Middle Eastern cities that has somehow secured life for multiple minorities by generating spatial liminality. This study's findings indicate that such positive socio-spatial qualities relevant to spatial liminality no longer exist (or only exist in fragmentary cases) in historic cities today, due to the emergence of contemporary urban transformation [41]. Here, along with Behzadfar [11], the current study found that current urban problems and the existence of DABs can encourage further emigration of local residents, and culminates in the formation of larger extents of DABs.

As spatial liminality represents a new approach beyond contemporary revitalisation methods, it can contribute to generalising socio-spatial problems and revealing historic city realities. Here, the major reason for the formation of DABs in historic urban areas is the emigration of local residents due to current urban problems, lack of spatial liminality, and the lack of sense of place/identity. The ramification of such emigration proved to be correlated with the formation of further DABs, which consequently encourages more families to abandon their properties.

This study's findings demonstrate that DABs are strongly associated with lack of spatial liminality, the absence of which amounts to a breakdown in community identification and sense of place/citizenship, which can further eradicate historic cities. Regarding the practical implication of this study, morphologically informed design methods need to be developed, particularly in historic areas where there is no reasonable economic stimulation for transforming DABs to reasonable in-between public spaces for re-establishing socio-spatial interactions and the consequent spatial liminality. In this sense, this paper acknowledges a need for replacing DABs with morphologically informed courtyards with regard to the revitalisation of historic cities. Hence, the proposition of such in-between public courtyards/roads can arguably facilitate rites of passage for local residents (as opposed to the physical crossing of borders), including a real-life transition contributing to the sense of community identification and sense of place/citizenship.

6. Conclusions

The decay of historic cores within contemporary cities, the exodus of population, and the abandonment of many buildings have resulted in large portions of historical areas being transformed into dilapidated abandoned buildings (DABs). Spatial liminality, along with mapped DABs, informs us that the percentage and distribution of DABs increased by an average of 14% between 2008 and 2018, proving that current revitalisation processes are inefficient; have lagged far behind a deleterious phenomenon; and have been linear,

physical, and mostly concentrated on freestanding interventions, rather than considering grassroots of social life. In response to this problem, this research proposed an original methodology for understanding socio-spatial vulnerability in historic Middle Eastern cities (focusing on the Iranian context) by proffering a specific focus on the correlation between DABs and spatial liminality. The results and analysis section compared several types of correlation between dependent and independent variables of spatial liminality in historic cities in Iran.

By discovering the correlation between lack of spatial liminality (that can encourage the emigration of residents) and the higher proportion of DABs, this study's findings indicated that the association between revitalisation programs and liminal conditions in the context of historic cities of Iran proved to be crucial. Through the lens of spatial liminality, it was suggested that DABs act as a deleterious phenomenon, which could pertain to a lack of sense of belonging, citizenship, and place identity among residents. This redresses a gap in the knowledge; that is, understanding spatial liminality and its social, cultural, physical and financial implications must be seen as a significant prerequisite for the proposition of revitalisation programs in all Iranian and perhaps Middle Eastern historic cities. In fact, this study demonstrated how spatial liminality offers a practical guideline for forming a strong sense of belonging to place and citizenship in historic cities. Subsequently, the findings confirmed past studies' results that residents' sense of belonging can be the driving force for revitalisation programmes. In this respect, the research outcomes also line up with the contemporary literature, where revitalisation of historic cities has become a holistic matter, to be highly associated with larger city planning and social development schemes. The research also opens up innovative opportunities for practitioners and policymakers to be provided with new integrated types of regulations and programs, which are equally legible among governmental layers, and can directly address infill building practices inside historic cities.

By highlighting the current and previous spatial arrangements of traditional fabrics, the research results revealed that when DABs do not include significant/registered heritage buildings, it is best to reutilise them, either by implementing building restoration or by creating new morphologically and socioeconomically informed infill developments in historic cities that can meet local/regional needs. Nonetheless, in line with liminality of DABs, this paper acknowledges that other cultural, social, and financial implications of disused buildings need to be further scrutinised to improve the theory of spatial liminality in conjunction with spatial cultural affairs. In this respect, the rehabilitation of DABs should consider restoration and rehabilitation in place and unchanged, as well as revitalisation using the provision of social and economic services. In this regard, studies on cultural aspects of spatial liminality can become detrimental to future research that pursues the implementation of in-between spaces as a morphologically informed method for the socio-spatial revitalisation of historic cities. These aspects are necessarily related to larger political, spatial, and commercial arrangements pertaining to the implementation of socially sustainable architecture, appropriate change in land use, and adaptive reuse of existing structures, as well as generating affordable housing and employment opportunities for local communities in historic cities.

The current research undertook case studies in 12 urban blocks, within six urban tissues, in two historic cities of Iran. Street surveys were also conducted among 141 participants. In the current research, the number of local Iranian residents who participated in street surveys would seem to be insufficient, especially for reaching reliable outcomes that can be generalised in historic cities of Iran. Therefore, a larger number of case studies and participants need to be investigated. The theory of liminality, as discussed here, can be further developed by studying spatial liminality in historic cities in countries other than Iran. In this case, reference to the field research on sub-cultures in different historic Middle Eastern cities could provide a rich context for conducting further exploration on spatial liminality. The theory can be further developed by studying spatial liminality in other historic cities in Europe, Oceania, Asia, Africa, and America.

Author Contributions: Conceptualization, H.T.; methodology, H.T. and M.H.M.; validation, H.T.; formal analysis, H.T. and M.H.M.; investigation, M.J.M.T.; resources, H.T., M.H.M. and M.J.M.T.; data curation, H.T.; writing—original draft preparation, H.T. and M.H.M.; writing—review and editing, M.H.M. and M.J.M.T.; visualization, H.T.; funding acquisition, M.H.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Universiti Sains Malaysia and the Ministry of Higher Education Malaysia (grant number FRGS 203.PPBGN.6712098).

Institutional Review Board Statement: This study was conducted according to the guidelines of the University of Adelaide, and approved by the Office of Research Ethics, Compliance, and Integrity, The University of Adelaide (protocol code H-2018-047 on 9 March 2018).

Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: The authors would like to thank the Universiti Sains Malaysia and the Ministry of Higher Education Malaysia for providing financial support.

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

Appendix A

Appendix A: Ethics approval

THE UNIVERSITY of ADELAIDE

RESEARCH SERVICES
OFFICE OF RESEARCH ETHICS, COMPLIANCE AND INTEGRITY
THE UNIVERSITY OF ADELAIDE

LEVEL 4, RUNDLE MALL PLAZA
50 RUNDLE MALL
ADELAIDE SA 5000 AUSTRALIA

TELEPHONE +61 8 8313 5137
FACSIMILE +61 8 8313 3700
EMAIL hrec@adelaide.edu.au

CRICOS Provider Number 00123M

Our reference 32794

09 March 2018

Associate Professor Julian Worrall
School of Architecture & Built Environment

Dear Associate Professor Worrall

ETHICS APPROVAL No: H-2018-047
PROJECT TITLE: Application of spatial liminality in urban design, towards an approach for revitalising unexploited land areas historical Iranian cities

The ethics application for the above project has been reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions) and is deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research (2007)* involving no more than low risk for research participants.

You are authorised to commence your research on: 09/03/2018
The ethics expiry date for this project is: 31/03/2021

NAMED INVESTIGATORS:

Chief Investigator:	Associate Professor Julian Worrall
Student - Postgraduate Doctorate by Research (PhD):	Mr Hamed Tavakoli
Associate Investigator:	Mr Ehsan Sharifi
Associate Investigator:	Dr Nigel Westbrook

CONDITIONS OF APPROVAL: The revised application provided 06.03.2018 and the revised table 1 and table 7 provided 08.03.2018 have been approved.

Ethics approval is granted for three years and is subject to satisfactory annual reporting. The form titled Annual Report on Project Status is to be used when reporting annual progress and project completion and can be downloaded at http://www.adelaide.edu.au/research-services/oreci/human/reporting/. Prior to expiry, ethics approval may be extended for a further period.

Participants in the study are to be given a copy of the information sheet and the signed consent form to retain. It is also a condition of approval that you immediately report anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants,
- previously unforeseen events which might affect continued ethical acceptability of the project,
- proposed changes to the protocol or project investigators; and
- the project is discontinued before the expected date of completion.

Yours sincerely,

Dr Anna Olijnyk
Convenor

Dr Jungho Suh
Convenor

The University of Adelaide

References

1. Bican, N.B. Public mass housing practices in Turkey: The urgent need for research-based spatial decision-making. *J. Hous. Built Environ.* **2020**, *35*, 461–479. [CrossRef]
2. Tanrıkul, A.; Hoşkara, Ş. A new framework for the regeneration process of Mediterranean historic city centres. *Sustainability* **2019**, *11*, 4483. [CrossRef]
3. Tavakoli, H.; Marzbali, M.H. Urban Public Policy and the Formation of Dilapidated Abandoned Buildings in Historic Cities: Causes, Impacts and Recommendations. *Sustainability* **2021**, *13*, 6178. [CrossRef]
4. Farhad, S.; Maghsoodi Tilaki, M.J.; Hedayati Marzbali, M. Returning to historic neighborhoods: Exploring the role of architectural identity elements on the formation of physical identity. *Hous. Care Support* **2022**, *25*, 90–106. [CrossRef]
5. Hosseini, A.; Finn, B.M.; Momeni, A. The complexities of urban informality: A multi-dimensional analysis of residents' perceptions of life, inequality, and access in an Iranian informal settlement. *Cities* **2023**, *132*, 104099. [CrossRef]
6. Tavakoli, H.; Westbrook, N.; Sharifi, E.; Marzbali, M.H. Socio-spatial vulnerability and dilapidated abandoned buildings (Dabs) through the lens of spatial liminality: A case study in Iran. *A/Z ITU J. Fac. Archit.* **2020**, *17*, 61–78. [CrossRef]
7. Jucu, I.S. When Service-Led Activities and Tertiarization Processes Replace Old Industries and Local Brownfields: Changes, Perceptions and Perspectives in the Northern Industrial Area of Lugoj, Romania. *Land* **2022**, *12*, 37. [CrossRef]
8. Askarizad, R.; Dadashpour, A.; Faghirnavaz, J.; He, J.; Safari, H. Organizing worn-out neighborhoods with the new-urbanism approach using mixed methods in Rudsar, northern Iran. *Smart Sustain. Built Environ.* **2023**, *12*, 128–155. [CrossRef]
9. Maghsoodi-Tilaki, M.J.; Marzbali, M.H.; Safizadeh, M.; Abdullah, A. Quality of place and resident satisfaction in a historic–religious urban settlement in Iran. *J. Place Manag. Dev.* **2021**, *14*, 462–480. [CrossRef]
10. Bevilacqua, C.; Sohrabi, P.; Hamdy, N.; Mangiulli, F. Mapping Connections between Neighborhoods in Response to Community-Based Social Needs. *Sustainability* **2023**, *15*, 4898. [CrossRef]
11. Behzadfar, M. *Strategic Plan for Historic Yazd Volume 6-1*; Ministry for Roads and Urban Development: Tehran, Iran, 2012.
12. Mirmiran, H. *Kashan Strategic Plan Volume 3. Ministry-of-Housing-and-Urban-Development*; Pars-Naghshe-i-Jahan-Consultants, Ed.; Ministry of Housing and Urban Development: Tehran, Iran, 2011; Volume 3.
13. Rezaei, N.; Alborzi, G.; Alilou, L. Transformation of historic neighborhoods: How tourism is changing the historic center of Kashan, Iran. *Herit. Soc.* **2019**, *12*, 176–196. [CrossRef]
14. Habibi, K. *Behsazi va Nosazi-e Bafthaye-i Kohane-i Shahri [Urban Rehabilitation and Renovation in the Old Textures]*; Nashri Entekhab: Tehran, Iran, 2010.
15. Tavakoli, H. Spatial Liminality as a Framework for Evaluating Revitalisation Programs in Historic Iranian Cities: The Case of the Imam-Ali Project in Isfahan. In Proceedings of the What If? What Next? Speculations on History's Futures, Perth, Australia, 18–25 November 2020; pp. 261–278.
16. Spennemann, D.H. The Shifting Baseline Syndrome and Generational Amnesia in Heritage Studies. *Heritage* **2022**, *5*, 2007–2027. [CrossRef]
17. Australia ICOMOS. *Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*; Autralia ICOMOS: Burwood, Australia, 1999.
18. Roberts, P.; Sykes, H.; Granger, R. *Urban Regeneration*, 2nd ed.; Sage: London, UK, 2016.
19. Roberts, L. *Spatial Anthropology: Excursions in Liminal Space*; Rowman & Littlefield: London, UK, 2018.
20. Szakolczai, A. Liminality and experience: Structuring transitory situations and transformative events. *Int. Political Anthropol.* **2009**, *2*, 141–172.
21. van Gennep, A. *The Rites of Passage: A Classic Study of Cultural Celebrations*; University of Chicago: Chicago, IL, USA, 1960.
22. Thomassen, B. Revisiting liminality: The danger of empty spaces. In *Liminal Landscapes*; Routledge: London, UK, 2012; pp. 37–51.
23. Stavrides, S. *Towards the City of Thresholds, Professional Dreamers*; Professional Dreamers: Toronto, ON, Canada, 2010.
24. Stavrides, S. Open space appropriations and the potentialities of a "City of Thresholds". In *Terrain Vague*; Routledge: London, UK; New York, NY, USA, 2014; pp. 62–75.
25. Simmel, G. The metropolis and mental life. In *The Urban Sociology Reader*; Routledge: London, UK, 1997; pp. 37–45.
26. Foucault, M.; Miskowiec, J. Of other spaces. *Diacritics* **1986**, *16*, 22–27. [CrossRef]
27. Mortada, H. *Traditional Islamic Principles of Built Environment*; Routledge: Abingdon, UK, 2003.
28. Habib, F.; Moztarzadeh, H.; Hodjati, V. The concept of neighborhood and its constituent elements in the context of traditional neighborhoods in Iran. *Adv. Environ. Biol.* **2013**, 2270–2279.
29. Holt, P. The Islamic city. Edited by AH Hourani and SM Stern. *J. R. Asiat. Soc.* **2011**, *104*, 147–148. [CrossRef]
30. Correia, J. Looking beyond the lens' veil. In *Inside/Outside Islamic Art and Architecture: A Cartography of Boundaries in and of the Field*; Bloomsbury Publishing: New York, NY, USA, 2021; p. 61.
31. Tavakoli, H. *Dilapidated Abandoned Buildings (DABs) and Socio-Spatial Vulnerability: Application of Spatial Liminality for Revitalising Historic Iranian Cities*; The University of Adelaide: Adelaide, Australia, 2020.
32. Alawadi, K. A return to the old landscape? Balancing physical planning ideals and cultural constraints in Dubai's residential neighborhoods. *J. Hous. Built Environ.* **2019**, *34*, 235–263. [CrossRef]
33. Thomassen, B. *Liminality and the Modern: Living through the In-Between*; Routledge: London, UK, 2016.
34. Saoud, R. Introduction to the Islamic City. In *Discover the Golden Age of Muslim Civilization*; Foundation for Science Technology and Civilization: Manchester, UK, 2001; pp. 90–98.

35. Stavrides, S. Heterotopias and the experience of porous urban space. In *Loose Space*; Routledge: London, UK, 2007; pp. 174–192.
36. Yin, R.K. *Case Study Research: Design and Methods*; Sage: Thousand Oaks, CA, USA, 2009; Volume 5.
37. Hakim, B.S. *Arabic Islamic Cities: Building and Planning Principles*; Routledge: London, UK, 1989.
38. Tavassoli, M. *Qavaid Va Meyarhay-i Tarahi-i Fazay-i Shahri [Urban Space Design Criteria]*, 2nd ed.; UARC (Urban Planning and Architecture Research Center of Iran): Tehran, Iran, 2015.
39. Edwards, J.E.; Thomas, M.D.; Rosenfeld, P.; Booth-Kewley, S. *How to Conduct Organizational Surveys: A Step-by-Step Guide*; Sage: Thousand Oaks, CA, USA, 1997.
40. Farhad, S.; Maghsoodi Tilaki, M.J.; Hedayati Marzbali, M. Architectural identity and place attachment in historic neighbourhoods: An empirical study in Sanandaj, Iran. *J. Place Manag. Dev.* **2021**, *14*, 148–162. [CrossRef]
41. Akbar, J. Crisis in the Built Environment: The Case of the Muslim City. *Rev. Middle East Stud.* **1992**, *26*, 150–152.

land

MDPI

Article

Research on the Slope Gradient Effect and Driving Factors of Construction Land in Urban Agglomerations in the Upper Yellow River: A Case Study of the Lanzhou–Xining Urban Agglomerations

Hanxuan Zhang [1], Xiangjuan Zhao [1], Jun Ren [1,2,*], Wenjing Hai [1], Jing Guo [3], Chengying Li [1] and Yapei Gao [1]

[1] School of Civil Engineering, Qinghai University, Xining 810016, China
[2] Graduate School of Qinghai University, Qinghai University, Xining 810016, China
[3] Research Department of Ecological Civilization, Qinghai Academy of Social Sciences, Xining 810000, China
* Correspondence: renjun@qhu.edu.cn

Abstract: Analyses of the scale and structural characteristics of construction land serve as the basis for optimizing the spatial pattern of territorial planning. Existing studies have focused mainly on the horizontal expansion of urban construction land. Therefore, based on the Google Earth Engine (GEE) platform, in this paper, we use high-precision land-use cover data, DEM data and socioeconomic data to construct the standard dominant comparative advantage index (NRCA) using the geological mapping analysis method and we systematically analyze the horizontal scale, slope spectrum characteristics, gradient effects and driving factors of construction land in the Lanzhou–Xining urban agglomeration (LXUA) from 1990 to 2020 at four scales: the urban agglomeration, provincial area, typical city and county (district) scales. The results of the study show that urban construction land, rural settlement land and other construction land in the LXUA show "linear", inverted-"U" and "J" growth patterns, respectively. Three types of construction land show different spatial transfer characteristics. The scale and extent of climbing of urban construction land in the LXUA is gradually decreasing over time, and the number of climbing rural settlement lands in 2000–2010 was as high as 34 counties (districts), while the number of counties (districts) with strong climbing degrees of other construction land rose to 12 from 2010 to 2020. The relative hotspots of the slope-climbing phenomenon of the three types of construction land have gradually expanded spatially, with Lanzhou city and Xining city as the center, and the overall spatial characteristics are "more in the east and less in the west". The population and GDP are the main factors influencing the slope-climbing phenomenon of urban construction land, while rural settlements are influenced mainly by natural conditions, and accessibility is the key factor affecting other construction land.

Keywords: new type of urbanization; territorial spatial planning; construction land slope spectrum; GEE; NRCA; Lanzhou-Xining urban agglomeration

Citation: Zhang, H.; Zhao, X.; Ren, J.; Hai, W.; Guo, J.; Li, C.; Gao, Y. Research on the Slope Gradient Effect and Driving Factors of Construction Land in Urban Agglomerations in the Upper Yellow River: A Case Study of the Lanzhou–Xining Urban Agglomerations. *Land* **2023**, *12*, 745. https://doi.org/10.3390/land12040745

Academic Editors: Pasquale de Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 18 February 2023
Revised: 16 March 2023
Accepted: 23 March 2023
Published: 26 March 2023

1. Introduction

Land resources are the foundation of survival, the basis of development, the source of wealth and the key to ecology, and these are an important material basis and spatial carrier for economic and social development and ecological civilization construction [1–3]. Construction land is an important type of land use among land resources and is the most direct evidence of human behavioral activities that transform the surface of the Earth [4]. Construction land can be divided into commercial service land, industrial and mining land, residential land, public administration and public service land, transportation land, and special land such as military facilities, according to the land-use classification scheme currently used in China (GB/T 21010-2017). The expansion of construction land plays an important role in supporting and guaranteeing the development of urbanization, industrialization and modernization in China [5]. Many cities around the world are expanding at twice the rate of their average population growth [6]. The global urban

population is projected to exceed 5 billion by 2030 [7]. Nearly 50 percent of newly built land is expected to be concentrated in Asia [8]. However, with rapid urbanization, the current land-use pattern of more rapid land urbanization than population urbanization in China has given rise to a series of problems, such as the rough expansion of construction land, rapid consumption of resources and the environment, hollowing out in the countryside, non-agriculturalization of high-quality arable land and fragmentation of ecological space. Urban expansion has become an important topic in urban research and a core Issue of urban sustainable development [9]. Building livable and appropriate living spaces, intensive and efficient production spaces, and beautiful ecological spaces is the eternal goal of efficient and sustainable utilization of land resources and an important path to achieving sustainable development and building a beautiful China. Therefore, systematically exploring the dynamic evolution of construction land is an important issue faced in the territorial spatial planning, construction and governance of the country [10], and it is critical to promote new and improved urbanization strategies in China.

With the rapid promotion of urbanization and the flourishing development of remote-sensing information technology in China, scholars have conducted rich and important research on construction land using multisource remote-sensing products. The relevant studies have focused mainly on analyzing horizontal-scale-dimension delineations [11–13], morphological evolution [14,15], center-of-gravity shifts [12,16,17] and land-use patterns of urban construction land [5,14,18] or on assessing the vertical dimensional gradient effect of construction land using indices such as the topographic relief [19], topographic position index [20] and average climbing index [21]. In contrast, few comprehensive studies have explored construction land in both the horizontal and vertical dimensions. The existing studies did not classify or refine construction land, and the research objects focused on the evolution laws of urban construction land; thus, those studies were not conducive to obtaining a comprehensive or systematic understanding of the evolution law of construction land and did not differentiate among the management frameworks of various types of construction land from the perspective of fine-scale management. At the same time, studies have been conducted mainly at the national [10], regional [19,21,22], city [23] and district (county) [24] scales, especially in mountainous cities. While urban agglomerations are an important form and carrier of China's future urbanization development [25], few studies have been conducted at the urban agglomeration scale. Therefore, it is necessary to study the evolution characteristics and slope gradient effect of construction land in urban agglomerations at multiple scales based on highly detailed land classification data.

In view of this, this study takes the Lanzhou–Xining Urban Agglomeration (LXUA), where the ecological environment of in the Upper Yellow River is important and fragile, with fast development speed and severe contradiction between people and land. Based on the Google Earth Engine (GEE) platform, in this paper, we use remote sensing images taken from 1990 to 2020 to construct a standardized Revealed Comparative Advantage Index (NRCA) and comprehensively analyze the horizontal expansion and vertical gradient of urban construction land, rural settlement land and other construction land at the urban agglomeration, provincial area, typical city and county (district) scales in the LXUA to provide an empirical reference for the scientific management of construction land, optimize the territorial spatial pattern in the LXUA, and provide a theoretical basis for the implementation of ecological protection and high-quality development strategies in the Yellow River Basin.

2. Data Sources and Methodology

2.1. Study Area

The Lanzhou–Xining Urban Agglomeration is located at 98°05′ E~105°38′ E, 34°07′ N~39°05′ N, with the transition zone between the Loess Plateau and Qinling Mountains in the eastern area, separated from the Tarim Basin in Xinjiang to the north, connected to the Tibetan Plateau in the south, and connected to the Sichuan Basin through mountains and plateau basins in the southeast, with a total area of 97,500 km^2 (Figure 1). The LXUA takes the

Hehuang Valley as the basic bearing area, the Yellow River ecological protection axis runs through the whole radiating area, the Qilian Mountains serve as an ecological security barrier in the north, the Gannan Plateau serves as an ecological security barrier in the south, and the Sanjiangyuan Region serves as an ecological security barrier in the west. Overall, the terrain is high in the west and low in the east, and the landform types in the region are complex and diverse [26]. The LXUA is centered on Lanzhou city and Xining city, including 4 typical cities and 20 counties (districts) in Gansu Province and 5 typical cities and 19 counties (districts) in Qinghai Province (Table 1). It is a relatively dense area of towns in the upper reaches of the Yellow River region. In the past decade, the urbanization process of the LXUA has accelerated, with an annual population growth rate of 2.05% and an annual GDP growth rate of 8.15%. The per capita disposable income of urban and rural residents is relatively high, and there is a large gap between urban and rural areas [27]. This urban agglomeration is located in the international economic cooperation corridor of the New Asia–Europe Continental Bridge and is an important component of the China–Central Asia–West Asia economic corridor [28]. As an important regional city agglomeration in western China, the Lanzhou–West City Agglomeration is led by the national strategies of "Western Development", "the Belt and Road" and the ecological protection and high-quality development of the Yellow River Basin. The population scale continues to increase, and the level of urbanization and infrastructure continue to improve. Due to the valley-type landform characteristics of "two mountains sandwiched by a river", the phenomena of "building land on mountains" and "cutting mountains for development" have become increasingly obvious in this region.

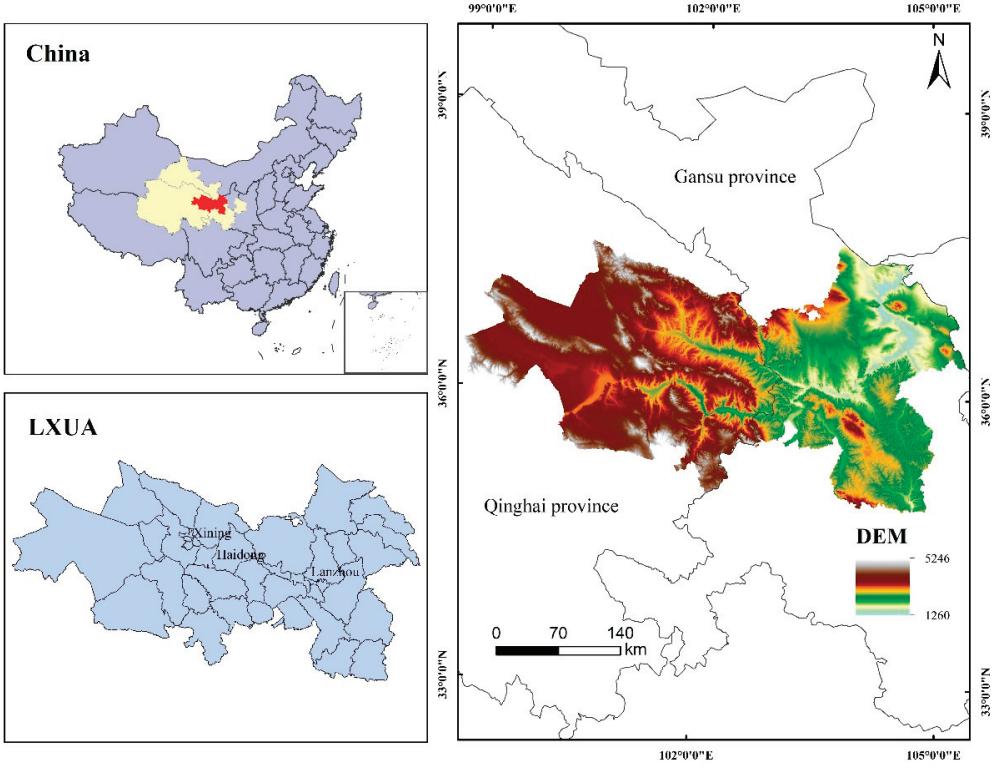


Figure 1. The location map of the study area.

Table 1. The administrative divisions of the research area.

Agglomerations	Provincial Area	Typical Cities	Counties (Districts)			
Lanzhou–Xining Urban Agglomerations (LXUA)	Gansu (GS)	Lanzhou (LZ)	Chengguan (CG)	Qilihe (QLH)	Xigu (XG)	Anning (AN)
			Honggu (HG)	Yongdeng (YD)	Gaolan (GL)	Yuzhong (YZ)
			Baiyin (BY)	Pingchaun (PC)	Jingyuan (JY)	Jingtai (JT)
			Anding (AD)	Longxi (LXX)	Weiyuan (WY)	Lintao (LT)
			Linxia (LX)	Yongjing (YJ)	Dongxiangzu (DXZ)	Jishishan (JSS)
	Qinghai (QH)	Xining (XN)	Chengdong (CD)	Chengxi (CX)	Chengzhong (CZ)	Chengbei (CB)
			Datong (DT)	Huangzhong (HZ)	Huangyaun (HY)	
		Haidong (HD)	Ledu (LD)	Pingan (PA)	Minhe (MH)	Huzhu (HZX)
			Hualong (HL)	Xunhua (XH)		
			Haiyan (HYX)	Tongren (TR)	Jianzha (JZ)	Gonghe (GH)
			Guide (GD)	Guinan (GN)		

2.2. Data Source and Processing

Considering the completeness of administrative divisions and the representativeness of the study area, Lanzhou City, Xining City and Haidong City were chosen as typical cities at the city scale to carry out this study. Therefore, the analyses in this paper are based on four scales—urban agglomeration, provincial area, typical city and county (districts) scale—and the time span is 1990–2020, with 10 years as the considered time period. The administrative boundary vector data are obtained from the 1:1 million basic geographic information database provided by the National Geographic Information Resources Catalog Service System (https://www.webmap.cn/ (accessed on 5 November 2022)). We chose the land-use data obtained from the Resource and Environment Science and Data Center (https://www.resdc.cn/ accessed on 5 November 2022) with a resolution of 30 m × 30 m, and the primary land categories included arable land, forestland, grassland, urban and rural industrial, mining and residential land, water area and unused land. The construction land used in this study consist of urban construction land, rural settlement land and other construction land in the secondary classification scheme of urban and rural industrial, mining and residential land. The accuracy of the first-class land-use data and the second-class classification data of this data is more than 90%, which meets the requirement of the research precision [2]. The digital elevation data were obtained from the SRTM (Shuttle Radar Topography Mission) DEM dataset of the GEE platform with a resolution of 30 m (Table 2). In addition, based on the requirements of the Code for Vertical Planning of Urban and Rural Construction Land (CJJ83-2016) and the characteristics of the topographic slope spectrum of the LXUA, and considering the suitability of construction land, we conducted our analyses only for construction land with slopes at or below 25°. Below is a general framework for the study (Figure 2).

2.3. Methodology

2.3.1. Construction Land Level Expansion Measure

Based on the reality that research on the horizontal expansion of construction land is relatively mature, in this study, we mainly examine the characteristics of the horizontal expansion of construction land in the LXUA from 2 aspects: the scale and speed of construction land expansion; the utilized calculation formulas are detailed in the literature [29,30].

Table 2. Descriptions of the data used in this study.

Data Name	Data Source	Data Type	Data Description
Meteorological data	http://data.cma.cn/ accessed on 5 November 2022	excel	Precipitation and relative humidity data obtained by interpolation
Spatial population (Nighttime light data)	http://www.geodata.cn/ accessed on 5 November 2022	500 m × 500 m raster data	SNPP-VIIRS-like data (2000–2021)
Road data	Openstreetmap	30 m × 30 m raster data	Preprocessing of Arcgis Euclidean distance tool
GDP	https://www.resdc.cn/ accessed on 5 November 2022	1 km × 1 km raster data	Preprocessing of Arcgis Euclidean distance tool
Distance from the county government	——	30 m × 30 m raster data	Preprocessing of Arcgis Euclidean distance tool
Distance from an ecological reserve	https://data.tpdc.ac.cn/ accessed on 5 November 2022	30 m × 30 m raster data	Preprocessing of Arcgis Euclidean distance tool
Level of urbanization	Statistical Yearbook	excel	Arcgis spatial analysis tool

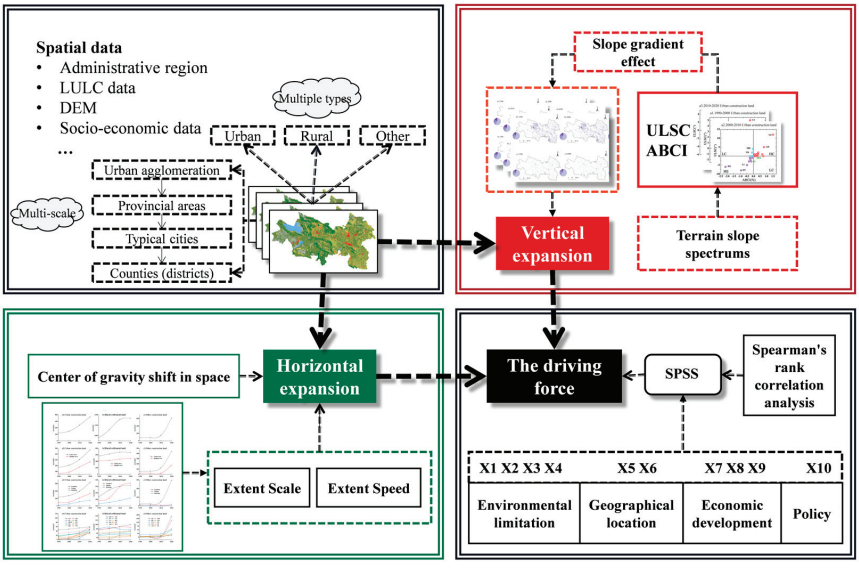


Figure 2. General research framework.

2.3.2. Terrain and Construction Land Slope Spectra

Drawing on the slope spectrum geoanalysis method proposed by Tang et al. [31], based on the GEE platform, the slope data were rasterized with the 4-period land-use data, the number of rasters for each slope interval and the number of regional construction land rasters were counted at 1° intervals, and the topographic slope spectrum curves and construction land slope spectrum curves were drawn. The topographic slope spectrum (land area frequency slope spectrum) is a statistical map of the percentage of the land area corresponding to the slope factor in a specific statistical area to the total statistical area; such maps can visually reflect the overall slope distribution of the background land [23]. The construction land slope spectrum (construction land area frequency slope spectrum) is a statistical map of the percentage of the construction land area corresponding to the slope factor in a specific statistical area to the total construction land area in the statistical area; these maps can visually reflect the overall slope distribution of the background land and visually reflect the land-use preference of construction land at different slopes [10]. The calculation formulas are expressed as follows:

$$P_{t,i} = A_{t,i} / A_t \times 100\% \quad (1)$$

$$P_{b,i} = A_{b,i}/A_b \times 100\% \quad (2)$$

where $P_{t,i}$ and $P_{b,i}$ are the topographic slope spectrum and construction land slope spectrum of i raster cells, respectively; $A_{t,i}$ and $A_{b,i}$ are the land area and construction land area of i raster cells, respectively; and A_t and A_b are the total land area and construction land area of the study area, respectively.

2.3.3. Comparative Advantage Index of the Construction Land Distribution

To further characterize the suitability of the construction land distribution, we tried to introduce the *NRCA* proposed by Yu et al. [32] into our study of the construction land slope-climbing law to reflect the dynamic and continuous comparative advantage of the research object in different intervals; this index is not limited temporally or spatially and has been widely used in judgments of the dominant land-use functions and optimizations of the spatial national land-use pattern. In the related research, the calculation formula is expressed as follows:

$$NRCA_{i,j} = P_{i,j}/P_b - P_iP_j/P_bP_b \quad (3)$$

where $NRCA_{i,j}$ indicates the comparative advantage of slope level j in i raster cells, $P_{i,j}$ is the construction land slope spectrum of slope level j in i raster cells, P_i is the sum of the construction land slope spectrum in i raster cells, P_j is the sum of the construction land slope spectrum of slope level j, P_b is the sum of the construction land slope spectrum in the study area, $NRCA_{i,j} > 0$ means that slope level j has a comparative advantage in i raster cells, and $NRCA > 0$ means that the construction land has a better suitability at the jth slope level and vice versa. Moreover, when $P_{b,i} = P_{t,i}$, the slope spectrum of construction land and the ground slope spectrum intersect, and the slope at this time is defined as the advantageous slope threshold (T). When $P_{b,i} > P_{t,i}$ and $NRCA_{i,j} > 0$, the slope spectrum of construction land with slopes less than T is larger than the terrain slope spectrum, and at this time, construction land is distributed mainly in the raster areas with slopes less than T, also called the advantageous area (AA). For the convenience of facilitating the statistical analysis, the other cases are regarded together as the inferior area (inferior area, IA).

2.3.4. Average Construction Land Climbing Index and Upper-Limit Slope

To quantitatively measure the degree of construction land climbing, the built-up land climbing index (BCI), which is the proportion of the construction land area in the disadvantaged area to the total construction land area in a given period of time, was used. To facilitate a comparison of the changes in the extent of built-up land climbing in different periods, the average built-up land climbing index ($ABCI$) was calculated using the following formula:

$$BCI = (IA_{t\prime}/BA_{t\prime} - IA_t/BA_t) \times 100\% \quad (4)$$

$$ABCI = BCI/(t\prime - t) \quad (5)$$

where BCI is the built-up land climbing index from year t' to year t; $IA_{t'}$ and IA_t are the areas of construction land in the disadvantaged area in year t' and year t, respectively; BA_t and BA_t are the total areas of construction land in year t' and year t, respectively; and $ABCI$ is the average climbing index of construction land from year t' to year t. $ABCI > 0$ indicates that the proportion of construction land in the disadvantaged area increases with time, i.e., the construction land exhibits a climbing expansion; the larger the $ABCI$ value, the stronger the climbing capacity of the construction land.

In addition, to analyze the difference in slope maxima over time for different construction land distribution scales, the upper limit slope (downward accumulation key value) was used. To compare the changes in the upper-limit slope angle among different periods, the upper-limit slope angle change (ULSC) was calculated. ULSC > 0 indicates that the

construction land is climbing to the disadvantaged area in that period, and the larger the value of this term, the greater the climbing capacity of the construction land. ULSC ≤ 0 indicates that the construction land is expanding horizontally in the advantaged area in that period.

2.3.5. Construction Land Climbing Heat

The spatial distributions of the relative hot and cold patterns of the construction land climbing phenomenon were explored using the construction land climb heat index proposed by Peng et al. [23]. The specific formula is expressed as follows:

$$R_{\mathrm{i}} = \frac{S_i}{\sum_{i=1}^{n} S_i} \times 100 \tag{6}$$

where R_i is the slope share index (%) of the construction land in the ith raster, and the larger the value of this index is, the higher the climbing heat is. S_i is the total slope of the construction land in the ith raster, and n is the total number of statistical cells. For the convenience of description, the cumulative series is divided into 5 groups in 20% equal steps after the slope shares are stacked sequentially from smallest to largest.

2.3.6. Spearman's Rank Correlation Analysis

The main driving factors of urban expansion are the location, economy, transportation, natural resources, population, culture and national policies [33,34]. Spearman's rank correlation coefficient was used to reveal the driving factors behind urban expansion in the study area. Referring to previous research on the driving forces of urban expansion and by combining the available data, we chose natural resource endowments (slope X1, elevation X2, precipitation X3, and relative humidity X4), location conditions (accessibility X5 and distance from county government X6), socioeconomic conditions (population density X7, urbanization level X8 and average land GDP X9), and policy factors (distance from ecological protection zone X10) and determined the influence of these 10 indicator factors on the climbing heat of construction land in the LXUA. Spearman's rank correlation can measure the associations between independent variables even when they do not follow a normal distribution [35].

3. Results and Analysis

3.1. Analysis of the Multiscale Horizontal Expansion Characteristics of Construction Land

3.1.1. Horizontal Expansion Characteristics of Urban-Agglomeration-Scale Construction Land

In terms of urban construction land, the area of urban construction land in the LXUA has been increasing continuously in a "linear" growth pattern (Figure 3(a1)). From 238.86 km^2 in 1990 to 739.84 km^2 in 2020, this area increased by 500.98 km^2, with an average growth rate of 16.70 km^2/a. Especially after 2000, with the implementation of the national strategy of "Western Development", the urban construction land in the LXUA has increased rapidly. Regarding rural settlement land, these lands in the LXUA have also increased continuously, showing an inverted-U-shaped growth pattern of "fast first and then slow" (Figure 3(b1)). In terms of other construction land, the area of other construction land in the LXUA has continued to increase, showing a "slow and then fast" "J" growth pattern (Figure 3(c1)). The area of other construction land in 2020 was nearly 8 times that in 1990 and nearly 4 times that in 2010. With the implementation of the national "the Belt and Road" new urbanization strategy, the rapid increase in land for transportation facilities and other construction land in the LXUA has increased rapidly.

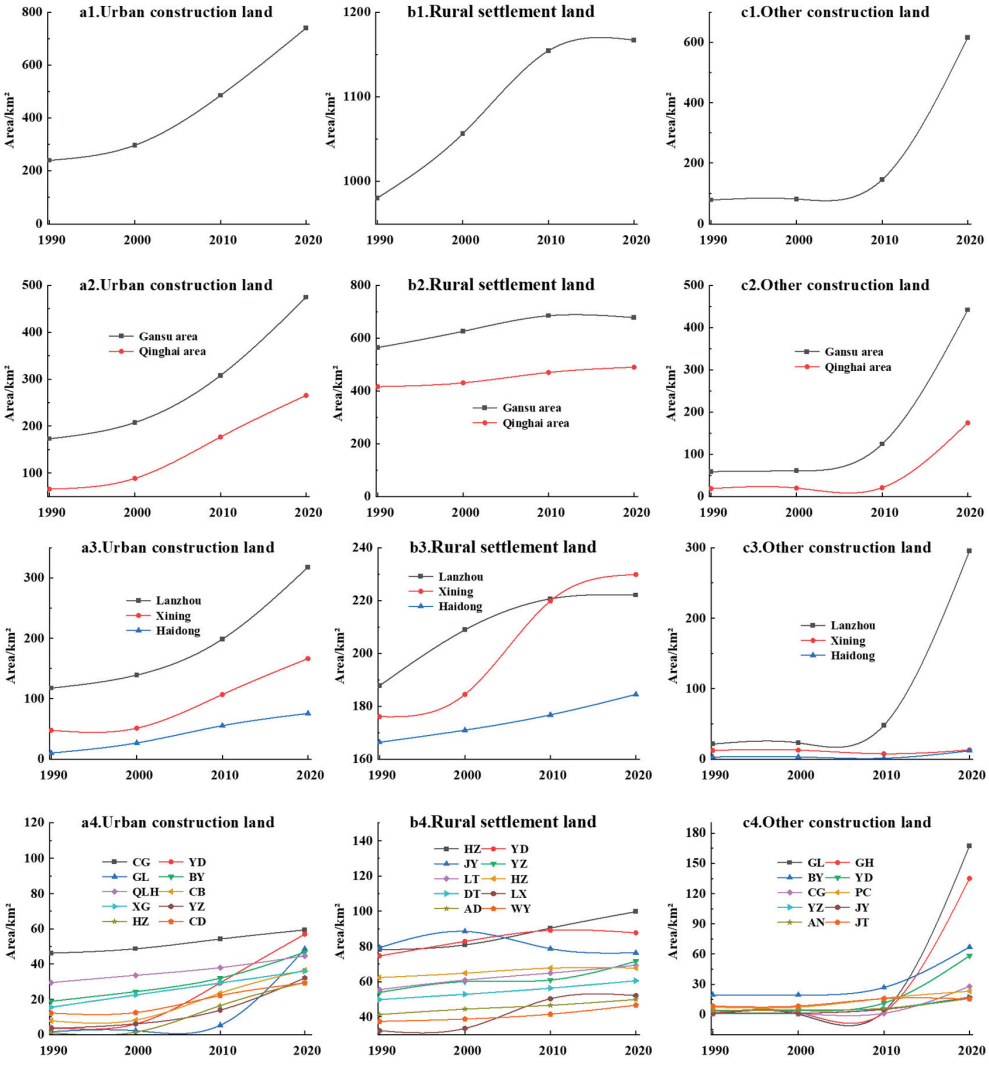


Figure 3. Multiscale areal changes in the three types of construction land in the LXUA from 1990 to 2020. Note: For clarity of the graphical expression, only the top 10 counties in terms of area in 2020 are mapped for the three types of construction land changes at the county scale.

3.1.2. Provincial-Tract-Scale Construction Land Level Expansion Characteristics

In terms of urban construction land, both Gansu and Qinghai continued to experience urban construction land increases with "linear" growth patterns, and the area and growth rate of urban construction land in Gansu were larger than those in Qinghai (Figure 3(a2)). In terms of land for rural settlements, the Gansu area showed an inverted-"U" pattern of "first increasing and then decreasing", while the Qinghai area showed an "I" pattern of slow growth. The area of rural settlements in Gansu was always larger than that in Qinghai (Figure 3(b2)). The land area of rural settlements in Gansu increased continuously from 564.03 km^2 in 1990 to 684.53 km^2 in 2010; after 2010, with the implementation of the national new urbanization strategy, the land area of rural settlements in Gansu decreased from 684.53 km^2 in 2010 to 677.41 km^2 in 2020, with a growth rate of -0.71 km^2/a. In

contrast, the area of rural settlements in Qinghai increased slowly, growing from 416.01 km^2 in 1990 to 489.54 km^2 in 2020. In terms of other construction land, the other construction land areas in both Gansu and Qinghai were increasing in a "J" pattern throughout the study period. The area of other construction land in Gansu was always larger than that in Qinghai (Figure 3(c2)). The area of other construction land in Gansu in 2020 was nearly 8 times that in 1990 and nearly 4 times that in 2010. The area of other construction land in Qinghai in 2020 was nearly 9 times that in 1990 and nearly 8 times that in 2010.

3.1.3. Typical City Construction Land Horizontal Expansion Characteristics

In terms of urban construction land, the urban construction land areas in Lanzhou, Xining and Haidong all continuously increased in a "linear" growth pattern, and the area and growth rate of urban construction land in Lanzhou were always larger than those in Xining and Haidong (Figure 3(a3)). In terms of rural settlement land, the areas of rural settlement land in Lanzhou City, Xining City and Haidong City all showed increasing trends (Figure 3(b3)). The land area of rural settlements in Lanzhou City increased continuously from 187.76 km^2 in 1990 to 222.08 km^2 in 2020, with an average rate of 1.14 km^2/a, with the increase rate decelerating to 0.14 km^2/a after 2010. The land area of rural settlements in Xining City increased continuously from 176.07 km^2 in 1990 to 229.84 km^2 in 2020, with an average rate of 1.79 km^2/a, and the area of rural settlement land in Xining City exceeded that of Lanzhou City in 2020. The area of rural settlement land in Haidong City increased continuously from 166.38 km^2 in 1990 to 184.49 km^2 in 2020, with an average rate of 0.60 km^2/a. In terms of other construction land, other construction land in Lanzhou City showed a "J" growth pattern (Figure 3(c3)); especially after 2010, the area of other construction land in Lanzhou City increased rapidly, but the areas of other construction land in Xining City and Haidong City "decreased first and then increased". The "U"-shaped growth pattern was mainly the result of the conversion of other construction land in Xining and Haidong cities to urban construction land under the intensive implementation of the "Western Development" policy.

3.1.4. County (District)-Scale Construction Land Level Expansion Characteristics

In terms of urban construction land, the areas of urban construction land in Chengguan District, Qilihe District, Xigu District and Baiyin District were always larger than those in the remaining districts and counties, and the area of urban construction land in Dongxiang County was always the smallest (Figure 3(a4)). The growth rates of urban construction land in Yongdeng County, Gaolan County, Yuzhong County and Chengbei District were the fastest, and the growth rate of urban construction land in Jianzha County was the slowest, mainly because the establishment of Lanzhou New District in 2012 led to rapid increases in urban construction land in Yongdeng County and Gaolan County, the construction of Yuzhong Peace University City led to the rapid increase of urban construction land in Yuzhong County, and the establishment of university cities such as Xining Biotechnology Industrial Park and the new campus of Qinghai Normal University made the urban construction land area in Chengbei District increase rapidly. In terms of rural settlement land, the number of counties (districts) with decreasing rural settlement land areas increased throughout the study period (Figure 3(b4)). Thirty counties (districts), including Yongjing County, Anding District and Mutual County, had increasing rural settlement land areas, while 9 counties (districts), including Jingyuan County, Pingchuan District and Chengxi District, had decreasing rural settlement land areas from 1990 to 2020. The number of counties (districts) with decreasing rural settlement land areas was increasing, and this was closely related to China's current new urbanization strategy and the policy of stock construction land development. In terms of other construction land, the areas of other construction land increased in most counties (districts) (Figure 3(c4)). The areas of other construction land in 34 counties (districts), including Baiyin District, Xigu District and Huanzhong District, increased; the areas of other construction land in two districts, Chengxi District and Chengzhong District, remained unchanged; and the

areas of other construction land in three districts, namely, Xigu District, Chengbei District and Chengdong District, decreased. In general, after the implementation of the "Western Development" strategy in 2000, the scale of other construction land in each county and district continued to increase due to the construction of a number of major infrastructure projects, such as the Lanzhou–Xinjiang railroad relink, while decreased other construction land areas in some regions were the result of urbanization development converting some industrial and mining land areas belonging to urban areas into urban construction land.

3.2. Analysis of the Spatial Transfer Characteristics of Construction Land

3.2.1. Land for Urban Construction

At the urban agglomeration scale, the center of gravity of urban construction land in the LXUA shifted northwestward, especially after 2000. As shown in Figure 4a, with the implementation of the national "Western Development Strategy", the distance of the center of gravity of urban construction land in the LXUA shifted the most between 2000 and 2010, with a shift of 12.70 km, and the standard deviation ellipse also became flatter. At the provincial level, the center of gravity of urban construction land in the Gansu area shifted southeastward, the center of gravity of urban construction land in the Qinghai area shifted northeastward, while these two areas expanded in the same direction. From Figure 4b,c, it can be seen that the oval shape and area of the standard deviation of urban construction land in Gansu were basically unchanged throughout the study period, and the distance of the center-of-gravity shift was the largest between 2000 and 2010, at 8.29 km. The oval shape of the standard deviation of urban construction land in the Qinghai area was compact and flat, especially between 1900 and 2000. The oval area of the standard deviation decreased, the shape became similar to a circle, and the distance of the center-of-gravity shift was largest, at 16.96 km, indicating that the urban construction land in the Qinghai area was allocated mainly to the main urban areas of Xining City and Haidong City, driven by the development of the Xining Caojiabao International Airport. At the municipal scale, the centers of gravity of urban construction land in both Lanzhou City and Xining City first shifted southeastward and then northwestward, while the center of gravity of urban construction land in Haidong City first shifted northwestward and then southeastward. From Figure 4d–f, it can be seen that the center of gravity of urban construction land in Lanzhou City shifted toward Yuzhong County in the southeast direction first, mainly due to the jumping and compact land-use patterns in regions such as Peace University City and the Lanzhou University Yuzhong Campus, which prompted the southeastward expansion of urban construction land in Lanzhou City; with the establishment of Lanzhou New District, the urban construction land in Lanzhou City expanded northwestward. The center of gravity of urban construction land in Xining City also shifted southeastward. After 2010, the short axis of the standard deviation ellipse of urban construction land in Xining became longer, and the center of gravity shifted northwestward across a distance of 9.99 km, mainly due to the construction of Haihu New District in Chengxi District. The standard deviation ellipse of urban construction land in Haidong City "first decreased and then increased", and the area of the standard deviation ellipse of urban construction land in Haidong City "decreased and then increased". The long axis in the east-west direction elongated, mainly due to the development of Haidong City to the west under the policy guidance of Qinghai Province's vigorous development of Xining Caojiabao International Airport and the development of Haidong City to the east with the relocation of Haidong Municipal Government's residence to Ledu District and the construction of Huanghuang New District. Through the above analysis, it can be seen that the center of gravity of urban construction land in the LXUA shifted northwestward throughout the study period, with a compact layout, and that the expansion of urban construction land in the Qinghai and Gansu areas and in Lanzhou and Xining cities had the characteristic of "centrifugal in the same direction", while the expansion of urban construction land in Xining and Haidong cities had the characteristic of "same frequency". These results indicate that the "centripetal

force" of the Lanzhou–West urban agglomeration needs to be further enhanced to achieve "competitive" development.

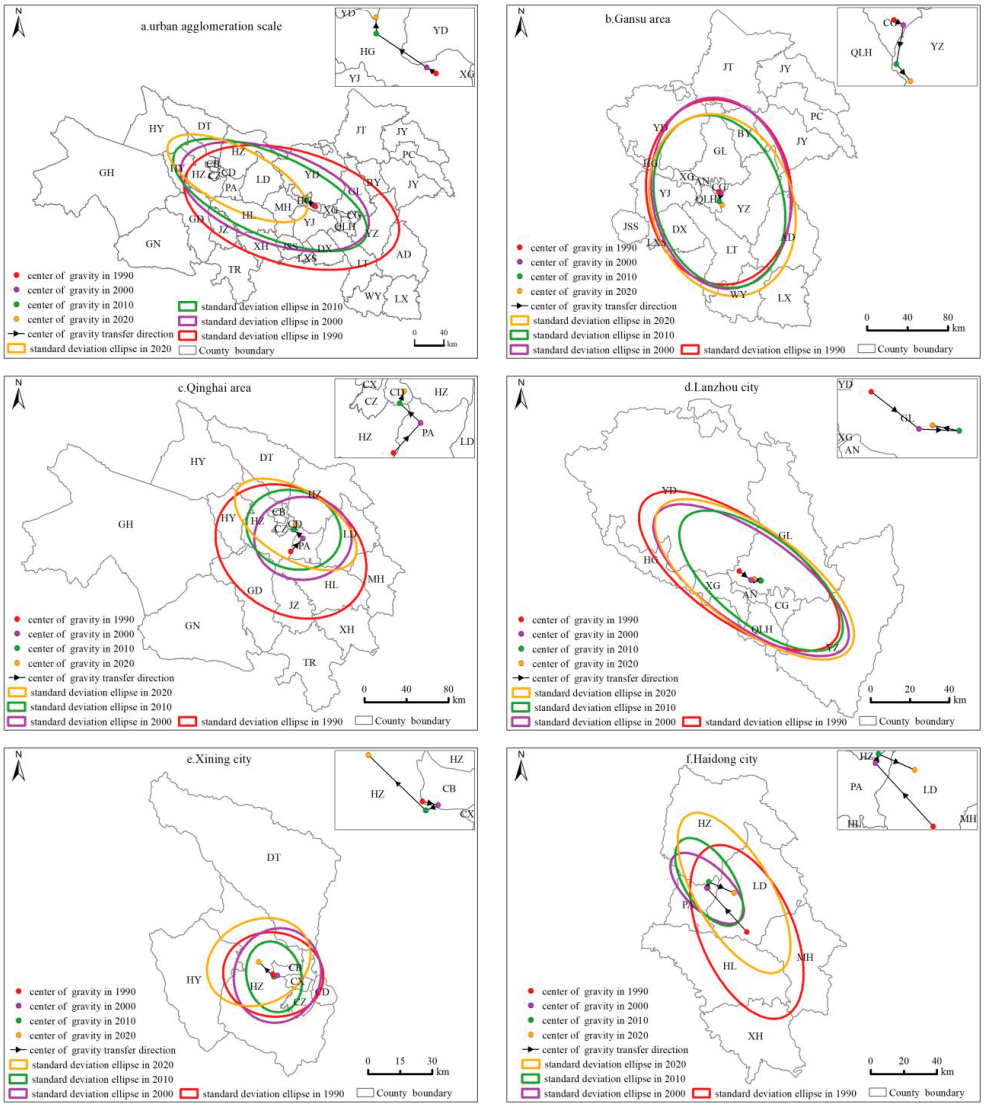


Figure 4. Distributions of the central shifts of construction land above the city level in the study area from 1990 to 2020.

At the county (district) scale, the centers of gravity of urban construction land in the vast majority of counties (districts) did not shift significantly, while the centers of gravity of urban construction land in counties (districts) within Lanzhou City, Xining City and Haidong City shifted significantly, and the spatial dispersion of the standard deviation ellipse increased. To analyze the spatial and temporal change characteristics of urban construction land at the county (district) scale, 15 counties (districts) with a medium-rate or higher expansion grades from 1990 to 2020 were selected for standard deviation ellipse analysis. As shown in Figure 5, the standard deviation ellipses flattened and the centers of

gravity shifted significantly in Gaolan, Yongdeng and Yuzhong counties in Lanzhou, in Chengbei and Huanzhong districts in Xining, and in Ledu, Pingan and Mutual counties in Haidong, while the standard deviation ellipses and centers of gravity changed slightly in the rest of the counties (districts). At the same time, we also found that the urban construction land in the inner counties (districts) of Lanzhou City increased slightly, while the areas in three counties increased significantly, showing "jump" land-use patterns; in Xining City and Haidong City, urban construction land mainly expanded in the inner counties (districts), showing an "infill" land-use pattern. The more distant the counties (districts) were from these three cities, the weaker the oval variation in the standard deviation of urban construction land and the change in location; these findings are consistent with the result that the intensity of urban construction land expansion in counties (districts) exhibits a "core-edge" pattern.

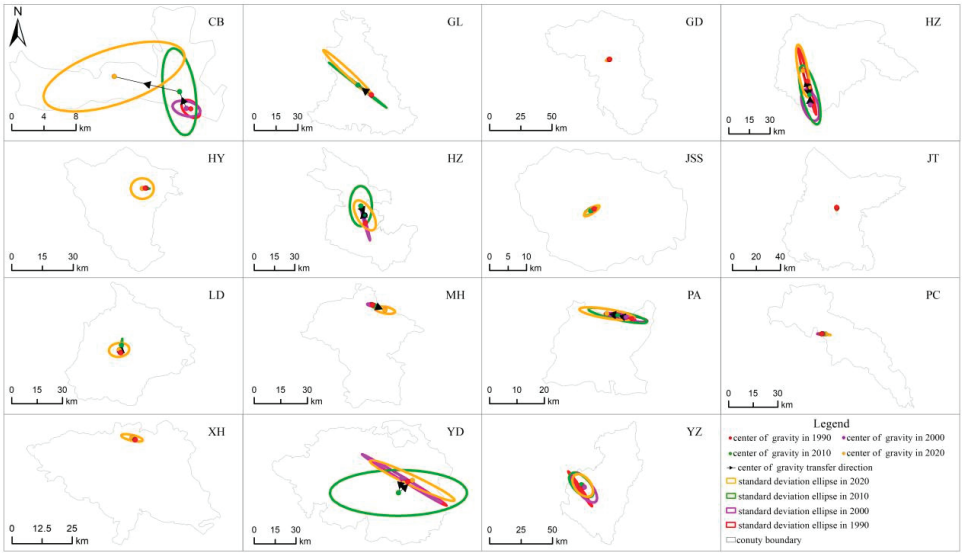


Figure 5. Distributions of central construction land shifts at the county level in the study area from 1990 to 2020.

3.2.2. Rural Settlement Land

At the urban cluster scale, the center of gravity of rural settlements in the Lanzhou–Xining Urban Cluster continued to shift southeastward. As shown in Figure 6a, especially after 2000, with the implementation of the "Three North Protective Forests" and "Returning Cultivated Land to Forests and Grasses" national policies, some farmers in the ecologically fragile areas of the LXUA underwent ecological migration. During the 2000–2010 period, the centers of gravity of rural settlements in the LXUA shifted with a maximum distance of 4.55 km, and the center of gravity shifted from Minhe County in Qinghai to Yongjing County in Gansu. At the provincial level, the centers of gravity of rural settlements in the Gansu area shifted southeastward, and the centers of gravity of rural settlements in the Qinghai area shifted northwestward. From Figure 6b,c, it can be seen that the oval shape and area of the standard deviation of rural settlement land in the Gansu area and Qinghai area basically remained unchanged, and the distance shifted between 2000 and 2010 was largest. At the municipal level, the elliptical shape and size of the standard deviations of Lanzhou, Xining and Haidong were basically unchanged, and the centers of gravity shifted southeastward and then northwestward; then, the centers of gravity of these three regions shifted westward, southward and southeastward, respectively. From Figure 6d–f, it can be seen that the elliptical shape and size of the standard deviation of

rural settlement sites in Lanzhou City remained basically unchanged, and the center of gravity shifted northwestward; this was the result, on the one hand, of the area of rural settlement sites decreasing due to the continuous urbanization of Qilihe, Chengguan and Yuzhong in Lanzhou City, while, on the other hand, the area of rural settlement sites in Xining City increased due to the migration of ecological immigrants from other places in Lanzhou New Area. The oval shape and size of the standard difference were basically unchanged, and the center of gravity continued to shift westward, mainly due to the rapid urbanization of the main urban area in the southeastern region, thus reducing the area of rural settlements around the city. The oval shape and size of the standard difference of rural settlements in Haidong City were basically unchanged, and the center of gravity shifted toward agricultural counties such as Minhe in the southeastern area. Through the above analysis, it can be seen that the layout of rural settlements in the east-west direction of the LXUA was scattered, the center of gravity shifted southeastward during the study period, and the standard deviation oval shape and size of the area and typical cities remained basically unchanged, indicating that the layout of rural settlements in the LXUA region remained basically stable. However, in the context of new urbanization modes with county cities as the carriers, the LXUA needs to further revitalize its stock of rural settlement land and improve the efficiency of rural settlement land.

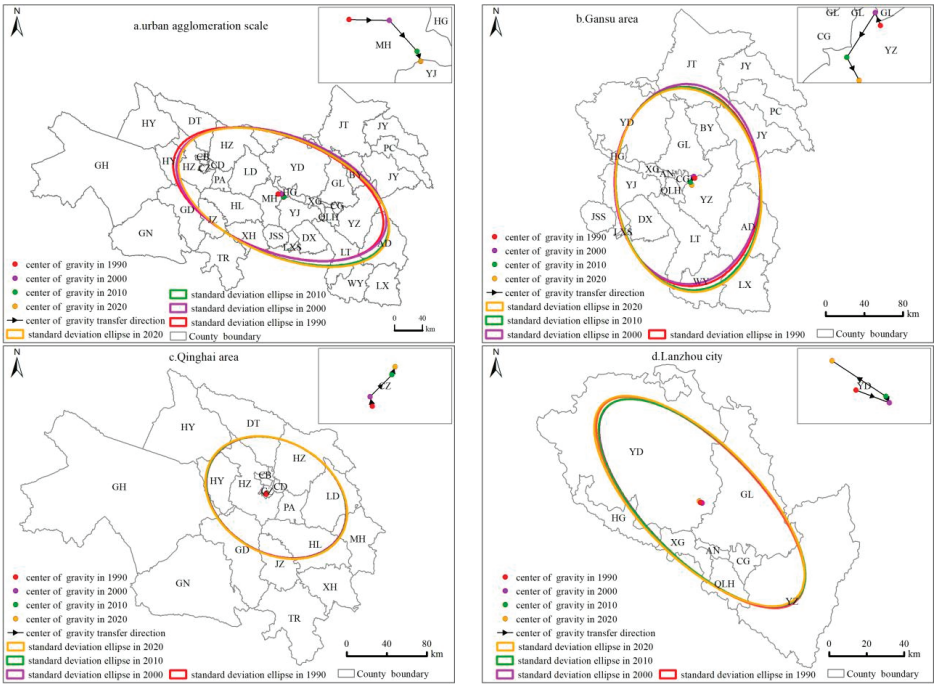


Figure 6. *Cont.*

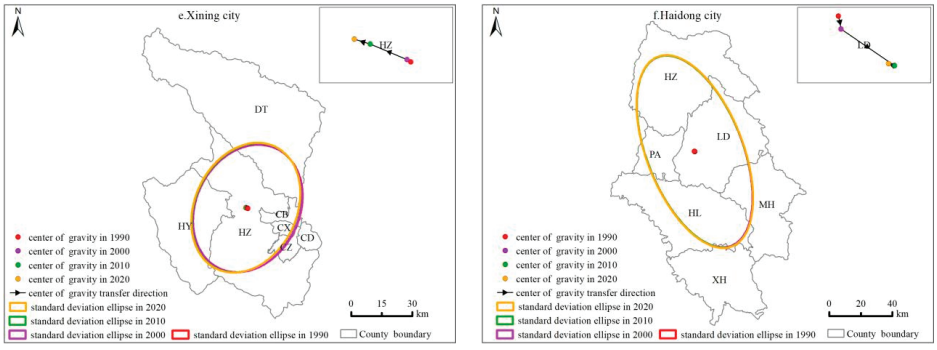


Figure 6. Distributions of central rural residential land shifts at the city level in the study area from 1990 to 2020.

At the county (district) scale, most of the counties (districts) rural residential land-use standard deviation ellipse variations and locations changed significantly throughout the study period, especially the counties (districts) covering Lanzhou City, Xining City and Haidong City, which experienced rapid declines in rural residential land use. To dissect the spatial and temporal characteristics of rural settlement sites at the county (district) scale, 20 counties (districts) with grades above low expansion or below slow decline from 1990 to 2020 were selected for standard deviation ellipse analysis. As shown in Figure 7, the areas where the standard deviation ellipse shape and location of rural settlement sites changed significantly were concentrated mainly in the main urban areas of Lanzhou, Xining and Haidong, and the standard deviation ellipse areas decreased and dispersed, while the standard deviation ellipse areas of rural settlement sites in the suburban counties (districts) of Yuzhong, Jingyuan and Yongjing became larger and dispersed. In the rural settlement sites in the agricultural areas of Jishishan, Dongxiang and Guide counties (districts), the elliptical shape and location of the standard deviations basically remained unchanged.

3.2.3. Other Construction Land

At the urban cluster scale, the center of gravity of other construction land in the Lanzhou–Xining urban cluster continued to shift southwestward, especially after 2000, and the center of gravity also shifted significantly. As shown in Figure 8a, the standard deviation ellipse of other construction land in the LXUA flattened, with a scattered layout in the east-west direction, and the center of gravity shifted from northeastern Yongdeng County to northwestern Honggu District, with the largest shift distance of 40.45 km recorded between 2000 and 2010. At the provincial area scale, the other construction land areas in both Gansu and Qinghai shifted southwestward overall. From Figure 8b,c, it can be seen that the ellipse of the standard deviation of other construction land in the Gansu area diverged in the north-south direction but exhibited a clustering trend, with the center of gravity shifting first southwestward and then southeastward; simultaneously, the center of gravity "jumped" from Jingyuan County to Gaolan County. The ellipse of the standard deviation of other construction land in the Qinghai area tended to be circular, with an increasing clustering trend observed toward the center, and the center of gravity shifted first southeastward and then southwestward; the southeastward shift was driven mainly by major infrastructure such as the Qinghai–Tibet Railway, Beijing–Tibet Expressway and Zhang Wen Expressway, while the southwestward center-of-gravity shift was due to the vigorous development of the PV industry in Qinghai after 2010. At the municipal scale, the ellipses of the standard deviations of other construction land in Lanzhou, Xining and Haidong tended to be circular, and the dispersion was weakened. From Figure 8d–f, it can be seen that the ellipse of standard deviation of other construction land in Lanzhou City first increased and then decreased in the east-west direction, the center of gravity

first shifted northwestward and then southeastward. The ellipse of the standard deviation of other construction land in Xining City tended to be circular, but the area continued to increase, and the center of gravity shifted from Datong County to Huanzhong District. Regarding the north-south-direction distribution of other construction land in Haidong City, the dispersion was enhanced, but the aggregation force in the east-west direction was also enhanced, the standard deviation ellipse tended to be circular, and the center of gravity shifted first southeastward and then northeastward. Through the above analysis, it can be seen that the other construction land in the LXUA had the tendency to disperse in the east-west direction, while the agglomerations in the north-south direction in Gansu Area and Lanzhou City were enhanced and the standard deviation ellipses of other construction land in Qinghai Area, Xining City and Haidong City tended to be circular with weakened dispersion, indicating that the other construction land in the LXUA tended to be balanced in the county-scale development, thus compensating for the infrastructure shortcomings.

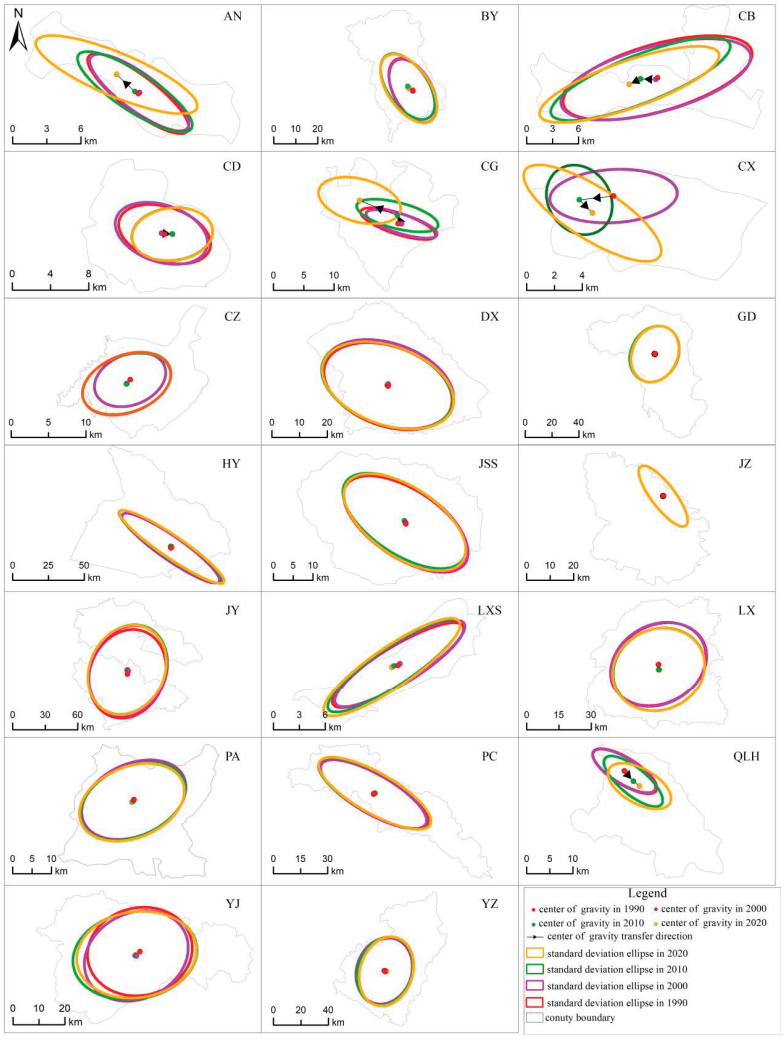


Figure 7. Distributions of the central rural residential land shifts at the county level in the study area from 1990 to 2020.

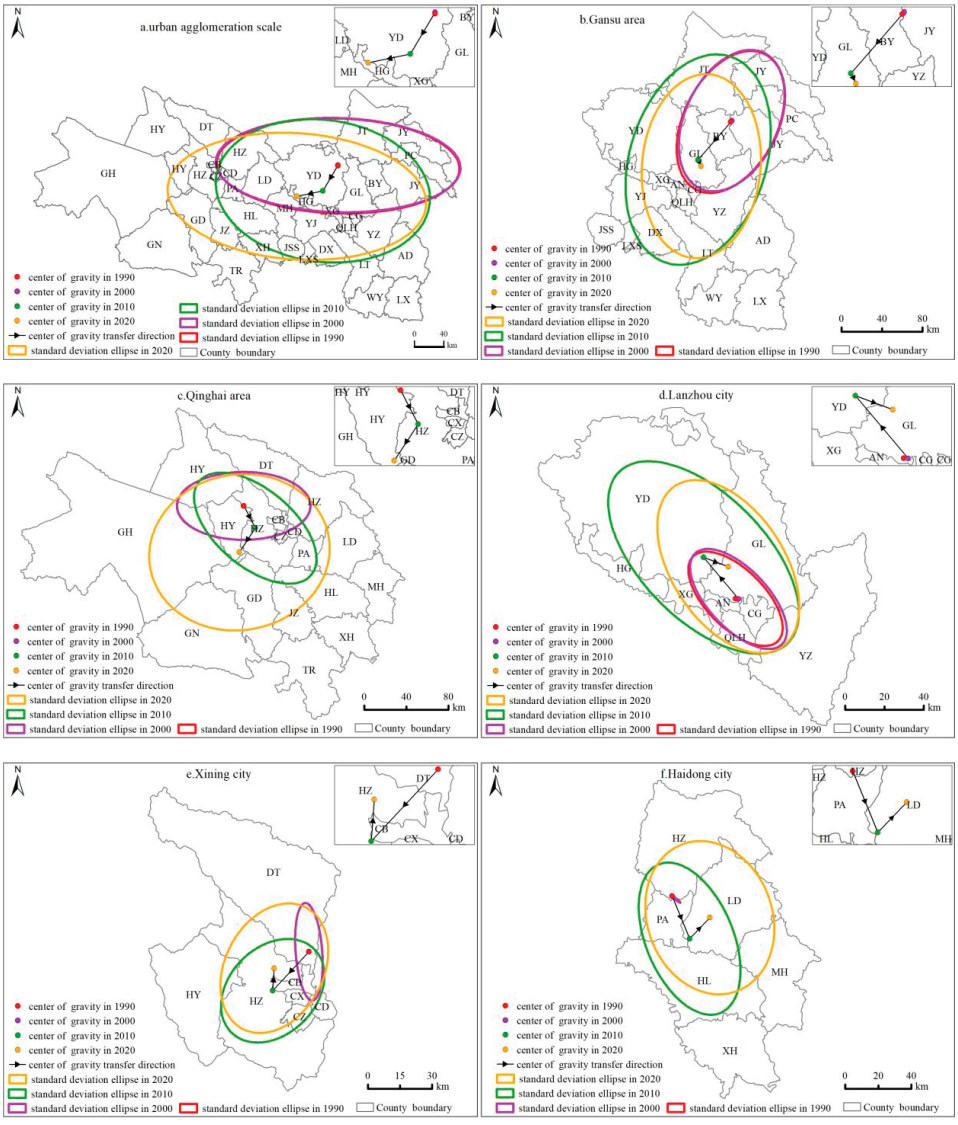


Figure 8. Distributions of central other construction land shifts at the city level in the study area from 1990 to 2020.

At the county (district) scale, the majority of counties (districts) underwent significant changes in their standard deviation elliptical shapes and locations of other construction land, especially in the counties (districts) located along the Longhai Railway and the Qinghai–Tibet Railway. To dissect the spatial and temporal change characteristics of other construction land at the county (district) scale, 17 counties (districts) with grades above low expansion or below slow decline from 1990 to 2020 were selected for standard deviation ellipse analysis. As seen from Figure 9, the standard deviation ellipses of other construction land in Jingyuan, Pingchuan and Xigu counties (districts) along the Longhai Railway and in Chengbei, Datong and Haiyan counties (districts) along the Qinghai–Tibet Railway, as well as in Yongdeng and Gaolan counties supporting the construction of Lanzhou New Area, changed significantly during the study period, thereby enhancing the location advantages

of counties (districts) along the route under the construction of major national infrastructure and increasing the "logistics and people flow" pattern, under which the areas of other construction land increased.

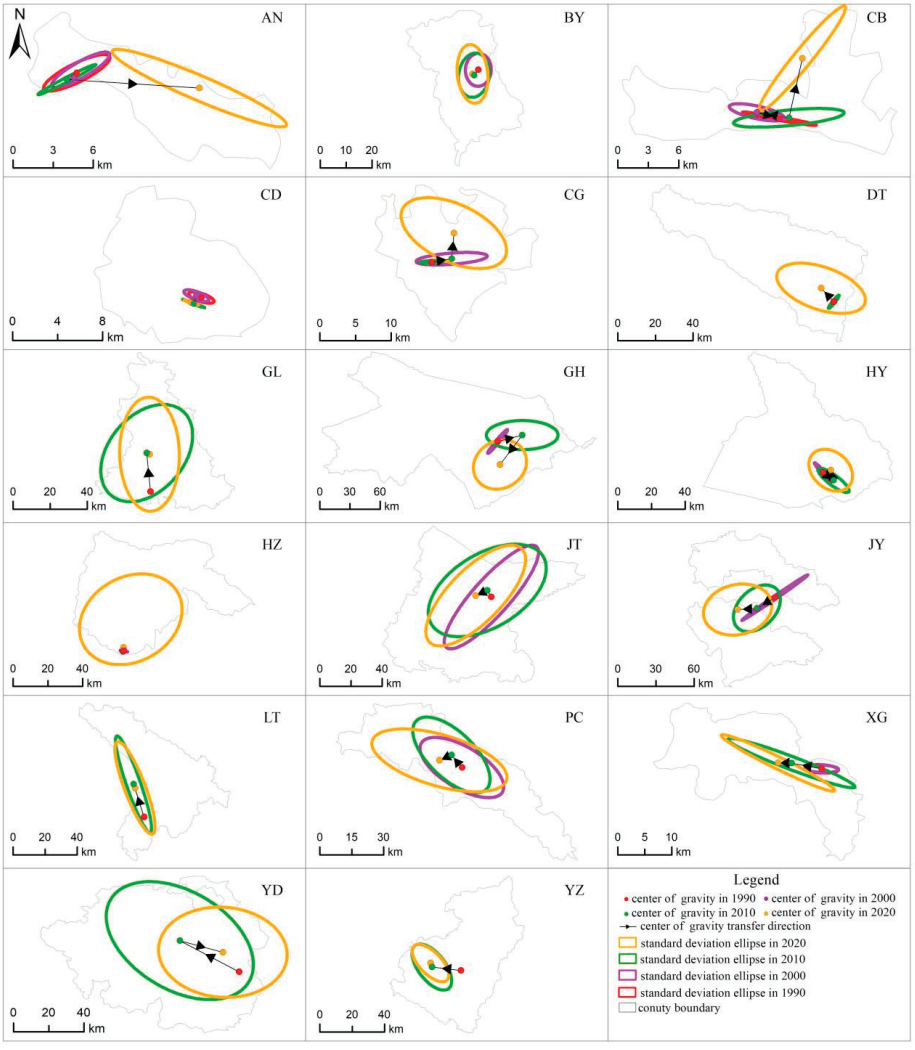


Figure 9. Distributions of central other construction land shifts at the county level in the study area from 1990 to 2020.

3.3. Analysis of the Evolutionary Characteristics of the Multiscale Slope Spectrum of Construction Land

3.3.1. Characteristics of the Urban Agglomeration Construction Land Slope Spectrum

The slope spectra of urban construction land, rural settlement land and other construction land in the LXUA from 1990 to 2020 were similar to the topographic slope spectra, and all exhibited skewed slope gradient distributions (Figure 10). The peaks of the slope spectra of all three types of construction land were located in the 1°–2° slope range, and the proportions of land areas gradually decreased as the slope increased after these peaks. The topographic slope spectrum of the LXUA reached a peak in the 2°–3° slope range and gradually decreased after 3°. The slope spectrum of urban construction land intersected the topographic slope spectrum at approximately 6° (Figure 10a). Urban construction land

was distributed mainly in areas below 6°, and the proportion of urban construction land in areas below 6° to the total area of urban construction land reached 85.27% in 1990, but this proportion increased over time to 86.27% in 2020; the largest increase occurred from 2010 to 2020, reaching 0.91%. The rural settlement land was distributed mainly in areas below 8° (Figure 10b), and over time, the rural settlement land also showed an upward trend in the dominant area. In contrast, other construction land was distributed mainly in areas below 7° from 1990 to 2010 (Figure 10c), but the T value of other construction land increased to approximately 9° from 2010 to 2020, and the areal proportion of this land type in the dominant area fluctuated over time, with the most obvious change occurring from 2010 to 2020, when the areal proportion in the dominant area increased by 0.59%. By analyzing the change values of the upper-limit slope and the average climbing index of the three types of construction land in the LXUA from 1990 to 2020 (Figure 10d), it can be seen that the ABCI revealed fluctuating changes over time, and the average climbing index values of rural settlement land and other construction land were maximized from 2000 to 2010, at 0.04% and 0.06%, respectively. The maximum value of the change in the upper-limit slope of other construction land from 2000 to 2010 reached 3°. The ABCI and ULSC values of all three types of construction land from 2010 to 2020 were less than 0, indicating that the expansion of construction land in that period was still distributed within the dominant area. These results show that, due to the development characteristics of the population and economy, the construction land in the LXUA mainly expanded horizontally in the dominant area during the study period, while an obvious climbing phenomenon toward the inferior area could be observed from 2000 to 2010.

3.3.2. Slope Spectrum Characteristics of Construction Land at the Provincial Tract Scale

Due to their different physical-geographical conditions and regional development stages, the slope spectrum distribution characteristics and the degree of climbing changes of construction land in the Gansu and Qinghai zones also differed (Figure 11). The areal proportions of urban construction land and rural settlement land distributed in the dominant area in 2020 did not differ excessively between the two zones, while 95.84% of other construction land in the Qinghai zone was distributed in the dominant area and only 71.45% was distributed in the Gansu zone. With time, the peak of the slope spectrum of construction land in the Gansu area showed a decreasing trend and moved toward the inferior area (Figure 11a,b), and the peak of other construction land decreased the most, reaching 6.23% (Figure 11c); that is, the rural residential land and other construction land in the Gansu area gradually climbed toward the inferior area. The peaks of the spectra of urban construction land and rural residential land in the Qinghai area both showed increasing trends (Figure 11d,e), while the spectral peak of other construction land decreased and moved toward the inferior area (Figure 11f).

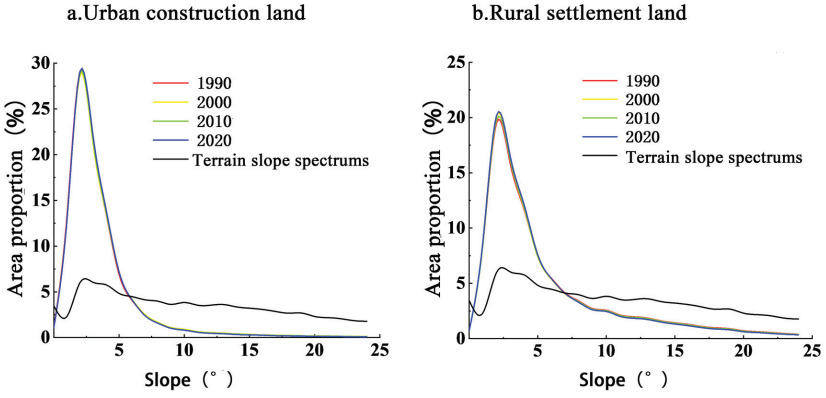


Figure 10. *Cont.*

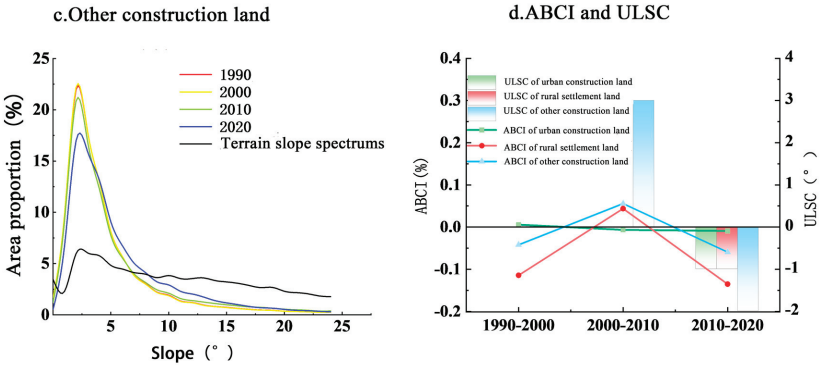


Figure 10. Terrain and construction land slope spectra and ABCI and ULSC values in the LXUA from 1990 to 2020.

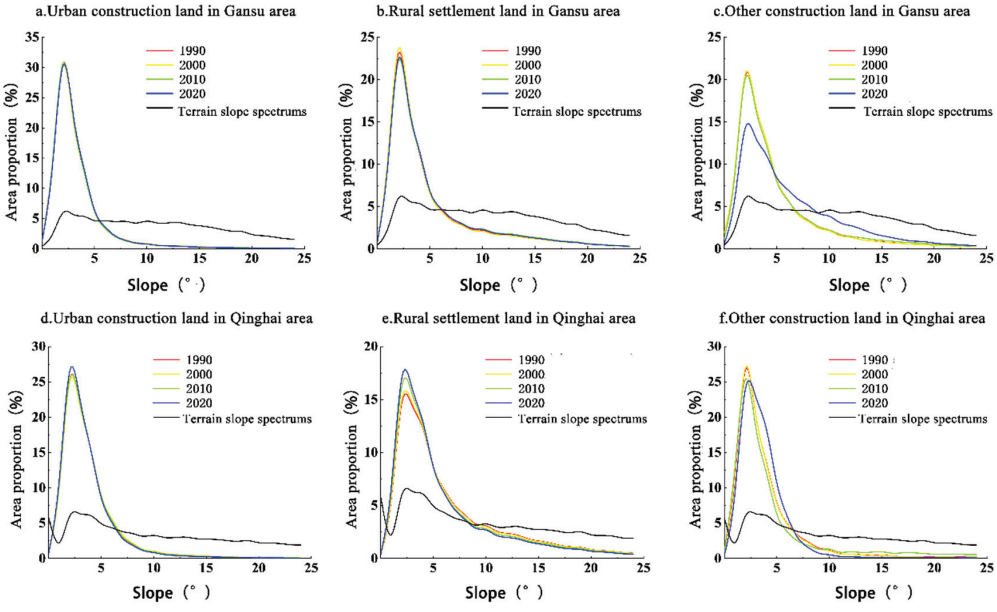


Figure 11. Terrain and construction land slope spectra of two regions within the LXUA from 1990 to 2020.

The average slope climbing index (ABCI) values of construction land within different slices of the LXUA all showed fluctuating trends over time, and the upper-limit slope values mostly decreased over time (Figure 12). The upper-limit slope of urban construction land in the Gansu area was distributed at approximately 10° (Figure 12a), and the ABCI peaked at 0.04% from 1990 to 2000 (Figure 12b), indicating a small slope-climbing phenomenon in urban construction land. The upper-limit slope of rural settlement land was distributed at approximately 17° and did not change over time. The ABCI peaked at 0.26% from 2000 to 2010. The increase in the upper-limit slope value of other construction land was accompanied by an increase in the average slope climbing index, which showed obvious slope-climbing characteristics. The urban construction land in the Qinghai area also developed toward the inferior area from 1990 to 2000 (Figure 12a,b) and maintained low slope-level expansion after 2000. From 2000 to 2010, rural settlement land showed a slow climbing phenomenon, while other construction land climbed more drastically, with ULS growth as high as 9° and an ABCI index value as high as 1.04%. These findings

are closely related to the large-scale urban and rural construction implemented after the proposal of the "Western Development" strategy. The construction land-use methods of "building up on the mountains" and "cutting the mountains for development" became important means for alleviating land shortages during this period.

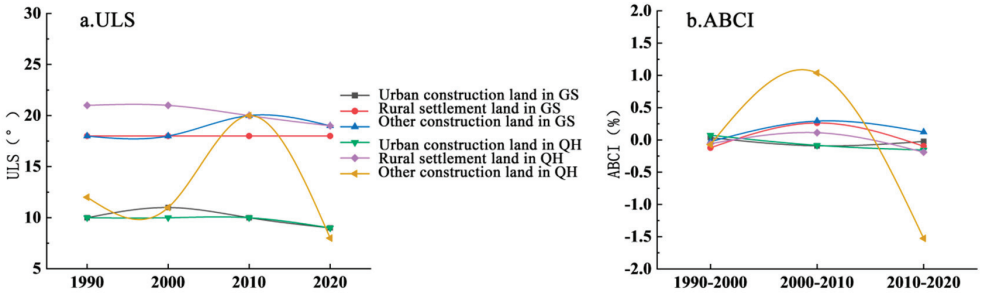


Figure 12. ABCI and ULS results of two regions within the LXUA from 1990 to 2020.

3.3.3. Characteristics of the Construction Land Slope Spectra of Typical Cities

Due to the influence of the natural conditions, the slope spectra of construction land in the three cities differed, and obvious differences in the spatial distributions of the slopes were also observed. By analyzing the slope-spectrum distribution characteristics of construction land in the three cities between 1990 and 2020, we found (Figure 13) that the overall proportion of the three types of construction land distributed in the dominant area in Lanzhou city was approximately 85%. With the passage of time, the proportion of urban construction land in the dominant area gradually increased, and the spectrum peak rose by 1% during the study period, indicating that the urban construction land area expanded in the dominant area (Figure 13(a1)). The proportions of rural settlement land and other construction land in the inferior area gradually increased, and the greatest increase occurred between 2000 and 2010, at 0.74%. The proportions of rural residential land and other construction land in the disadvantaged area gradually increased, with the largest increases of 0.74% and 13.26% between 2000 and 2010, and the spectral peaks both decreased, indicating that rural residential land and other construction land gradually climbed toward the disadvantaged area (Figure 13(b1,c)). The spectral peaks of urban construction land and rural settlement land in Xining City increased during the study period, indicating the expansion of these land types in the dominant area (Figure 13(a2,c)), and significant changes in the distribution of rural settlement land were observed between 2000 and 2010, with the proportion of the dominant area increasing by 4.78% and the spectral peak increasing by 2.22%. The other construction land area had a tendency to climb toward the inferior area (Figure 13(b2)). The spectrum of urban construction land in Haidong City showed a decreasing trend (Figure 13(a3)), with the largest decrease of 1.75% occurring between 1990 and 2000, indicating that urban construction land was climbing toward the inferior area at this time. The slope spectrum of rural settlement land shows a inverted-"U" distribution (Figure 13(b3)), and the spectrum peak was increasing annually; the proportion of land in the superior area was increasing by 4.78%, and the spectrum peak was increasing by 2.22%. The slope spectra of other construction sites exhibited significantly different characteristics (Figure 13(c3)), with a wide range of slope distributions and fluctuating spectral peaks, reaching a maximum value of 19.04% in 2020.

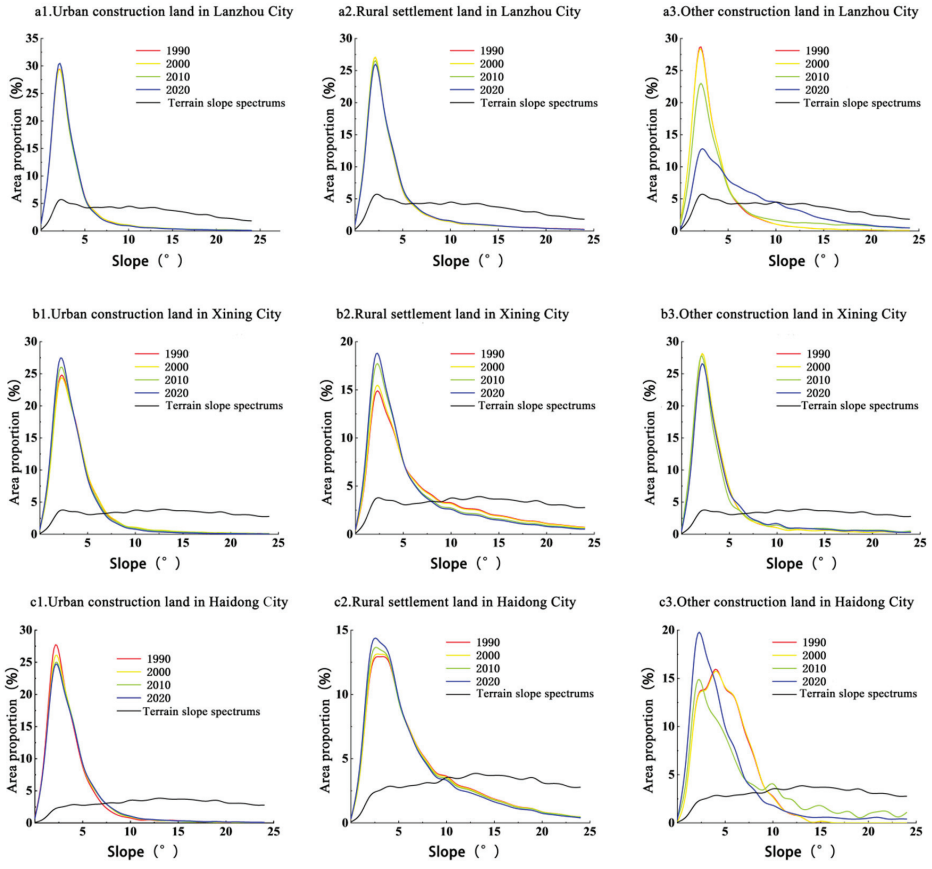


Figure 13. Terrain and built-up land slope spectra of typical cities in the LXUA from 1990 to 2020.

Our comprehensive analysis of the changes in the average construction land slope index and the upper-limit slope at the typical city scale showed that the upper-limit slopes of urban construction land in Lanzhou and Xining both experienced fluctuating trends of "first increasing and then decreasing" from 1990 to 2020, while the upper-limit slope of urban construction land in Haidong City gradually increased with time (Figure 14). The slope of the upper limit of rural residential land in Lanzhou City did not change over time, while the slopes of the upper limits of rural residential land in Xining City and Haidong City both tended to decrease (Figure 14a). The slopes of the upper limits of other construction land in all three cities fluctuated significantly during the study period, with the largest change occurring between 2000 and 2010. The average slope climbing indices of rural residential land and other construction land in Lanzhou City, of urban construction land and other construction land in Xining City, and of construction land in Haidong City all peaked with positive values from 2000 to 2010, indicating that a significant slope climbing phenomenon of construction land was occurring during this period. The average climbing index of urban construction land in Lanzhou City and other construction land in Haidong City all peaked with positive values from 2000 to 2010, indicating that there was an obvious phenomenon of construction land climbing during this period and that the degree of climbing was intense. In addition, the urban construction land in Lanzhou City also exhibited a low-degree climbing phenomenon from 1990 to 2000, and the rural residential land in Xining City also exhibited this phenomenon from 2010 to 2020.

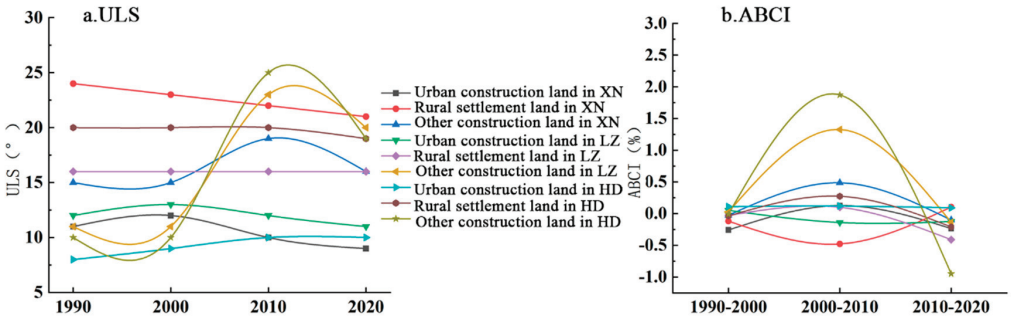


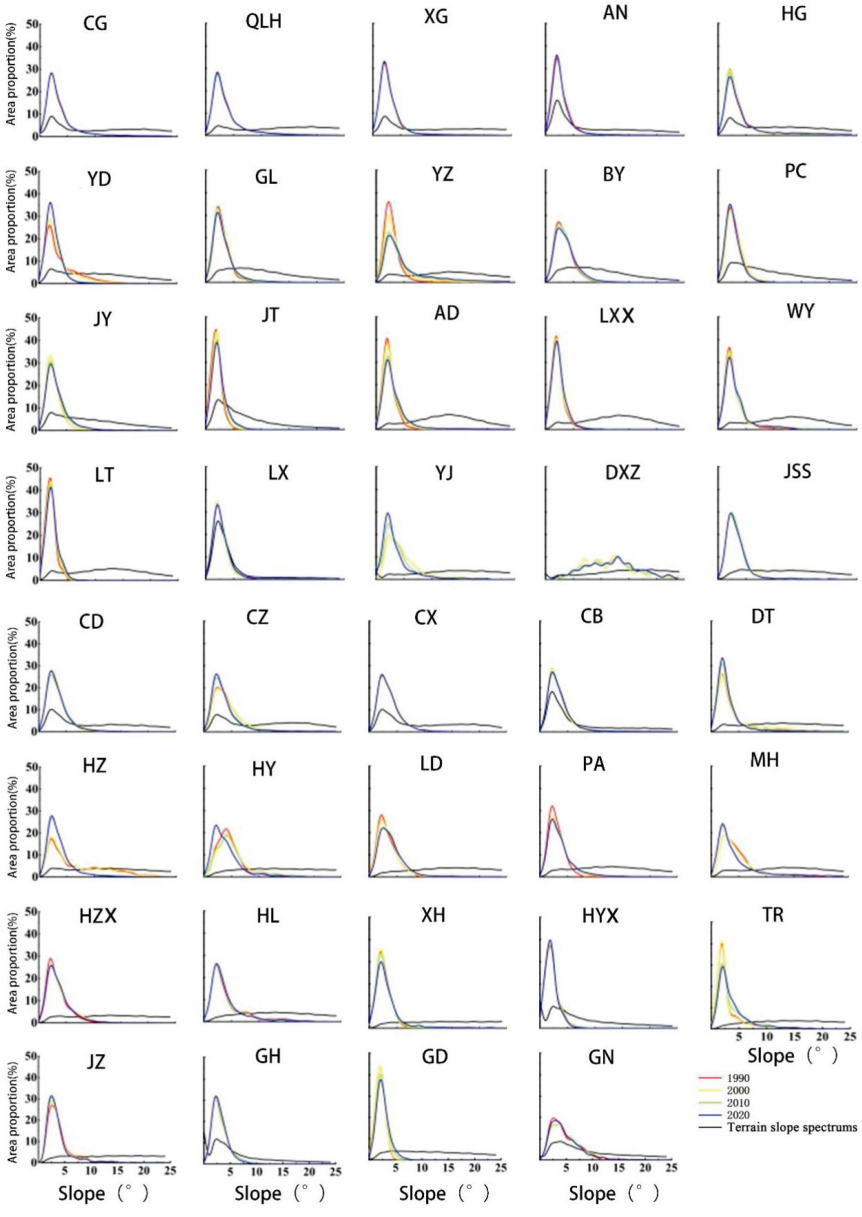
Figure 14. ABCI and ULS values of typical cities in the LXUA from 1990 to 2020.

3.3.4. Characteristics of the Slope Spectrum of Construction Land at the County (District) Scale

The spatial distribution of the slope spectrum of construction land in each county (district) also exhibited obvious differences, and by observing the morphology of the three types of construction land slope spectra in each county (district), we found that most of the counties (districts) had smooth, inverted-"V" curves of the construction land slope spectra, highly similar to the morphology of the topographic slope spectra (Figure 15), and the dominant areas were located within these areas in 2020. However, although the slope spectra of construction land in some counties (districts) also showed the trend of "increasing and then decreasing", several slight fluctuations were observed, and some counties (districts) had a "few" shape in their slope spectra of construction land. For example, for the urban construction land in Jianzha County and Guinan County, the rural residential land in Mutual Aid County and Ledu District, and the other construction land in Baiyin District and Jingyuan County, the proportions of the construction land areas in these counties (districts) were less than 85%, indicating that the slopes of construction land distributions were wide. As determined from the change in the slope spectrum curve of construction land over time, most counties (districts) contained urban construction land and other construction land distributed within the dominant area, and the areal proportion increased gradually over time; that is, the urban construction land expanded horizontally within the dominant area. The rural residential land in most of the counties (districts) exhibited the phenomenon of climbing up toward the inferior area, with the most obvious changes observed in the counties (districts) of Chengzhong District and Huanzhong District, while in other counties (districts), this land type expanded toward the superior area, such as in Chengguan District, Qilihe District and Anning District.

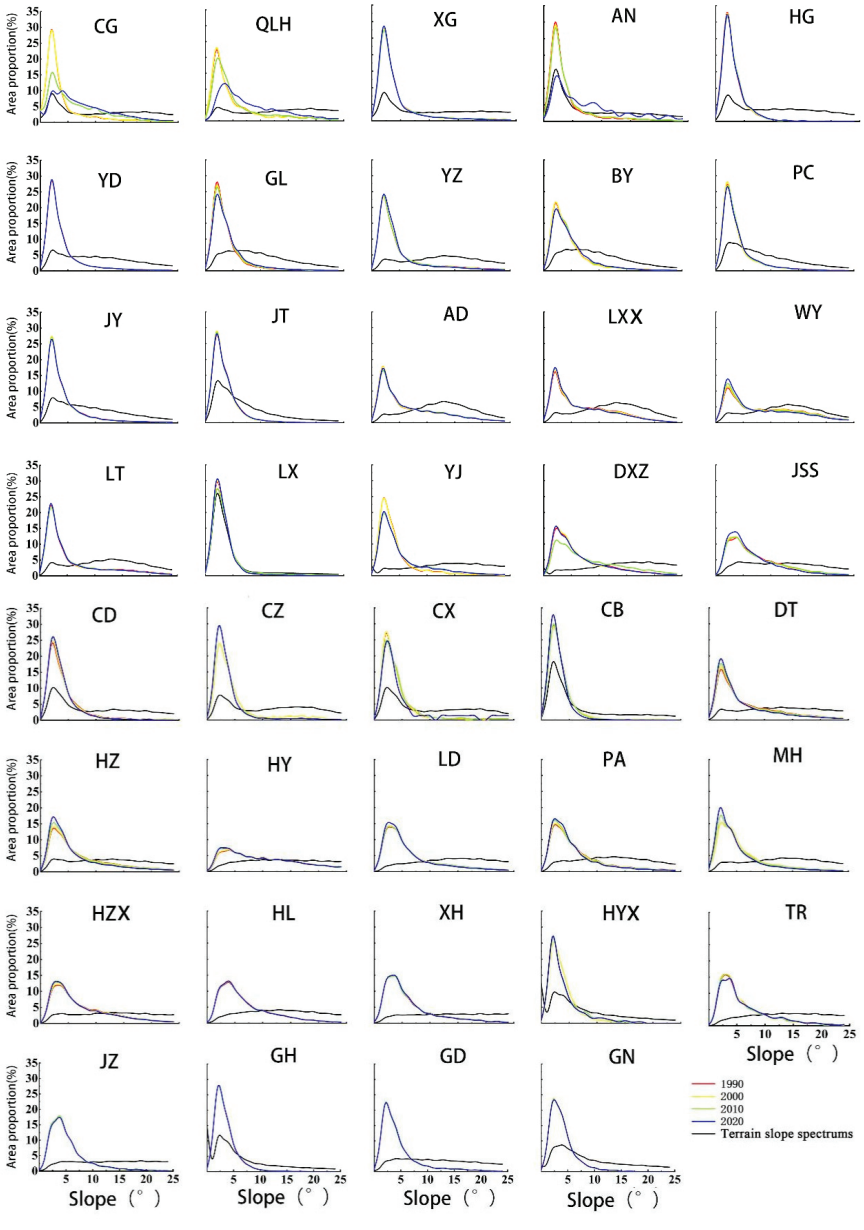
Based on our comprehensive analysis of the average construction land climbing index (ABCI) and the upper-limit slope change (ULSC) values of the three types of analyzed land in the counties (districts) of the LXUA during the study period, the 39 counties (districts) could be roughly divided into three categories: the high-climbing type (HC, ABCI > 0 and ULSC > 0), low-climbing type (LC, ABCI > 0 and ULSC $\leq$ 0, or ABCI $\leq$ 0 and ULSC > 0), and horizontally extended type (HZ, ABCI $\leq$ 0 and ULSC $\leq$ 0) (Figures 10 and 16). Among them, a high-climbing-type county (district) does not indicate that the climbing slope of the construction land was large, but rather that the value of the upper-limit slope change during the climbing process as well as the degree of climbing were large. The largest climbing magnitudes observed during the study period exhibited the strongest increases in rural settlement sites in Dongxiang County (Figure 16(a2,b,c)). There were three counties (districts) with relatively few distribution areas of other construction land before 2000 and three counties (districts) with obvious climbing phenomena, namely, Lintao County, Chengbei District and Republican County (Figure 16(a3,b,c)). From our analysis, we found that there were 34 urban-construction-land-climbing counties in the 1990–2000 period, 31 in the 2000–2010 period, and 23 in the 2000–2020 period, and both the scale and degree of urban construction land climbing gradually decreased over time (Figure 16(a1,b,c)). The

number of rural settlement sites in the 2000–2010 period reached 34 in the climbing-type counties, and regarding the scale and degree of climbing in 2000, the number of counties (districts) with climbing other construction land increased significantly, and Chengguan District showed significant a climbing phenomenon; from 2010 to 2020, the number of counties (districts) with strong climbing degrees rose to 12.



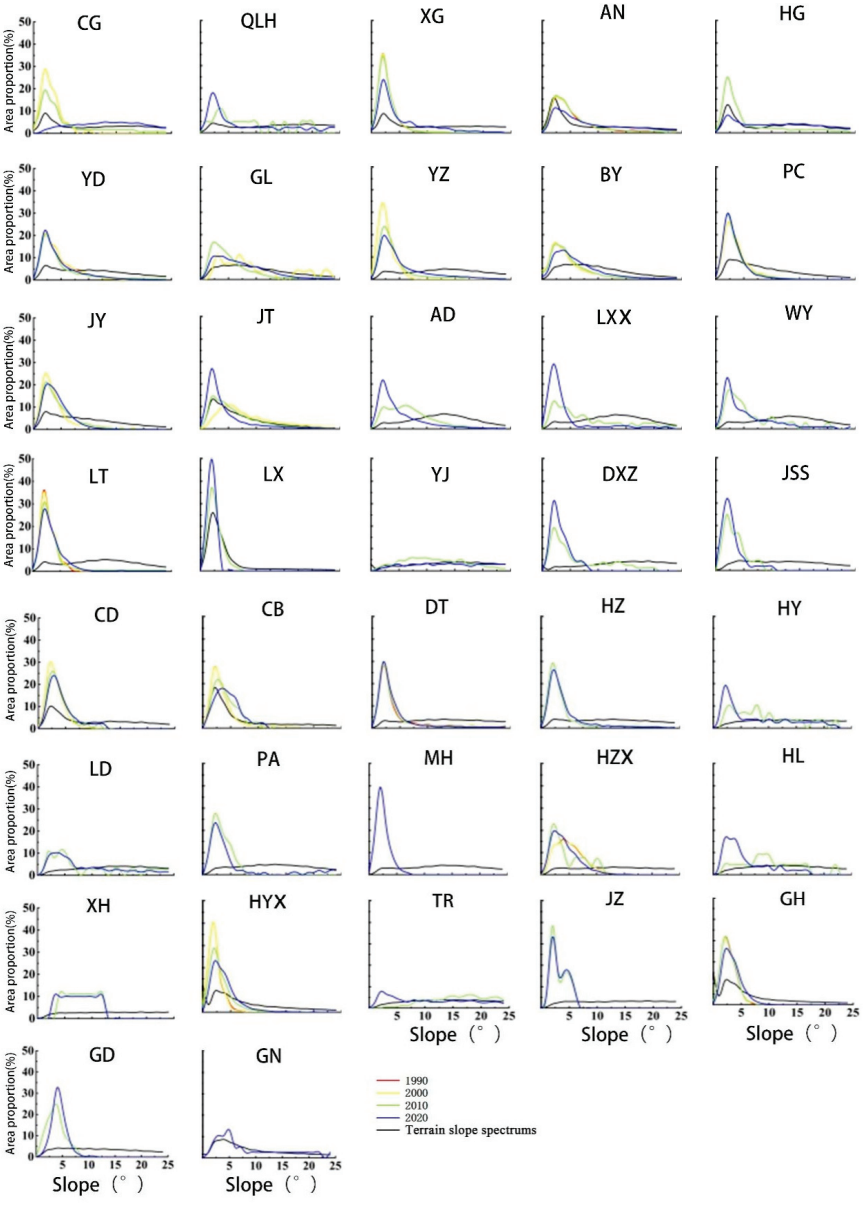
(**a**) Urban construction land

Figure 15. *Cont.*



(**b**) Rural settlement land

Figure 15. *Cont.*



(**c**) Other construction land

Figure 15. Terrain and built-up land slope spectra of counties (districts) in the LXUA from 1990 to 2020.

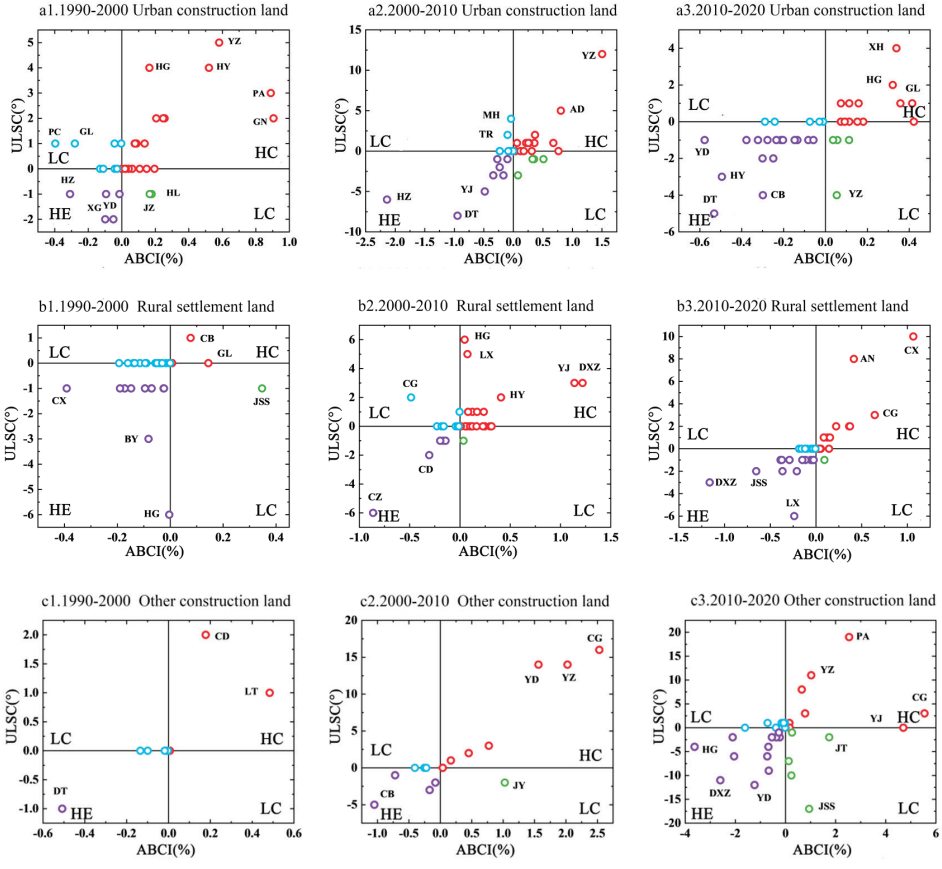


Figure 16. ABCI and ULSC results of counties (districts) in the LXUA from 1990 to 2020.

3.4. Analysis of the Construction Land Climbing Gradient Effect

To further explore the relatively hot and cold patterns of the spatial distribution of the construction-land-climbing phenomenon, a map of the slope-share classes of the three types of construction land was drawn based on grid cells (Figure 17). From the four time points of 1990–2000, the relatively hot areas of the three types of climbing construction land slopes showed gradually expanding trends in space. Among them, three main hot zones of slope-climbing were observed for urban construction land in 1990 and 2000, corresponding to the main urban areas of Lanzhou, Xining and Baiyin (Figure 17a). By 2010, a corridor-type climbing hot zone with Lanzhou–Xining as two axes was formed, and obvious scattered hot zones also appeared in Baiyin District of Baiyin City, Dingxi An Ding District, and Yongdeng County of Lanzhou City. These climbing hot zones continued to expand in 2020, and at the same time, with the establishment and development of Lanzhou New District, the number of patches of climbing hot zones in the Lanzhou–Baiyin metropolitan area gradually increased. The climbing relative hot zone of rural residential construction land was distributed mainly in Xining City and connected with Haidong City Lanzhou City to the east, showing an obvious linear hot zone (Figure 17b). From the four change periods, the rural settlement sites basically did not show any major changes in the pattern of climbing hot zones. Other construction sites in the 1990–2010 climbing hot zone were distributed mainly in the area around the Lanzhou–Baiyin metropolitan area, and the climbing hot zone around the Lanzhou–Baiyin metropolitan area continued to expand in 2020 and was basically connected to Lanzhou New District, while new climbing hot zones also appeared

in Tongren City and Gonghe County (Figure 17c). However, the relative hot zones of the three types of climbing construction land did not change significantly over time in terms of their areal shares, and the relative hot zone of climbing urban construction land had the highest areal share of 6%. The relative hot zones of rural settlements and other construction land accounted for 4% and 3%, respectively, indicating a synergistic partnership between the horizontal expansion of construction land and the vertical climbing of construction land in the LXUA.

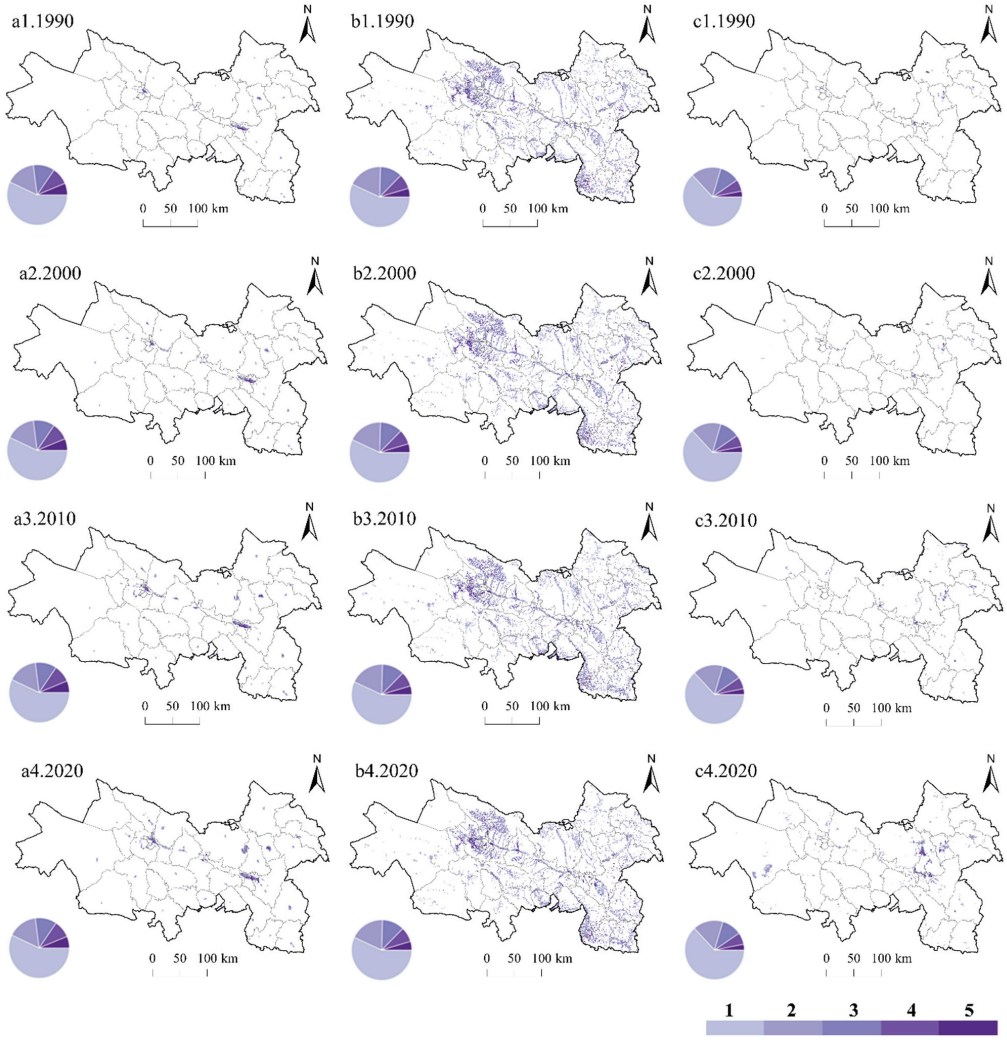


Figure 17. Grades of construction land slope shares corresponding to the three types of analyzed construction land in the LXUA from 1990 to 2020.

3.5. Correlation Analysis of the Driving Forces of Slope-Climbing Construction Land

The correlation results show (Table 3) that population had the greatest influence on the climbing slope in urban construction land hot zones, with a coefficient of 0.49, followed by the average GDP, with a coefficient of 0.35. These findings indicate that, the faster the population growth and the faster the GDP development, the larger the scale of urban construction land expansion, and the more these factors drive cities uphill. Natural

conditions such as elevation, relative humidity and precipitation are the main factors driving the development of rural settlements to higher-slope areas. The better the natural conditions, the better the agricultural infrastructure conditions; additionally, the better the land-use conditions, the greater the increase in new rural settlements in large areas and the rapid development and utilization of mountainous areas. In addition to the socioeconomic and natural conditions, the distribution of other construction land is influenced by the distance from public utilities such as the Qinghai–Tibet Railway, Beijing–Tibet Expressway and Zhang Wen Expressway and by the construction of expressways contributing to the expansion of industrial land.

Table 3. Results of the driving factor analysis.

Variable	Environmental Limitation				Geographical Location		Economic Development			Policy
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Urban	−0.06	−0.30 **	−0.32 **	−0.279 **	−0.15 **	−0.16 **	0.49 **	−0.03	0.35 **	−0.04
Rural	0.10 **	0.13 **	0.18 **	0.138 **	−0.01	−0.08 **	0.10 **	0.01	0.12 **	0.09 **
Other	0.17 **	−0.07 *	−0.20 **	−0.120 **	0.19 **	−0.01	0.21 **	0.02	0.13 **	−0.02

Note: ** $p < 0.05$, * $p < 0.1$.

4. Discussion and Conclusions

4.1. Discussion

The development of construction land has an important impact on urban morphology, the ecological environment and the territorial spatial layout. Due to continuous population growth and agglomeration, urban expansion is characterized by the sustained interaction between horizontal and vertical growth [36,37]. However, existing studies have focused mainly on the expansion of construction land in the horizontal direction, while less research has explored the slope-climbing phenomenon of construction land in the vertical dimension. Therefore, in this paper, we comprehensively analyzed the horizontal expansion and vertical slope-climbing characteristics of construction land from the perspective of urban agglomeration in a multiscale and refined manner, marking the first that construction land has been studied at a fine classification scale and thereby compensating for the shortcomings of existing research. Moreover, this long-time-series study can enhance our understanding of the evolution of spatiotemporal patterns and driving factors of vertical urban sprawl. The latest study found that the underestimation of the urban land area by LULC products can be described by a logarithmic law, and the potential threshold of this law is approximately a 30 m resolution [38]. Therefore, we chose land-use data with a resolution of 30 m × 30 m to best reveal the evolutionary characteristics of construction land in urban agglomerations.

Our results show that the horizontal expansion and vertical slope-climbing of urban construction land in the LXUA coexist and show a continuous and rapid increase, and have obvious spatial variation characteristics; this observation is the same as the existing hotspot studies [23,39,40]. Specifically, the findings of this study are similar to those of the Yangtze River Delta urban agglomeration, the Pacific Coast urban agglomeration of Japan, and Asia and North America. All of these regions show a faster development trend in terms of construction land expansion. The results of the identification of influencing factors indicate that the combination of geographic location and economic development has led to the rapid growth of construction land in the study area, which is consistent with this study, and the effects of average slope, GDP growth and population growth on land use have been widely verified. However, this study again focuses on the influence mechanisms related to urbanization, accessibility and policy factors.

Scientific and effective spatial planning and tailored development models are essential for sustainable urban development [41]. The rural settlement land in the Gansu area decreased after 2010. This finding is consistent with China's new urbanization strategy and the policy of tapping the stock of land, while, in contrast, the rural settlement land in the Qinghai area has been slowly increasing, although the reality of deep poverty and

the many herdsmen in Qinghai Province suggest that the rural settlement land in this region cannot be developed as much as the agricultural area. Although the reality of Qinghai Province is that the land-use types in rural settlements are not as concentrated as those in agricultural areas and the policy of "one house per household" is not as strictly implemented, Qinghai Province still needs to pay more attention to rural land use and to the remediation of "hollow villages". The results of these studies have important reference value for national differentiated land planning and annual land-allocation indices in China. Facing the contradiction of the "development and protection" of land shortages and fragile ecological environments, determining how to realize the "win-win" goal of "development in protection and protection in development" will be important for the construction and development of the LXUA. In this paper, we studied only the horizontal expansion and vertical slope-spectrum characteristics, gradient effects and driving factors of construction land; in the future, we plan to conduct comprehensive research on construction land, arable land protection and ecological space fragmentation. Long-time-series research and more highly detailed studies of the evolutionary characteristics of construction land using higher-spatial-resolution and higher-precision data are needed in the future. In addition, in determining the driving forces of climbing construction land due to policy influence, we quantified only the influence of the distance of the study area from an ecological reserve. More variables, such as government policies, living customs and historic preservation, should be considered to assess the driving mechanisms. Moreover, from the green and low-carbon target requirements, we plan to study low-carbon construction land-use patterns, make suggestions for the high-quality development of the LXUA, and contribute wisdom to the high-quality protection of the Yellow River basin.

4.2. Conclusions

Our results show that the construction land in the LXUA has continued to expand and exhibits varying expansion characteristics. At the urban agglomeration scale, urban construction land, rural settlement land and other construction land show "linear", inverted-"U" and "J" growth patterns, respectively. The areas of rural settlements in 9 counties (districts) are decreasing, and the number of counties (districts) with decreasing areas is increasing, while the areas of other construction land in most counties (districts) are increasing. The center of gravity of urban construction land continued to shift northwestward during the study period, and the standard deviation ellipse flattened. The center of gravity of rural settlement land continued to shift southeastward, the center of gravity of other construction land continued to shift southwestward, and the dispersion degree increased in the east-west direction.

The slope-spectra curves of construction land in the LXUA were found to be similar to the topographic slope-spectra curves, and they all exhibited skewed distributions in terms of the slope gradients. Urban construction land expanded at the level of the dominant areas, while rural settlement land and other construction land climbed up to the inferior areas. The relatively hot zones of slope-climbing of construction land in the LXUA showed a trend of gradual expansion with regards to their spatial extent, with relatively small areal-share changes observed. The hot zone of the slope-climbing of urban construction land was centered on the cities of Lanzhou and Xining. Rural settlements appeared as obvious hot zones in Xining city. The hot zones of other construction land climbing areas were concentrated in the Lanzhou–Baiyin metropolitan area. The slope-climbing phenomenon of construction land was subject to the combined effects of natural environmental conditions and social factors, including GDP, population, precipitation and relative humidity. Accessibility was found to be the key factor influencing the other construction land area.

Author Contributions: Conceptualization, J.R.; methodology, J.R. and H.Z.; validation, J.G. and C.L.; formal analysis, J.R.; investigation, H.Z.; resources, X.Z. and Y.G.; data curation, X.Z. and H.Z; writing—original draft preparation, H.Z. and J.R.; writing—review and editing, H.Z. and W.H.; visualization, W.H. and C.L.; supervision, C.L.; project administration, J.R. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the National Social Science Foundation Youth Project of China (21CGL040); the Qinghai Provincial Social Science Foundation General Project (21021); and the Qinghai Provincial Social Science Foundation General Project (22Y011).

Data Availability Statement: The data presented in this study are available from the corresponding author upon request.

Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

References

1. Ning, J.; Liu, J.; Kuang, W.; Xu, X.; Zhang, S.; Yan, C.; Li, R.; Wu, S.; Hu, Y.; Du, G.; et al. Spatiotemporal patterns and characteristics of land-use change in China during 2010–2015. *J. Geogr. Sci.* **2018**, *28*, 547–562. [CrossRef]
2. Liu, J.; Kuang, W.; Zhang, Z.; Xu, X.; Qin, Y.; Ning, J.; Zhou, W.; Zhang, S.; Li, R.; Yan, C.; et al. Spatiotemporal characteristics, patterns, and causes of land-use changes in China since the late 1980s. *J. Geogr. Sci.* **2014**, *24*, 195–210. [CrossRef]
3. Ren, J.; Zhou, W.; Guo, J.; Huang, Y.; Hai, W. Analysis on Spatial-Temporal Characteristics and Influencing Factors of Multi-functionality of Land Use in Qinghai-Tibet Alpine Mountain Areas: A Case Study of Haidong City in Qinghai Province, China. *China Land Sci.* **2021**, *35*, 90–100.
4. Li, X.B. Explanation of land use changes. *Prog. Geogr.* **2002**, *21*, 195–203. [CrossRef]
5. Kuang, W. 70 years of urban expansion across China: Trajectory, pattern, and national policies. *Sci. Bull.* **2020**, *65*, 1970–1974. [CrossRef] [PubMed]
6. Angel, S.; Parent, J.; Civco, D.L.; Blei, A.; Potere, D. The dimensions of global urban expansion: Estimates and projections for all countries, 2000–2050. *Prog. Plan.* **2011**, *75*, 53–107. [CrossRef]
7. United Nations. World Cities Report 2020: The Value of Sustainable Urbanization.UN-HABITAT. 2020. Available online: https://unhabitat.org/world-cities-report-2020-the-value-of-sustainable-urbanization (accessed on 5 November 2022).
8. Seto, K.C.; Güneralp, B.; Hutyra, L.R. Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proc. Natl. Acad. Sci. USA* **2012**, *109*, 16083–16088. [CrossRef] [PubMed]
9. Qiao, W.; Liu, Y.; Wang, Y.; Fang, B.; Zhao, Y. The relationship of evolution between urban land use types and intensity in Nanjing since the early 21st century. *Acta Geogr. Sin.* **2015**, *70*, 1800–1810. [CrossRef]
10. Zhou, L.; Dang, X.; Zhou, C.; Wang, B.; Wei, W. Evolution characteristics of slope spectrum and lope-climbing effects of built-up land in China. *Acta Geogr. Sin.* **2021**, *76*, 1747–1762. [CrossRef]
11. Xu, Y.; Zhao, S.; Fan, J. Urban planning construction land standard and its revision based on climate and topography in China. *J. Geogr. Sci.* **2020**, *31*, 603–620. [CrossRef]
12. Lv, X.; Huang, X.J.; Zhang, J.Q. A literature review on urban-rural construction land transition. *City Plan. Rev.* **2015**, *39*, 105–112. [CrossRef]
13. Ren, J.; Zhou, W.; Liu, X.; Zhou, L.; Guo, J.; Wang, Y.; Guan, Y.; Mao, J.; Huang, Y.; Ma, R. Urban Expansion and Growth Boundaries in an Oasis City in an Arid Region: A Case Study of Jiayuguan City, China. *Sustainability* **2019**, *12*, 210. [CrossRef]
14. Luo, J.; Liu, Y.; Yue, W.; Huang, J. Evolution of urban spatial structure in a mountainous city: Transforming from linear expansion along valleys to polycentric urban development. *Econ. Geogr.* **2013**, *33*, 61–67.
15. Qiao, W.F.; Mao, G.X.; Wang, Y.H.; Chen, Y.J. Research on urban expansion and land use change in Nanjing over the past 32 years. *J. Geo-Inf. Sci.* **2016**, *18*, 200–209. [CrossRef]
16. Wang, D.Y.; Ji, X.P.; Huang, X.J. Spatial and temporal pattern analysis of construction land in Yangtze River Economic Zone since 1990s. *Mod. Urban Res.* **2018**, *4*, 30–36. [CrossRef]
17. Gao, Q.; Fang, C.; Zhang, X.; Lui, H.; Ren, Y. Spatio-temporal evolution characteristics and mechanisms of influence of urban construction land expansion in Xinjiang, the Core Area of the Silk Road Economic Belt. *Acta Ecol. Sin.* **2019**, *39*, 1263–1277. [CrossRef]
18. Deng, Y.W.; Zhen, J.H.; Ma, C.Y. Multi-scenario simulation of the impact of urban expansion on ecological risk: A case study of Hohhot City, Inner Mongolia. *Acta Ecol. Sin.* **2021**, *41*, 1199–1208. [CrossRef]
19. Sun, P.L.; Xu, Y.Q.; Wang, S. Terrain gradient effect analysis of land use change in poverty area around Beijing and Tianjin. *Trans. Chin. Soc. Agric. Eng.* **2014**, *30*, 277–288. [CrossRef]
20. Zang, Y.Z.; Liu, Y.S.; Yang, Y.Y. Land use pattern change and its topographic gradient effect in the mountainous areas: A case study of Jinggangshan city. *J. Nat. Resour.* **2019**, *34*, 1391–1404.
21. Zhu, C.L.; Zhang, J.F.; Zhao, Y.L.; Liu, C. Topographic gradient effects of typical watershed ecosystem services in the eastern Tibetan plateau: A case study of the upper reaches of Minjiang Rive. *Resour. Environ. Yangtze Basin* **2017**, *26*, 1687–1699. [CrossRef]
22. Zhang, J.; Zhu, W.; Zhao, F.; Zhu, L.; Li, M.; Zhu, M.; Zhang, X. Spatial variations of terrain and their impacts on landscape patterns in the transition zone from mountains to plains—A case study of Qihe River Basin in the Taihang Mountains. *Sci. China Earth Sci.* **2018**, *61*, 450–461. [CrossRef]
23. Peng, Q.Z.; Ma, S.H.; Deng, Q.H.; Ma, J.W. Relationship between construction land and slope in rapidlyexpanding mountain cities: A case study in Guiyang, China. *J. Nat. Resour.* **2022**, *37*, 1865–1875.

24. Guo, H.F.; Xu, Y.Q.; Wu, Y.F. Analysis of the Land Use Spatial Pattern and Spatio-Temporal Changes Based on Terrain Gradient: A Case Study of Pinggu District in Beijing. *Econ. Geogr.* **2013**, *33*, 160–166, 186.
25. Fang, C.L.; Zhang, G.Y.; Xue, D.S. High-quality development of urban agglomerations in China and construction of science and technology collaborative innovation community. *Acta Geogr. Sin.* **2021**, *76*, 2898–2908. [CrossRef]
26. Luo, J.; Shi, P.J.; Zhang, X.B. Relationship between Topographic Factors and Population Distribution in Lanzhou-Xining Urban Agglomeration. *Econ. Geogr.* **2020**, *40*, 106–115.
27. Li, G.P. Multiple measures to promote the high-quality development of urban agglomerations in China. *Acad. Front. People's Forum* **2022**, 18–28. [CrossRef]
28. Yang, X.; Chen, X.; Qiao, F.; Che, L.; Pu, L. Layout optimization and multi-scenarios for land use: An empirical study of production-living-ecological space in the Lanzhou-Xining City Cluster, China. *Ecol. Indic.* **2022**, *145*, 109577. [CrossRef]
29. Qu, S.J.; Hu, S.G.; Tong, L.Y.; Li, Q.F. Spatiotemporal patterns of urban land use transition in the middle Yangtze River Economic Belt. *Resour. Sci.* **2017**, *39*, 240–251. [CrossRef]
30. Ren, J.; Liu, X.L.; Yue, J.Y.; Wang, Y.H.; Zhang, T.Z. Delimiting the urban development boundary of Jiayuguan City based on MCE-CA model. *Arid Land Geogr.* **2016**, *39*, 1111–1119.
31. Wang, C.; Tang, G.; Li, F. Fundamental conditions of slope spectrum abstraction and application. *Sci. Geogr. Sin.* **2007**, *27*, 587–592. [CrossRef]
32. Yu, R.; Cai, J.; Leung, P. The normalized revealed comparative advantage index. *Ann. Reg. Sci.* **2009**, *43*, 267–282. [CrossRef]
33. Liu, H.; Shi, P.; Tong, H.; Zhu, G.; Liu, H.; Zhang, X.; Wei, W.; Wang, X. Characteristics and driving forces of spatial expansion of oasis cities and towns in Hexi Corridor, Gansu Province, China. *Chin. Geogr. Sci.* **2015**, *25*, 250–262. [CrossRef]
34. Liu, Y.; Song, W.; Deng, X. Understanding the spatiotemporal variation of urban land expansion in oasis cities by integrating remote sensing and multi-dimensional DPSIR-based indicators. *Ecol. Indic.* **2019**, *96*, 23–37. [CrossRef]
35. Gauthier, T. Detecting Trends Using Spearman's Rank Correlation Coefficient. *Environ. Forensics* **2001**, *2*, 359–362. [CrossRef]
36. Mahtta, R.; Mahendra, A.; Seto, K.C. Building up or spreading out? Typologies of urban growth across 478 cities of 1 million+. *Environ. Res. Lett.* **2019**, *14*, 124077. [CrossRef]
37. Zambon, I.; Colantoni, A.; Salvati, L. Horizontal vs vertical growth: Understanding latent patterns of urban expansion in large metropolitan regions. *Sci. Total. Environ.* **2018**, *654*, 778–785. [CrossRef]
38. Li, X.; Chen, G.; Zhang, Y.; Yu, L.; Du, Z.; Hu, G.; Liu, X. The impacts of spatial resolutions on global urban-related change analyses and modeling. *iScience* **2022**, *25*, 105660. [CrossRef]
39. Shi, K.; Wu, Y.; Liu, S. Slope climbing of urban expansion worldwide: Spatiotemporal characteristics, driving factors and implications for food security. *J. Environ. Manag.* **2022**, *324*, 116337. [CrossRef]
40. Zhou, L.; Dang, X.; Mu, H.; Wang, B.; Wang, S. Cities are going uphill: Slope gradient analysis of urban expansion and its driving factors in China. *Sci. Total. Environ.* **2021**, *775*, 145836. [CrossRef]
41. Dong, T.; Jiao, L.; Xu, G.; Yang, L.; Liu, J. Towards sustainability? Analyzing changing urban form patterns in the United States, Europe, and China. *Sci. Total. Environ.* **2019**, *671*, 632–643. [CrossRef]

land

MDPI

Article

Urban Commons between Ostrom's and Neo-Materialist Approaches: The Case of Lido Pola in Naples, Southern Italy

Maria Patrizia Vittoria *, Stefania Ragozino and Gabriella Esposito De Vita

Institute for Research on Innovation and Services for Development (IRISS), National Research Council (CNR), 80134 Naples, Italy
* Correspondence: p.vittoria@iriss.cnr.it

Abstract: The main aim of the study was reflecting on performative implications of the urban commons and their relational ability (i.e., inter- and/or intra-actioning) within an inclusive governance model and policy design context through two interpretative keys: Ostrom's idea of sustainability and the recent hybrid neo-materialist urban and organizational theoretical path grounded within the Metzger–Barad–Latour analyses. Firstly, we focused on defining the theoretical setting, background and selected codes. The resulting scheme was tested with a mixed methodology within the case study of the Lido Pola Commons in Naples, Southern Italy. Empirical analysis benefits from long-lasting research experience on the area and an action-research processes aimed at codesigning a living civic lab. The discussion illustrates the main pivots of the internal/external validation of the case study results, thus contributing to enhancing a participatory policy design by raising awareness regarding social intra/interactions.

Keywords: urban commons; intra-actioning; governance model; policy design; Ostrom's CPRs; neo-materialist approaches

Citation: Vittoria, M.P.; Ragozino, S.; Esposito De Vita, G. Urban Commons between Ostrom's and Neo-Materialist Approaches: The Case of Lido Pola in Naples, Southern Italy. *Land* **2023**, *12*, 524. https://doi.org/10.3390/land12030524

Academic Editors: Pasquale de Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 26 January 2023
Revised: 16 February 2023
Accepted: 17 February 2023
Published: 21 February 2023

1. Introduction

The present paper addresses the commons' self-organization models and their governance issues by combining different epistemological approaches. The main aim of the study was reflecting on performative implications of the urban commons and their relational ability within an inclusive governance model and policy design context through two interpretative keys: Ostrom's idea of sustainability and the recent hybrid neo-materialist urban and an organizational theoretical path grounded within the Metzger–Barad–Latour (M–B–L) approach [1–3].

To this end, this article explores and discusses the urban commons agency capacity by developing a novel theoretical coding based on the combination of Ostrom's model and a hybrid neo-materialist-based approach. This latter, mostly conveyed by the seminal Karen Barad articles published between 2003 and 2011, considers the "agential realism" logical process as a new method of scientific interpretation of urban phenomena [3–5].

The well-known organizational model of the commons developed by Elinor Ostrom (1990) introduced a concept of relative sustainability. In this framework, she addressed the question of "how to enhance the capabilities of those involved to change the constraining rules of the game to lead to outcomes other than remorseless tragedies" [6] (p. 7). She suggested, in other words, a collective action model in which "a group of principals can organize themselves voluntarily to retain the residual of their own efforts" [6] (p. 25). Her idea was indeed to analyze the organizational and institutional arrangements and thus to define the rules to avoid Hardin's inner concern summarized within the iconic title of "The tragedy of the commons" [7].

The system of rules provided within the aforementioned governance model structures the social interaction of appropriators of the commons and conditions their ability to

discuss, decide on, and monitor self-imposed constraints: "many groups can effectively manage and sustain common resources if they have suitable conditions, such as appropriate rules, good conflict-resolution mechanisms, and well-defined group boundaries" [8] (p. 11).

Considering that shared resources have become a part of everyday urban life, the inherent governance model has been transitioned from natural to urban resources discourse [9–13]. In so doing, it has been implemented within formal and informal practices, as well as in urban planning and management practices [14]. The discourse regarding the intermingling of urban agendas and governance models of the commons has been strongly influenced by Ostrom's seminal theoretical guidelines [15]. Her positions supported thoroughly the portability of the commons approaches from the natural to the urban environment [16]. Recently, scholars, practitioners, and activists have been revisiting those theoretical guidelines in order to better address issues and opportunities on an urban scale ([17–20], among others).

In order to investigate this commons conceptual migration in more depth, some studies [21] have suggested reviewing the specific literature to identify the characteristics of urban resources that make them different from natural ones (i.e., subtractability vs. relationality). Following these authors [21], an understanding of the emerging differences could offer important opportunities in dealing with commons' managerial challenges and in interpreting specific social "intra-actioning," as defined by Barad.

The main reference for the inherent policy-design theoretical context is the hybridization of an urban planning and regional sustainable development model [1,22,23] with Latour's ideas about the definition of the urban governance field of action (the "we" of the governance field) [2,24–26].

At a policy level, the above two theories could be complemented by the idea of inherent urban, current, and auspicated cultural formulae [27]. Within this range, the two extremes are defined through the main cultural schemas, imagined to be bordered by a "persistent cultural preconception status" and a "post-Anthropocene auspicated "we"." Between them, the commons are playing a crucial role in the politics of conviviality, urban resilience, and environmental sustainability, as "communing" toward resilience could be the key to sustainable and inclusive urban development [28,29]. It is "not just about learning about how humans and animals cope on their own with living in the city, but rather a program with a transformative ambition of becoming-together. It purports to reassemble both ecologies as urban and cities as ecological through the conceptualization of urban inhabitants as always—already entangled and more-than-human; more-than-animal; more-than-plant . . . complex assemblages, mutually affecting and affected by their fields of becoming" [22] (p. 120). A sustainable city, as considered in the context of our analysis, should be a place of cohabitation in the face of intense differences [30], and where even more people claim the necessity of a new more-than-human sensibility as well as policies for urban multispecies conviviality [22].

In order to deeply understand the interpretative capacity of both theoretical frameworks (Ostrom and neo-materialist), the authors observed and decoded an urban commons' experience (governance or assemblages) and its contribution to a sustainable city: the Lido Pola Commons in Naples.

The following text is arranged in three main sections corresponding to the research process, anticipated by the rationale and research protocol. The theoretical setting Section 3 introduces the two epistemological theories and the resulting theoretical coding of the relationships–results commons dynamic. Section 4 is dedicated to the testing phase, in which the researchers collected a case study context description and the narrative of experiencing a codesigning civic lab. The discussion Section 5 illustrates the main pivots of the internal/external validation of the case study results. Finally, the conclusions summarize theoretical and practical evidence, adding some policy implications.

2. Research Protocol

This paper is part of a research process in which an interdisciplinary group of scholars based in Naples within the Institute of Research on Innovation and Services for Development (IRISS) of the National Research Council of Italy (CNR) started reflecting from different perspectives on the experience of commons and the community's initiatives embedded in urban regeneration processes [31–37].

By engaging communities and interpreting networks related to different topics emerged the need of filling a gap regarding tools for understanding the overlapping of the growing shared experiences and informal community initiatives with the hierarchical systems of rules embedded in urban planning and governance models [38–40]. The debate on evolutionary planning and the need to redefine forms and outcomes of participatory processes within urban regeneration initiatives encourages us to increasingly refine the theoretical horizon and operational toolkit [41]. No less crucial is the need to implement new approaches and procedures for assessing the social impacts of planning choices, so as to include the multiple variables at stake and promote territorial cohesion actions [42,43]. Observing how local tangible and intangible resources have been exploited within spontaneous initiatives in which neighborhood residents share a stake in informal agreements encouraged reflection on performative implications of the urban commons [14,44].

The emerging research gap can be summarized as the need of enhancing conceptualization and defining tools for understanding the commons agency capacity, considering their multidimensional nature and the multiplicity of different experiences included under the umbrella of sharing common resources.

Figure 1 summarizes the research protocol that—in a continuous feedback process—addresses the issues and challenges of commons governance, combining incursions into current experiences and reinterpretations of established theories. Observing the dynamics and contributing to the current debate, the research group focuses on the commons relational ability within an inclusive governance model and policy design context.

For this purpose, the article explores and discusses the urban commons agency capacity by developing a new theory based on the combination of Ostrom's model and a hybrid neo-materialist-based approach. The theoretical setting has been designed through two interpretative keys: Ostrom's idea of sustainability and the recent hybrid neo-materialist urban and organizational theoretical path grounded within the Metzger–Barad–Latour analyses. The resulting theoretical coding has been built extracting the relational modes from the combined theories.

As per the complexity of both the object of the study and the peculiarities of the internal dynamics and external relations of each experience, the research group has chosen to set a testing phase of theoretical coding within a purposefully selected commons experience. The case selection criteria refer to a relationality that addresses internal collaborative forms of the commons community domain and the exploration of relationships with the urban institutional framework and other players in the area.

To do so, the authors have chosen an experience that—in collaboration with a network of researchers and other territorial players—they are conducting on the Lido Pola commons in Naples, southern Italy. The empirical analysis benefits from long-lasting research experience on the area and a more recent action-research process aimed at codesigning a civic living lab (cf. Section 4). The turning point of the experience is the opening of the community to a collaboration with researchers and institutions to participate in funding calls that support civic and educational activities in the community. This process offers the opportunity of understanding the internal/external relational modes for a successful commons experience by applying to the case the theoretical relational coding presented in Section 3.3.

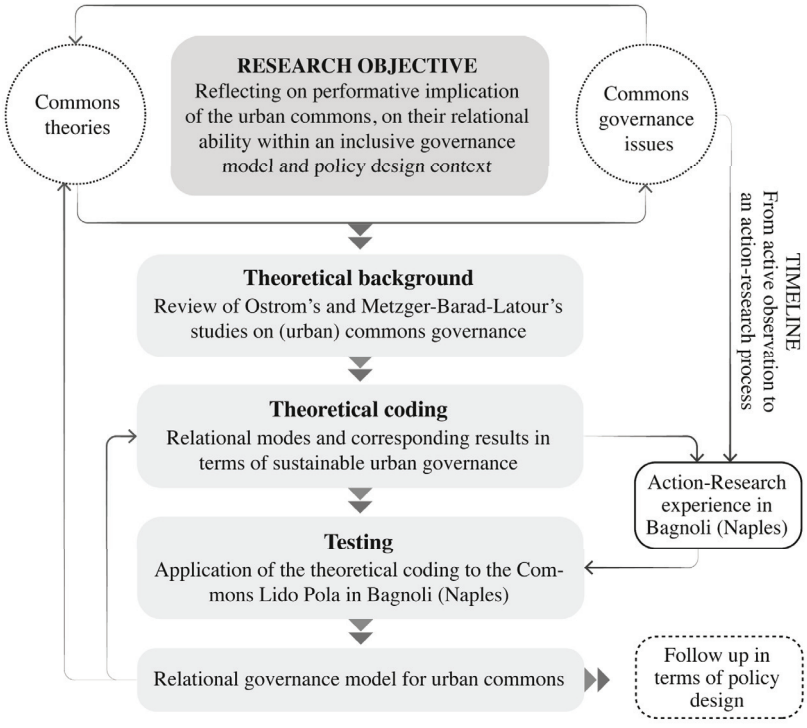


Figure 1. Research protocol (source: authors' elaboration).

The expected result of the testing phase is the validation of the theoretical coding to be applied in understanding the relational modes as part of a novel dynamic governance model of the commons, thus contributing to enhancing a participatory policy design by raising awareness regarding social intra/interactions.

Each research phase includes a validation step and feedback, and during follow-up it will benefit on the one hand from a return on theories, introducing new elements, and on the other, from a public consensus on the definition of a relational and dynamic governance model of the commons.

3. Theoretical Setting

3.1. Ostrom and the Urban in Making "Regulatory Slippage"

The polycentric governance of common pool resources (CPRs), such as watersheds, fisheries, forests, grazing lands, land tenure and use, wildlife, and village organization [45], has been at the core of Elinor Ostrom's eminent research contribution since the end of the last century. In Ostrom's model, CPRs are a resource that appropriators can use, and whilst doing so, they diminish its value. No fish caught or tree felled is available for anyone else any longer. In this way, CPRs have a crucial feature: their substantial subtractability. To contrast Hardin's ideas about the resources-in-common tragic ends, Ostrom organizes a successful third way of governing the commons based on institutional rules, where commoners would have focused all their efforts on organizing themselves voluntarily better than the Hardin's herdsman would. While leaving the assumptions of (limited) rationality and self-interest untouched, she worked on the central role of institutional rules. In this, she was driven by the results obtained from a large number of empirical studies.

Following these ideas, the CPR case is well represented by a model in which self-evident resource (object) could be used and exploited by its appropriator (subject). In this form, it has been translated into urban studies for many years. Therefore, from this perspective, Foster was uncritically concerned about urban commons for free riding behaviors [46]. In addition, for this author, there was the crucial role of managerial capabilities in the commons models, but enforced by the word "collaborative".

In terms of the widespread interest, felt within urban contexts, of privatized public spaces and the gap, Foster saw the reciprocal interest—among government agencies and other stakeholders—in collaborative management of urban commons, recognized as "regulatory slippage". "[. . .] the tragedy of the urban commons unfolds during periods of "regulatory slippage" when the level of local government oversight and management of the resource significantly declines, leaving the resource vulnerable to expanded access by competing users and uses. Overuse or unrestrained competition in the use of these resources can quickly lead to congestion, rivalry, and resource degradation. Tales abound in cities across the country of streets, parks, and vacant land that were once thriving urban spaces but have become overrun dirty, prone to criminal activity, and virtually abandoned by most users" [46] (p. 57). Based on these statements, urban commons always work if in cooperation with local authorities. This cooperation (in both the modular forms of bonding or bridging) is the base or the precondition for sustainable commons governance in Ostrom's inherent meaning.

The loss of effective regulation is what provides incentive for both citizens and governing bodies to find new means of addressing governance. Implications of these ideas about the centrality of cooperation in commons governance are relative to the need to conduct a balancing act so as not to crowd out civic engagement by excessive governmental presence, yet maintaining enough governmental control to avoid pitfalls of collective management, such as lack of accountability [46,47].

3.2. Metzger–Barad–Latour (M–B–L) Discourse about Urban Commons Relationality and Governance

An intense scientific debate about the urban version of Ostrom's CPRs started since urban theorists began to recall and claim the relational nature of urban resources.

This approach can be traced back: when Ebenezer Howard and Una Stubbs developed the classical contribution of the urban theory represented in *Garden Cities of Tomorrow* (1902), in which they argued for another way of considering urban resources. What made urban resources (for example, a building) valuable is not in the bricks and mortar, but in the proximity to other buildings and the density of activities and services unfolding between them. Urban resources within this view are depicted by relations and no more considered subtractable in the use. Thus, and contra Ostrom's and Foster's subsequent model, commons are a relational phenomenon in cities, and this implies that urban commons do not revolve around the problem of free-riding [21].

Such modes of "collectivity" in the city considered by urban theorists and sociologists (see, for example, Wirth [48] and Simmel [49]) differentiate sources of human characters in the city. Following these authors, it is not only the city that provides stages for its inhabitants; rather, the inhabitants result from the conditions of city life. On the wave of these ideas, Susser and Tonnelat [50] proposed an alternative discussion about urban commons, adopting an important observation: the commons are far from being a resource awaiting deployment—the city constitutes its subjects. In particular, "urban commons are not simply out there, waiting to be exploited; rather, they must first be produced and then constantly reproduced" [51] (p. 12).

By sharing the need to bypass Ostrom's ontological divide between subject–object, commoner–commons, and human–nonhuman, further analyses on urban commons have claimed that—more than an alternative conceptual solution—there is a substantial need to deconstruct the commons notion. This deconstruction would be driven by the need to recognize that any neat separation of "commons" on one hand and "commoners" on the

other involves what philosopher Karen Barad calls an "agentic cut," and as such, bears with it "an undisavowable ethico-political burden of responsibility to attend to the effects of any such enactment of ordering categories" [1] (p. 22).

Beyond overcoming the classical ontological divide, the new discourse about urban commons, following the neo-materialist Barad's approach, would have been focused eminently on another kind of causality, no more a linear one in research on new forms of agency, and in finding new positioning for responsibility and accountability issues. Starting from these points would be a new challenge to discuss commons borders, where the problem was no more to know the number of (inevitable) exclusions, but to have knowledge of specific exclusions and responsibility to perpetually contest and rework the boundaries.

Thus, the approach includes both the agential realism of Barad and Latour's social constructivism where the social practices are generally considered full of meaning and creativity. The shared incipit is about our need to accept Latour's eminent suggestion to look at the fundamental environmental and social crisis issues in terms of localized actioning [52].

In order to come away from the representationalist idea of reality, Barad's "agential realism" approach focuses on physics and arguments that deal with diffraction rather than reflection. "A diffractive reading of the insights from feminism, queer theory and science studies, crossing their perspectives, implies thinking about the social and scientific in a revealing way" [4] (p. 803). She therefore proposes an elaboration of the concept of performativity in a materialist, naturalist, and posthuman sense that dutifully recognizes matter as an active part of the world's becoming in its continuous intra-activity.

To have a theoretical code for intra-activity in our research context, an excursion within scientific studies looking at the entanglement notion from quantum physics could be recommended. Leaving at another work the mission of getting on the specific insights, we can recall that to the early definition of quantum entanglement, introduced by Schrödinger in 1933, a great deal of research was made, since Einstein, and not only, who worked about the two bodies' spatial distance (cfr. EPR paradox) or about the two bodies' conjoint measurement and inherent correlations.

To progress the concept in our context, we could see entanglement as a particular kind of connection between two entities in which it is difficult setting borders between the two, where it will be difficult to say where the first finishes and the second begins, as they would be interconnected in the same conceptual space. Thus, in urban commons practices it could correspond to a new relationality through intra-actioning. The already known dimension of interaction (bonding and bridging), captured by relational data that define all the connotations of relationality (geographical distance, number of participants, causes and results), is added to or replaced by the dynamic of intra-action, i.e., of conducting actions together, also physically distant, although in discourse, the process underlying decision-making is structurally altered. In this way, the dynamics of "consensus-based decision-making" that are inherent to the commons community are conveyed into the decision-making process [53,54]. Consensus building through meeting and talking is a complex practice, characterized by long periods of time and constant commitment, which can produce a sense of liberation and fulfilment involving actors both individually and collectively. The latter are invited to expound their own opinions as well as to listen to those of others in a dynamic that, as opposition emerges, pushes for argumentation, the acceptance of disagreement and the coordination of positions that have emerged, even if in conflict with each other. For the purposes of empirical analysis, therefore, the capturing of relationship data becomes in turn a complex process aimed at capturing emerging and informal ties and then at narrating, for example, the construction of decisions as they come about.

3.3. Theoretical Coding

According to both theories, the relational models are the foundation of a successful management of the commons able to overcome the issues of an unlimited extraction of resources, free riding, and revisiting boundaries. Table 1 introduces the foundations of sustainable commons governance highlighted by the analysis of both theories.

The Ostrom approach has been summarized on the first line, extracting the interactions within a micro-situational level of analysis embedded in a broader socioecological system based on direct causal links and feedbacks in terms of relational modes and governance scenarios. The concepts of bonding and bridging are included within the broader topic of social capital. The latter is understood as the structure of relationships among people that foster cooperation and the production of material and symbolic values. The distinction between the two types of relationships can be traced back to Mark Granovetter's [55] seminal work on embeddedness and the network approach, which is mainly used to access the topic of social capital from an economic perspective. Although there are a number of overlaps between the two concepts, one can refer to bonding as an exclusive, closed type of relationship characterized by strong ties and formed between people who are similar. This type of relationship tends towards isolation and is limited to reinforcing already existing ties, whereas bridging can refer to an inclusive, open type of relationship characterized by weak ties and formed among people with different characteristics. This type of relationship allows one to look outwards by acquiring information and advantages outside the network to which one belongs.

The M–B–L approach, included in the second line, goes beyond the human–nonhuman divide, modeling the tangible and intangible urban dynamics by ecologizing the urban commons. Although a concept ascribed to quantum physics, entanglement has acquired its own authority in the social sciences to explain more profoundly how relationships between two components can work. It starts from the assumption that each of us is entangled with every human and nonhuman with whom we come into contact and with whom we share a meaningful experience. Specifically, the entanglement is a relationship in which the "components," be they social groups, individuals, places, ideas or discourse, cyborgs, animals, or mechanical devices, are closely linked and intertwined in such a way that they don not forget their own counterpart.

While the first theory emphasizes a relational model of bridging and/or bonding that follows an a priori defined system of cooperation rules, in the neo-materialist approach, the authors agree to focus on a relational model based on entanglement. The latter is mainly rooted in entangling modes, favoring also the emotional relationship between the players, resulting in more inclusivity.

The following table has been designed in order to capture the complexity of human–nonhuman relationships within the urban environment as well as to push forward a renewed vision of the commons for a sustainable collective governance model.

Table 1. Relational modes and corresponding results in terms of sustainable urban governance (source: authors' elaboration).

Foundations of Sustainable Commons Governance	**Relational Modes**			**Results in Term of Sustainable Urban Governance/Assemblages**
	Bonding	**Bridging**	**Entangling**	
Ostrom (interactions within a micro-situational level of analysis embedded in a broader social-ecological system, based on direct causal link and feedback)	Face-to-face	Connecting		To be productive under specific cooperation rules (commons and local authorities)
M–B–L (Beyond human–nonhuman divide. Ecologizing the urban commons)			Participating (also emotionally)	To be inclusive without limits of genre, and adaptable in space and time

4. Testing Phase

In the framework of this disembodied vision of the commons as relational system, the authors purposely selected a case to be studied in order to test the interpretative synopsis. Antecedent to this choice, there is the direct involvement of members of the research group in the Permanent Citizen Observatory of Urban Commons[1]. Although there is deep reciprocal knowledge, our observational position with respect to the local commons is, for many reasons, of external third.

The selection criteria have been highlighted in the research protocol (cf. Section 2), including the following requirements: the urban scale, the presence of commons recognized through a system of rules or through the spontaneous commitment of a composite community of social actors, and, finally the opening of a new phase of dialogue with external institutional subjects for accessing funding opportunities and improving the supply of services for the communities involved. According to these premises, the experience of the civic community known under the Lido Pola Commons (Lido Pola Bene Comune) definition has been identified as an analysis framework. The community of Lido Pola has shared with the research group a turning point in their experiences by developing a transformative process inspired by an action-research model [57]. The latter criterion is critical in terms of allowing the identification of an observation framework that is open to dialogue and exchange. The selected case offers the opportunity to test the theoretical coding in order to understand the intermingling among the relational structure and the governance model.

The Lido Pola community established its geographical location in Bagnoli, a beautiful but depleted neighborhood on the west coast of Naples characterized by a long history (1903–1992) of production and withdrawal of a heavy metallurgy plant. This makes the community a potential hinge between environmental and social ecosystems and an ideal place to experiment with an ecosystem for innovation.

The experience is presented in narrative form, starting with a section dedicated to set the context in terms of planning overlapping in the area and in terms of evolutionary process of the community as a whole since its constitution in 2016. The crucial turning point runs from October 2021 to June 2022, when the Lido Pola community, established through an informal (illegal) occupation turned into an urban commons recognized by the local authorities and decided to start submitting applications for public funding. This transition in thinking and the related actions represent a challenge in terms of revisiting the informality, thus maintaining an inclusive and horizontal way of interacting. The survival of the informal community with porous and variable borders, beyond the public funding and an intense social intra-action construction, will reveal a successful outcome in terms of urban sustainability. The expected results of the application of the theoretical coding (Table 1) are the understanding of relational modes experienced within the following experience.

The timeline in Figure 2 illustrates the interaction among the researchers, the study area, and the Lido Pola Commons on the one hand and the main institutional steps of the planning process in the area on the other, in order to better understand the transition from the active observation [58] to the embedded action research [57]. The authors' positioning with respect to the Lido Pola Commons in Naples is evolutive in itself. It started (2015–2019) as an external third, then (2019–2021) become an institutional bond, and finally (2021–today) it became a kind of entanglement formed by direct and indirect reciprocal participation. The narrative of the research experience in progress in the area aims at identifying and systematizing relational modes within the theoretical coding scheme.

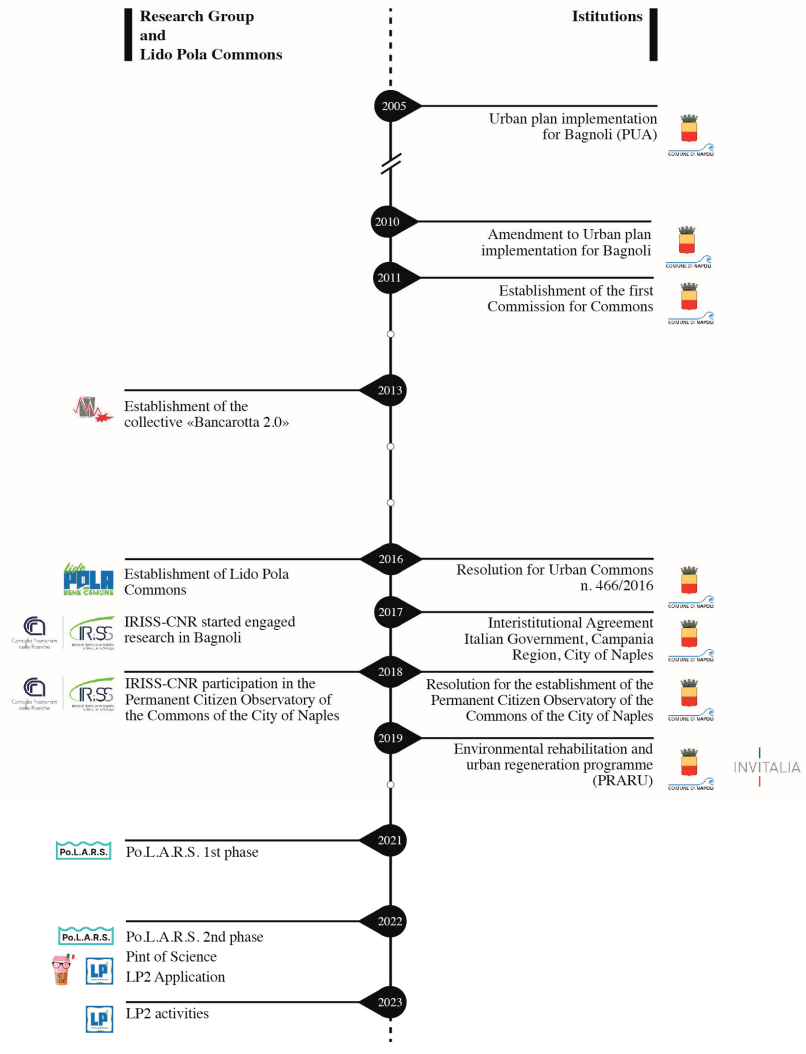


Figure 2. Research timeline: from active observation to action research in the Bagnoli district, focusing on the Lido Pola Commons establishment and evolution (source: authors' elaboration).

4.1. Materials and Timing

The area in which Lido Pola is located is characterized by significant environmental, social and economic fragility, with the Bagnoli district at the center of a decades-long demand for regeneration following the process of withdrawal and reconversion of the former industrial area that is still unfinished. The environmental rehabilitation of the brownfield left by the former industrial settlements has been the focus of the public investments and the institutional debate, leaving little room for discussing thoroughly the local demands of regeneration. The geomorphological, environmental, economic, social and cultural characteristics of the area have produced the overlapping of planning tools at different levels and sectors. The area is also included in the Programme for Environmental Restoration and Urban Regeneration (PRARU, 2019) and the former (PUA, 2005) Urban Plan Implementation. A short circuit among planning and decision-making processes accompanied by a lack of (or barely formal) listening campaign of the demands and priorities of the local communities

generated mistrust and the need for emancipation, redemption and resistance [32,59]. The incompleteness of the Bagnoli brownfield regeneration and reconversion process, at the center of the city and national political debate, has generated deep fractures in the civic, democratic, social and economic structure of the area. The progressive impoverishment of the area put young people in the position of leaving or being exposed to social risk factors such as school dropouts, poor employment opportunities and the presence of organized crime in various forms.

In this framework, the self-established collective Bancarotta 2.0 occupied in May 2013 the Lido Pola building on the Bagnoli waterfront, after more than 20 years of abandonment and progressive degradation. The former restaurant and beach club, active between the 1960s and 1990s, during the period of maximum industrialization of the Flegrean Area (Figure 3), was dilapidated when the community started a process of reappropriation of the abandoned building. The aim of the occupation was to prevent it from being transformed into an affluent tourist location, depriving the local communities of a place for connecting and building capacity, self-awareness and community engagement.

Figure 3. On the left, the Lido Pola location on the Bagnoli waterfront (**a**) within the city of Naples (**b**) and the metropolitan area of Naples (**c**). On the right, pictures of the Lido Pola building and its surroundings and the visual identity of the commons (source: authors' elaboration from Google Hearth; Lido Pola Archive).

The original collective evolved into the community of Lido Pola, recognized as an urban common by the city of Naples with Resolution 446/2016, and took on a management and impulse role for local development through asset valorization and territorial animation activities. This formal recognition of the public interest role of community activities within a dilapidated building under the umbrella concept of commons started a unique living laboratory of emancipation and self-organization, thus being designated a district civic facility.

In years of activism, since 2016, the Lido Pola Commons community has developed consolidated experience in activities and processes related to citizen science and the active engagement of citizens in urban transformation processes and environmental issues monitoring (Figure 4). Multiple public science outreach initiatives have been promoted, triggering the debate between researchers and local society on the topics of environmental science, both marine and geological, landscape protection, urban planning, social leadership, waste management, the use of chemicals in agriculture, and many others. The activists of the commons (the commoners), by activating various forms of collaboration with students and professionals from different disciplinary fields, developed several proposals regarding refurbishment and reuse of areas and infrastructures surrounding the main building.

The community also promoted citizen-led environmental monitoring activities, with the aim of implementing a process of collective self-protection involving the inhabitants of the neighborhood.

In line with the activities carried out, the community actively participates in the Popular Observatory for the Reclamation of Bagnoli, a consultative body recognized by the redevelopment public agency Invitalia and engaged in technical analysis and public awareness throughout the process of land reclamation and environmental cleanup in the area.

Figure 4. Some activities developed by the Lido Pola commoners and local communities and demonstrations within the Bagnoli area (source: Lido Pola and Bancarotta 2.0 Archives).

4.2. The Turning Point: Producing Ecosystemic Urban Commons

The turning point in the Lido Pola Commons experience dates back at the end of 2021, when a researcher in physics (a National Research Council CNR high-level executive and current institute director) shared with the community the dream of establishing a research center on marine sciences and environmental technologies on the seaside, restoring for this purpose the Lido Pola building. With the authors, he proposed to the Lido Pola community

a collaboration for the creation of an unusual initiative: apply for funding within the PNRR (National Recovery and Resilience Plan, implementing the Next Generation EU), developing the project of a public–civic lab codesigned experience that would be considered a sui generis urban regeneration process[2]. The Polo Litoraneo di innovazione per l'Ambiente marino e la Resilienza Sociale—PoLARS project aims to establish an experimental research center in the Lido Pola building. Thus, there are reasons to consider the PoLARS a unique unprecedented experience of partnership between public institutions and urban commons (the whole project's partners were the institutes IRISS, ISASI, ISMAR, ISPC, INM, INO, and IBBR of the National Research Council (CNR) based in Naples, the university consortium CoNisMA (Science of the Sea), the National Institute of Geophysics and Volcanology (INGV), and the City of Naples; and three social associations—Quadrifoglio Società Cooperativa Sociale, Associazione Caracol and Associazione Jolie Rouge APS, representing the commoners of Lido Pola, and finally the Città della Scienza—Idis Foundation). At the time of writing this article, the project had reached the score for approval, but failed to obtain funding. The PoLARS project, in addition to constituting a scientific research pole, aims to enhance and enrich the abovementioned experience of the commoners of Lido Pola by establishing a constant synergic relationship between them and the researchers from different scientific disciplines, including engineering, architecture, urban planning, economics, marine science and technology, physics, geophysics, volcanology, optics and sensor technology.

The objective pursued is to foster sharing experiences between the research and social actors, in order to put their different skills and knowledge at the service of citizenship, enhancing the collaboration and participation of citizens on environmental issues, public health and the monitoring and management of natural resources, and finally ensuring constant communication and dissemination on a local, metropolitan, regional and national scale.

The initiative is therefore based on the construction of a shared vocabulary that can enable communication and action together. Since October 2021, the PoLARS partners have worked together to prepare the PNRR funding request. The dialogue process, punctuated by interaction events, some internal to the partnership and others open to the local community, began at the stage of building the project team. The sharing of intentions and goals and ways to effectively achieve them was ensured through open and inclusive activities, such as online partnership meetings, interdisciplinary and thematic working groups, survey forms and data collection questionnaires administered online through the city commons network, local community networks and the scientific community.

The collaborative process made use of engagement and co-assessment protocols flowed into the construction of project choices and the identification of social, economic and environmental impacts through the drafting of a cost–benefit analysis based on EU models[3].

In the constellation of initiatives generated by the PoLARS intra-action, which can refer to a real process of institutional creativity [60], the experience of Pint of Science Italy 2022 and the launch of a cycle of scientific seminars also fits in. Finally, the community succeeded in obtaining funding within the national competition Creative Living Lab IV Edition, with the submission of another funding application. The project LP[2] Lido Pola Permanent Lab" was promoted, this time directly by the community through a social promotion association and with a partnership that retains the majority of the extended community (Lido Pola and CNR researchers). The aims of this project for the most part follow those pursued by PoLARS (i.e., the activation of a participatory planning process for the neighborhood and aimed at urban regeneration initiatives), finally finding concrete implementation (Figure 5).

Figure 5. Some activities developed by the Lido Pola commoners together with the researcher group within the project PoLARS, Pint of Science initiative, and LP^2 Lido Pola Permanent Lab (source: Ragozino 2022, 2023; Lido Pola archive).

5. Results and Discussion

Prior to the discussion of the evidence, it seems essential to clarify that our idea is not proposing a sort of theoretical hierarchy based on the two models' interpretative strength. Differences, as known, lie in the ways of classifying crucial commons governance structure and effectiveness. On one side, solutions are in institutional rules produced to overcome resource overuse, while on the other, they (solutions) are declined through adopting a new ecological sensibility, which "simultaneously takes life-engendering entanglements of local and planetary symbiotic mutualism" [1] (p. 39). Accordingly, the major differences between the two theories concerning urban commons governance and the ways of assuming access responsibilities revolve around relational modes.

What emerges from the practical experience, conducted on the relational behavior of a civic community extended by the inclusion of actors/groups pertaining to the world of research (CNR and University), is that different forms of relationality can coexist and play a different role in the construction of urban sustainability, as defined by Hinchliffe and Whatmore in 2017 [22].

From the narrative data reporting the experience of the Lido Pola community and the new experience of "becoming together," communities (Lido Pola and researchers), through the collaboration activated with the PoLARS Project and then continued (despite the failure of PoLARS funding) with other successful activities and projects, the relational diversity in the ways and results obtained emerges. It will concur, directly or indirectly, to form the governance capacity for urban sustainability.

Confronting the column on the far right dedicated to results in Table 2, there are several elements that can contribute to the construction of a governance for a sustainable city. In particular, among the activities that generate a more aware citizenship about environmental problems and a more inclusive, and therefore closer to an urban sustainability objective, there are the entanglement relations involving the Lido Pola community, the students of the neighborhoods, and the experts, in particular, through the activities carried out together with citizenship (civic desk, self-advocacy/help activities, citizen science or those involving codesign and co-assessment) and in any case reported in lines 1, 3, 4, 7 and 8.

The intra-action activated between the actors of the project, i.e., between the two communities, that of the scientists and the inhabitants of the Lido Pola Commons, reproduced the aforementioned dynamics of "consensus-based decision-making" (considered entanglements), including the scientific community in the collaborative decision-making process of the commons. The osmosis between social- and hard-science researchers and the community allows a mutual learning process and triggers new opportunities for the valorization of scientific results and knowledge transfer on the one hand and promotes greater social awareness of environmental challenges on the other. In addition, commons activities, which are usually aimed at social inclusion and the monitoring of problems affecting the area, will be enriched in the dialogue with researchers.

The centrality of citizenship in the production and dissemination of expert knowledge becomes the keystone in the formulation of strategic choices for territorial development and in restoring (or generating from the ground up) a constructive dialogue between institutions and territorial communities. The experiments conducted in this "presidium" of open access knowledge will contribute to the formation and transfer of knowledge and capacity building, both with reference to the productive world (patents and start-ups of local initiative) and to the construction of conscious choices by communities (smart communities, energy communities, participatory decision-making processes).

No less important, insofar as they are oriented towards achieving inclusion objectives, are the activities carried out through the formal collaborative relations between the community and the administration, which take the form of maintaining dialogue between the two poles. The numerous meetings between delegated groups of the two parties, as well as the exchange of emails and telephone calls make up the "red line" of this interaction (see lines 2, 5 and 6).

Table 2. The Lido Pola Commons: relational modes and corresponding results in terms of governance for sustainable city (source: authors' elaboration).

	Relational Modes (Agents Involved)			**Results in Terms of Governance**
	Bonding	**Bridging**	**Entangling**	
1			Civic desk (community and citizens)	Knowledge and information updating for the Lido Pola Commons community; development of proactive citizenship
2	Community collaboration with students and professionals for technical interventions in the area			Mutual learning in the fields: young resident education, professional self-determination, work skills

Table 2. *Cont.*

	Relational Modes (Agents Involved)			Results in Terms of Governance
	Bonding	**Bridging**	**Entangling**	
3			Community and resident self-advocacy activities	Increased civic awareness of the environment
4			Citizen science activities (community, experts and citizens)	Strengthening relations with students, citizens and experts
5		Dialogue between Lido Pola community and the city of Naples		Deliberations of the city of Naples for the recognition of 7 urban commons, including the Lido Pola
6	Popular Observatory for the land reclamation of Bagnoli (Lido Pola community and other commons)			Institutional recognition from Invitalia—National Agency for Inward Investment and Economic Development
7		PoLARS partnership (Lido Pola community, research, city of Naples)	Co-design and co-assessment process (Deep listening and engagement campaign, focus groups, cost-benefit and social return analysis)	Commons cohabitation by the Lido Pola community and CNR and university researchers, pooling of expertise, knowledge communication and dissemination, co-actioning to retrieve extra funds, definition of integrated visions for the final drafting of the project. including local knowledge, collective opinions, detection of alliances, obstacles and conflicts to be comanaged
8			"Living Lab" Lido Pola (Pint of Science, workshops, research meetings and LP^2)	Obtaining funding from the Italian Ministry of Culture

Finally, an interesting implication concerns relational modes and policy design in the urban commons field. As seen, social relationships, under the finite cover of bonding and bridging modes, can be easily recognized and thus regulated, while relationship as entanglement escapes by its nature the same possibility. Thus, it can be included among the indirect policy tools.

At the same time, as emerged from the empirical analysis, it is the relationship through entanglement (intra-actioning) of the most crucial relational mode in guarantee social inclusion and appreciable results. These are expressed in terms of allowing the commons to have a durable life and in also achieving public funding.

6. Conclusions and Follow-Up

This article is a research contribution to the nature of inter- and intra-actioning commons relationships. The main evidence has been presented by a picture of the preconditions for sustainable commons governance, along with the ways that urban social inter- or intra-actioning (i.e., respectively bonding, bridging, and entangling) contribute to it.

Acknowledging the research gap in terms of the lack of methodologies for interpreting urban commons performative issues and implications, we have reconsidered the migration of the commons concept from the natural to the urban context. Starting from the Ostrom-led theoretical framework, the successful experiences developed within the natural environment are less convincing if applied in an urban environment. Foster's application of Ostrom's theory encourages an interpretation of urban zoning and spatial planning as a system of rules for institutionalizing the commons [61]. This approach, ruled by the

need for institutionalization, has been challenged by the practices developed in different areas as well as by the debate developed in different social arenas [62]. More widely, the taken-for-granted ontological divide between subjects–objects, humans–nonhumans, resources–extractors, and commoners–commons remained substantially unquestioned within the specific commons literature.

In this field, the relationship variable and the ways in which it is managed is explicative. Between the two frameworks, there are the emerging interpretative keys for understanding (and capturing) social relationships. The modes of bonding, bridging (more in the Ostrom–Foster vein), and entangling (from the B-M-L approach), all concur, also if differently, as part of a single evolutionary path towards a common outcome of urban sustainability, opening to informality.

The resulting combined theoretical setting has been tested within the Lido Pola Commons, already included in an action-research process developed by the authors with a network of researchers, social enterprises, associations and institutions, with the aim of promoting sustainable and inclusive urban regeneration in the area. The codesign experience [63,64] the commoners are developing with researchers, communities and institutional players outlines an interesting arena for observation and fieldwork. By stepping aside and observing this practice, we considered it the best option to test the theoretical setting. Not only does the Lido Pola community meets the case selection criteria, but the turning point outlined in Section 4.2 offers useful insight into multidimensional and multilevel relationships.

The testing phase confirmed the rationale for the novel theoretical setting and encouraged us to step ahead in two intertwined directions. At the conceptual level, future development of the work could study the time variable in analyzing urban commons performative implications, by including the phenomenology of intersubjectivity in order to develop an interpretation of multifaceted relationships developed within each commons expression. In this analytical setting, the discourse could imply the diffraction from new M–B–L materialism to Levinas alterity [65]. The latter, following the main self-recognition issue, can give an interesting addition to the analytical tool set "phenomenology of intersubjectivity".

The main follow-up regards policy design implications about relational differences and their contribution to create urban sustainable-inclusive contexts. More than further discussing the regulatory slippage, it could be fruitful to address the issue of abandonment of public spaces and buildings. In these contexts, where the free-riding threat can be avoided, it is possible to exploit the inner sense of collectivity and the need for regeneration and accessible public spaces as part of the classic omnia sunt communia idea in our cities. The circular research process, in which theories and practices trigger mutual learning, encompasses the themes of social cohesion, urban regeneration, informal economics and the redefinition of the boundaries of public realm.

The next step of the research process is to further explore the relationships among internal and external agents in order to overcome the conflicting dualities of commoner–institution and informality–regulation, in order to seek an adaptive commons governance model.

A deep understanding of the commons' relational modes under the pressure of an urban transformative process can be the turning point for experimenting with a "dynamic institutionalization" in defining the governance model of these complex and vibrant entities.

Author Contributions: Conceptualization, M.P.V. and G.E.D.V.; data curation, S.R.; investigation, M.P.V., S.R. and G.E.D.V.; methodology, M.P.V., G.E.D.V. and S.R.; resources, S.R.; validation, M.P.V., S.R. and G.E.D.V.; visualization, S.R.; writing—original draft, M.P.V. and S.R.; writing—review and editing, G.E.D.V., M.P.V. and S.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no funding.

Data Availability Statement: Data sharing not applicable.

Acknowledgments: The research process presented in this paper—although not directly funded—has been developed within two projects included in the institutional programming of CNR IRISS: the project "An innovative place-based regeneration approach to balance marginalization and anthropogenic pressure" coordinated by Gabriella Esposito De Vita and its subproject "Place-based approaches to rebalancing anthropogenic pressures on the consolidated city" coordinated by Stefania Ragozino, as well as the project "The Economy of Commons and Collaborative Communities: For an Observatory on Urban Commons" coordinated by M. Patrizia Vittoria. Livia Russo participates in these research activities The authors would like to thank Ivo Rendina, director of the CNR ISASI and promoter of PoLARS, and all the partners in the project consortium for the extensive and fruitful interdisciplinary exchange carried out in the project. Finally, the authors are grateful to the Lido Pola community from which started the idea of "another" kind of relationality carried on within the urban Commons.

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

Notes

[1] The Permanent Citizen Observatory of the Commons of the City of Naples is a participatory consultative body, appointed by the Mayor through a public notice aimed at involving people who are competent but also personally active in participatory processes and the commons in Naples and beyond (Available online: https://commonsnapoli.org/en/new-institutions/citizen-observatory/, accessed on 15 January 2023). For more details on the political-institutional nature of the Observatory, see [56].

[2] This experience is part of a collaborative process that partly led to participation in the Expression of Interest "Ecosystems of Innovation in Southern Italy" (Cohesion Agency, Public Notice—Decree 204/2021).

[3] Available online: https://space-economy.esa.int/article/84/a-closer-look-at-the-european-commissions-guide-to-cost-benefit-analysis-of-investment-projects, accessed on 30 December 2022.

References

1. Metzger, J. The city is not a Menschenpark: Rethinking the tragedy of the urban commons beyond the human/non-human divide. In *Urban Commons: Rethinking the City*; Borch, C., Kornberger, M., Eds.; Routledge: London, UK; New York, NY, USA, 2015; pp. 32–56. ISBN 1315780593.
2. Latour, B. *An Inquiry into Modes of Existence*; Harvard University Press: Cambridge, MA, USA, 2013; ISBN 0674728556.
3. Barad, K. Quantum entanglements and hauntological relations of inheritance: Dis/continuities, spacetime enfoldings, and justice-to-come. *Derrida Today* **2010**, *3*, 240–268. [CrossRef]
4. Barad, K. Posthumanist performativity: Toward an understanding of how matter comes to matter. *Signs J. Women Cult. Soc.* **2003**, *28*, 801–831. [CrossRef]
5. Barad, K. Nature's queer performativity. *Qui Parle Crit. Humanit. Soc. Sci.* **2011**, *19*, 121–158. [CrossRef]
6. Ostrom, E. *Governing the Commons. The Evolutions of Institutions for Collective Actions*; Cambridge University Press: Cambridge, UK, 1990.
7. Hardin, G. The Tragedy of the Commons. *Science* **1968**, *162*, 1243–1248. [CrossRef] [PubMed]
8. Hess, C.; Ostrom, E. A framework for analyzing the knowledge commons. In *Understanding Knowledge as a Commons: From Theory to Practice*; MIT Press: Cambridge, UK, 2007; pp. 41–81.
9. Lefebvre, H. *The Production of Space*; Blackwell: Oxford, UK; Cambridge, MA, USA, 1991; ISBN 0631140484.
10. Harvey, D. The future of the commons. *Radic. Hist. Rev.* **2011**, *109*, 101–107. [CrossRef]
11. Harvey, D. *Rebel Cities: From the Right to the City to the Urban Revolution*; Verso Books: New York, NY, USA, 2012; ISBN 1844678822.
12. Davidson, N.M.; Infranca, J.J. The sharing economy as an urban phenomenon. *Yale Law Policy Rev.* **2016**, *34*, 215–279.
13. Finck, M.; Ranchordás, S. Sharing and the City. *Vanderbilt J. Transnatl. Law* **2016**, *49*, 1–70. [CrossRef]
14. Hillgren, P.-A.; Seravalli, A.; Agger Eriksen, M. Counter-hegemonic practices; dynamic interplay between agonism, commoning and strategic design. *Strateg. Des. Res. J.* **2016**, *9*, 89–99. [CrossRef]
15. Foster, S.R.; Iaione, C. Ostrom in the city: Design principles and practices for the urban commons. In *Routledge Handbook of the Study of the Commons*; Routledge: London, UK; New York, NY, USA, 2019; pp. 235–255. ISBN 1315162784.
16. Huron, A. Working with strangers in saturated space: Reclaiming and maintaining the urban commons. *Antipode* **2015**, *47*, 963–979. [CrossRef]
17. Borch, C.; Kornberger, M. *Urban Commons. Rethinking the City*; Routledge: London, UK; New York, NY, USA, 2015.
18. Ferguson, F.; Gaugliz, C. *Make_Shift City: Renegotiating the Urban Commons*; Jovis Publisher: Berlin, Germany, 2014; ISBN 3868592237.
19. Dellenbaugh, M.; Kip, M.; Bieniok, M.; Müller, A.K.; Schwegmann, M. *Urban Commons: Moving beyond State and Market*; Birkhäuser: Basel, Switzerland, 2015; Volume 154, ISBN 3038214957.
20. Enright, T.; Rossi, U. Ambivalence of the urban commons. In *The Routledge Handbook on Spaces of Urban Politics*; Routledge: London, UK; New York, NY, USA, 2018; pp. 35–46. ISBN 1315712466.

21. Kornberger, M.; Borch, C. Introduction: Urban commons. In *Urban Commons: Rethinking the City*; Borch, C., Kornberger, M., Eds.; Routledge: London, UK; New York, NY, USA, 2015; pp. 11–31. ISBN 1315780593.
22. Hinchliffe, S.; Whatmore, S. Living cities: Towards a politics of conviviality. In *Environment: Critical Essay in Human Geography*; Anderson, K., Braun, B., Eds.; Routledge: London, UK; New York, NY, USA, 2017; pp. 555–570. ISBN 1315256355.
23. Keil, R. The spatialized political ecology of the city: Situated peripheries and the capitalocenic limits of urban affairs. *J. Urban Aff.* **2020**, *42*, 1125–1140. [CrossRef]
24. Latour, B. *Politics of Nature: How to Bring the Sciences into Democracy*; Harvard University Press: Cambridge, MA, USA, 2004; ISBN 0674012895.
25. Latour, B. *Où atterrir?: Comment s' Orienter en Politique [Where to Land: How to Find Your Way in Politics]*; La Découverte: Paris, France, 2017; ISBN 2707197815.
26. Perrone, C.; Marchigiani, E.; Esposito De Vita, G.; Rossi, M. 'Terrestrial'. La sfida del gioco a tre [The challenge of the three-way game]. *Contesti* **2021**, *1*, 5–22.
27. Crutzen, J.; Stoermer, E.F. Global Change Newsletter. *Glob. Chang. Newsl.* **2018**, 17.
28. Feinberg, A.; Ghorbani, A.; Herder, P.M. Commoning toward urban resilience: The role of trust, social cohesion, and involvement in a simulated urban commons setting. *J. Urban Aff.* **2023**, *45*, 142–167. [CrossRef]
29. Broto, V.C.; Ortiz, C.; Lipietz, B.; Osuteye, E.; Johnson, C.; Kombe, W.; Mtwangi-Limbumba, T.; Macías, J.C.; Desmaison, B.; Hadny, A. Co-production outcomes for urban equality: Learning from different trajectories of citizens' involvement in urban change. *Curr. Res. Environ. Sustain.* **2022**, *4*, 1–11. [CrossRef]
30. German EU Presidency. Territorial Agenda 2030 "A Future for All Places". 2020. Available online: https://territorialagenda.eu/ (accessed on 20 November 2022).
31. Oppido, S.; Ragozino, S.; Micheletti, S.; Esposito De Vita, G. Sharing responsibilities to regenerate publicness and cultural values of marginalised landscapes: Case of Alta Irpinia, Italy. *Urbani Izziv* **2018**, *29*, 125–142. Available online: ttps://www.jstor.org/stable/26516366 (accessed on 20 November 2022). [CrossRef]
32. Ragozino, S.; Varriale, A. 'The City Decides!' Political Standstill and Social Movements in Post-Industrial Naples. In *Public Space Unbound. Urban Emancipation and the Post-Political Condition*; Routledge: London, UK; New York, NY, USA, 2018; pp. 209–224.
33. Esposito De Vita, G. How to Reclaim Mafia-Controlled Territory? An Emancipatory Experience in Southern Italy. In *Public Space Unbound. Urban Emancipation and the Post-Political Condition*; Knierbein, S., Viderman, T., Eds.; Routledge: London, UK; New York, NY, USA, 2018; pp. 54–68.
34. Vittoria, M.P. Commons and Cities. Which analytical tools to assess the Commons' contribution to the economic life of the cities? In *New Metropolitan Perspectives: Local Knowledge and Innovation Dynamics towards Territory Attractiveness through the Implementation of Horizon/E2020/Agenda2030–Volume 1*; Calabrò, F., Della Spina, L., Bevilacqua, C., Eds.; Springer: Berlin, Germany, 2019; pp. 599–605.
35. Vittoria, M.P. How much is Community Action Worth to the Local Economy? The Debate between «Instincts and Institutions» in the Process of Formation and Consolidation of Urban Commons in Naples. *Riv. Econ. Mezzog.* **2020**, *34*, 249–275. [CrossRef]
36. Esposito De Vita, G.; Ragozino, S. Civic activation, vulnerable subjects and public space: The case of the park of Rione Traiano in Naples. *TRIA Territ. Ric. Insediamenti Ambient. Riv. Internazionale Cult. Urban.* **2013**, *10*, 173–188. [CrossRef]
37. Esposito De Vita, G.; Trillo, C.; Martinez-Perez, A. Community planning and urban design in contested places. Some insights from Belfast. *J. Urban Des.* **2016**, *21*, 320–334. [CrossRef]
38. Tarlock, A.D. Toward a Revised Theory of Zoning. *L. Use Control. Annu.* **1972**, *141*.
39. Karkkainen, B.C. Zoning: A reply to the critics. *J. L. Use Envtl. L.* **1994**, *10*, 45.
40. Lee, S.; Webster, C. Enclosure of the urban commons. *GeoJournal* **2006**, *66*, 27–42. [CrossRef]
41. Rydin, Y.; Beauregard, R.; Cremaschi, M.; Lieto, L. *Regulation and Planning: Practices, Institutions, Agency*; Routledge: London, UK; New York, NY, USA, 2021; ISBN 1000450627.
42. Vanclay, F. Conceptualising social impacts. *Environ. Impact Assess. Rev.* **2002**, *22*, 183–211. [CrossRef]
43. Cerreta, M.; Daldanise, G.; La Rocca, L.; Panaro, S. Triggering Active Communities for Cultural Creative Cities: The "Hack the City" Play ReCH Mission in the Salerno Historic Centre (Italy). *Sustainability* **2021**, *13*, 11877. [CrossRef]
44. Schauppenlehner-Kloyber, E.; Penker, M. Between participation and collective action—From occasional liaisons towards long-term co-management for urban resilience. *Sustainability* **2016**, *8*, 664. [CrossRef]
45. Hess, C. Mapping the new commons. *SSRN e-Library* **2008**. [CrossRef]
46. Foster, S.R. Collective action and the urban commons. *Notre Dame Law Rev.* **2011**, *87*, 57.
47. Parker, P.; Johansson, M. The uses and abuses of Elinor Ostrom's concept of commons in urban theorizing. In Proceedings of the European Urban Research Association EURA "Cities without Limits", Copenhagen, Denmark, 23–25 June 2011.
48. Wirth, L. Urbanism as a Way of Life. *Am. J. Sociol.* **1938**, *44*, 1–24. [CrossRef]
49. Simmel, G. The metropolis and mental life. In *On Individuality and Social Forms*; University of Chicago Press: Chicago, IL, USA, 1971; pp. 324–339.
50. Susser, I.; Tonnelat, S. Transformative cities: The three urban commons. *Focaal* **2013**, *2013*, 105–121. [CrossRef]
51. Jerram, L. The false promise of the commons: Historical fantasies, sexuality and the 'really-existing' urban common of modernity. In *Urban Commons: Rethinking the City*; Routledge: London, UK; New York, NY, USA, 2015; pp. 57–77. ISBN 1315780593.

52. Latour, B. Anthropology at the time of the Anthropocene: A personal view of what is to be studied. In *The Anthropology of Sustainability*; Springer: Berlin, Germany, 2017; pp. 35–49.
53. Butler, C.T.; Rothstein, A. *Conflict and Consensus*; Food Not Bombs Publishing: Takoma Bay, DC, USA, 1998.
54. Tecchio, R. Il metodo del consenso: Un metodo decisionale morbido per gruppi forti [The consensus method: Soft decision-making for strong groups]. In *La Rete di Lilliput. Alleanze, Obiettivi, Strategie*; Emi: Bologna, Italy, 2001; pp. 149–158.
55. Granovetter, M.S. The strength of weak ties. *Am. J. Sociol.* **1973**, *78*, 1360–1380. [CrossRef]
56. Micciarelli, G. Hacking the legal. The commons between the governance paradigm and inspiration drawn from the "living history" of collective land use. In *Post-Growth Planning: Cities Beyond the Market Economy*; Savini, F., Ferreira, A., von Schönfeld, K.C., Eds.; Routledge: London, UK; New York, NY, USA, 2022.
57. Saija, L. *La Ricerca-Azione in Pianificazione Territoriale e Urbanistica [Research-Action in Spatial and Urban Planning]*; Franco Angeli: Milano, Italy, 2016; ISBN 9788891710734.
58. Gaber, J.; Gaber, S.L. Utilizing mixed-method research designs in planning: The case of 14th Street, New York City. *J. Plan. Educ. Res.* **1997**, *17*, 95–103. [CrossRef]
59. Ragozino, S.; Varriale, A.; Esposito De Vita, G. Self-organized practices for complex urban transformation. The case of Bagnoli in Naples, Italy. *Tracce Urbane Riv. Ital. Transdiscipl. Stud. Urbani* **2018**, *3*, 159–181. [CrossRef]
60. Pinto, M.; Recano, L.; Rossi, U. New institutions and the politics of the interstices. Experimenting with a face-to-face democracy in Naples. *Urban Stud.* **2022**, *0*, 1–19. [CrossRef]
61. Kashwan, P.; Mudaliar, P.; Foster, S.R.; Clement, F. Reimagining and governing the commons in an unequal world: A critical engagement. *Curr. Res. Environ. Sustain.* **2021**, *3*, 1–10. [CrossRef]
62. Seravalli, A.; Hillgren, P.-A.; Agger-Eriksen, M. Co-designing collaborative forms for urban commons: Using the notions of commoning and agonism to navigate the practicalities and political aspects of collaboration. In Proceedings of the The City as a Commons: Reconceiving Urban Space, Common Goods and City Governance, 1st Thematic IASC Conference on Urban Commons, Bologna, Italy, 6–7 November 2015; pp. 6–7.
63. Bason, C. Discovering Co-Production by Design. In *Public and Collaborative: Exploring the Intersection of Design, Social Innovation and Public Policy*; DESIS Network Press: Milan, Italy, 2013.
64. Parker, P.; Schmidt, S. Enabling urban commons. *CoDesign* **2017**, *13*, 202–213. [CrossRef]
65. Levinas, E. La signification et le sens. *Rev. Métaphysique Morale* **1964**, *69*, 125–156.

land

MDPI

Article

How Can the Risk of Misconduct in Land Expropriation for Tract Development Be Prevented and Mitigated: A Study of "Good Land Governance" Inspection in China

Lingling Li [1,*], Yansong He [1] and Changjian Li [2]

[1] School of Humanities and Social Development, Northwest A & F University, Yangling, Xianyang 712100, China
[2] School of Law, Huazhong University of Science and Technology, Wuhan 430223, China
* Correspondence: li_lingling@nwafu.edu.cn

Abstract: In the context of China's new round of land reform, narrowing the scope of land expropriation, standardising the procedures for land expropriation, and building a unified urban and rural construction land market have become the objectives of land expropriation reform. The new Land Management Law of the People's Republic of China confirms land expropriation for tract development as a new situation for the land acquisition system. However, in the process of implementing the system, the new land acquisition mode is plagued by the dual dilemma of the falsification of public interests and the lack of a mechanism to realise public interests, which leads to the real risk of misconduct in standards. The concept of the coordination of interests and co-operative governance in "Good Land Governance" is a sure way to overcome this structural risk. The article analyses the causes through the lens of "Good Land Governance" and concludes that the risk of failure of the standards can be addressed through the binary public good remedy: On the one hand, from the perspective of coordination of interests, drawing on the principle of proportionality, the system can be built by improving the way of purposeful examination, so as to achieve the effect of preventing the risk of deflating and generalising public interests in order to achieve the effect of realising and reinforcing public interests. On the other hand, from the perspective of synergistic shared governance and drawing on the logic of land justice, institutional insight can be built by way of establishing a pattern of shared public interest, thus achieving the effect of preventing the risk of public interest erosion in order to achieve the effect of shared public interest replenishment.

Keywords: land expropriation for tract development; public interest; risk of standard failure; "Good Land Governance"; dualistic public good remediation

Citation: Li, L.; He, Y.; Li, C. How Can the Risk of Misconduct in Land Expropriation for Tract Development Be Prevented and Mitigated: A Study of "Good Land Governance" Inspection in China. *Land* **2022**, *11*, 2019. https://doi.org/10.3390/land11112019

Academic Editors: Pasquale de Toro, Francesca Buglione, Martina Bosone and Francesca Nocca

Received: 30 September 2022
Accepted: 8 November 2022
Published: 11 November 2022

1. Introduction

The post liberalisation economic boom continues to create a voracious appetite for space to meet the demands of industrialisation, infrastructure building, urban expansion, and resource extraction [1,2]. During the process of rapid urbanization and industrialization, urban–rural integrated development has become an important socioeconomic phenomenon around the world [3–5]. Against this backdrop, the demands of economic development have led most developing countries into unhealthy and inefficient patterns of land acquisition in order to attract private investment [6]. For developing countries, the rational use of land acquisition powers to provide land resources for urbanisation on the basis of economic growth and the promotion of human settlements is one of the most important challenges in terms of land management [7].

China's land ownership system is an urban–rural dualistic land management system, which, combined with the high dependence of China's public interest expropriation on policy guidelines and administrative discretion, gives its land expropriation issues a strong local character. The long-term preferential urban development strategy in China has led to

conflicts such as divided land management, separation of people and land, and urban–rural division [8–10]. The rights and interests of rural development have been seriously compromised in the process of urban and rural development. According to the provisions of Article 10 of the Constitution of the PRC, land in urban areas is owned by the state, while land in rural and suburban areas is owned collectively. Collective land is converted to state land through land expropriation. According to the Chinese Constitution, the constitutionality of land expropriation is judged by "public interest needs", which, as a historical category, are necessarily linked to social patterns [11].

China's newly revised Land Administration Law clearly divides land expropriation into expropriation for purely public purposes and land expropriation for tract development. This amendment classifies land expropriation for tract development as a form of expropriation that is not purely for public interest into the land expropriation system [12]. According to the "The Standard for land expropriation for tract development (Trial)" formulated by the Department of Natural Resources of of the PRC, land expropriation for tract development refers to the comprehensive development and construction activities on a certain area of land organized by local people's governments at or above the county level in the concentrated construction areas within the development boundaries of towns and cities as determined by the territorial spatial planning. It has been included in the land acquisition system for economic construction purposes since its inception as an important tool for the construction of new cities, new districts, urban renewal, and the transformation of old cities. The amendment not only reflects the State's commitment to the reform of land acquisition, but also the law's consideration of whether "national construction", especially "economic construction", can be incorporated into the public interest. The lack of legal control over the land expropriation for tract development, a new legal provision, has led to many problems in the process of implementation: In terms of institutional design, the amendment to the Land Administration Law, while providing for a system of land expropriation for tract development, also clarifies the system of the market entry of collectively owned commercial construction land (Article 63 of the Land Management Law allows collective business construction land to enter the construction land market directly by way of sale or lease). There is a conflict of application between the land expropriation for tract development and the market entry of collectively owned commercial construction land in the interface of the systems: the price of collective business construction land when it is put on the market is a market agreement price resulting from an agreement or a tendering and auctioning procedure. Under such circumstances, if the compensation for the land expropriation of collective land cannot be coordinated and connected with the distribution of the value-added proceeds of land in the field of the market entry of collective business construction land, there will be a large number of contradictions in land management practice: "the farmers (collectives) want to directly enter the market for the same plot of land, but the government wants to expropriate it", and this contradiction could expose the collective land acquisition and market entry system established by the Land Management Law to the risk of "institutional bankruptcy" due to the uneven distribution of the proceeds of land appreciation. Meanwhile, The involvement of private commercial development has also led to many conflicts and contradictions between public and private interests and between expropriation and development, within the land expropriation for tract development. At the level of institutional implementation, on the one hand, this new type of land expropriation also suffers from an imbalance between public land and commercial land, the waste of land resources, and poverty among landless farmers. On the other hand, the current system of land expropriation for tract development has not yet developed a sound mechanism for safeguarding the public interest. As a result of this, land expropriation has not been as effective as it should have been, and the question of how to interpret the legal reform of land expropriation for tract development and the formation of an operational mechanism for safeguarding the public interest has become an urgent issue to be resolved.

2. Literature Review

The current standard system of land expropriation for tract development is not yet complete. The issue of whether commercial development can be used as a means of achieving the public interest to facilitate the exercise of the right of eminent domain has become a major controversy in the expropriation of tracts of land for development. Analysed from a universal perspective, some scholars argue that economic development and business activities should not be included in the public interest [13] and that tract development expropriation, which includes commercial development, should not be included in the expropriation system. Even under conditions of full compensation, the expropriated person, while receiving a higher than fair market value for the compensation, does not share in the value-added benefits of the land expropriation [14]. The benefit to the public in the expropriation of tract development is a reflexive interest and does not meet the criteria of direct and substantial benefit to the public [15]. If the public purpose is understood to be merely the enhancement of the overall net social good, then almost any socially viable project justifies intervention by the state if there are land-related obstacles to its realization. It would be more appropriate to say that the particular nature of the land required to achieve the public good justifies state expropriation or intervention [16]. The fundamental purpose of the expropriation of tract development is to engage in business activities. Land acquisition and development should be subsumed under the land reserve system [17]. Commercial development can lead to an overlap in the government's identity as the owner, planner, and investor in the process of land acquisition and development. While this may enable the government to effectively promote urban development, it is also problematic because, by assuming this dual role, municipalities place themselves in a biased position that has the potential to undermine the legitimacy of government action [18]. Analysed in terms of specificity, some scholars argue that, as China already has a market system for collective business construction land, it allows the commercial development of land expropriated for tract development to squeeze the space for the market reform of collective business construction land. This scenario leads to institutional contradictions between land reforms and contradictions in the reform requirement of narrowing the scope of land expropriation in China (Reference Zheng Zhenyuan's speech at the seminar on "Improving the Expropriation System for tract Development", 13 June 2020, http://law.suda.edu.cn/c4/f1/c1056a378097/page.htm, last accessed on 12 May 2022). The connotation of public interest should be understood in a broad sense. At the level of legitimacy, scholars have argued that a certain limit of commercial development in the expropriation of tract developments is in line with public interest through the analysis of constitutionality, the supply of public goods, and the values of the times [19–21]. At the level of institutional realisation, Hua Ziyan advocates the control of risk in the land expropriation for tract development in three dimensions: content, process, and outcome [22]. Shi Jiayou advocates that the public interest element should be determined to ensure the public interest of the expropriation of land in a tract development [23]. Furthermore, Liu Yuzi proposes to ensure the public interest of the expropriation of land by explicitly listing and limiting the circumstances in which public interest can be applied to the land expropriation for tract development and by strengthening the obligation to assess the public interest and necessity [24]. Patrick Bishop argues for the promotion of a balance between public and private interests in land acquisition by strengthening the courts' review of public interest criteria such as the democratic process and private rights protection [25]. Johan Svensson argues that the interests of the state can be promoted through the integration and synergy of public and private land use interests [26]. Brightman Gebremichael argues that the achievement of the public interest requires balancing two conflicting interests in the eminent domain: a public need for land and landholders expecting the security of tenure and protection of their private property rights [27].

The discussion of public interests has always been the core of land expropriation. Public interest is a concept that evolves and changes with the times [28]. It is all the more necessary to evaluate the public interest on the basis of national circumstances. The inclu-

sion of commercial development into the scope of land expropriation for tract development is both reasonable and legal. From the analysis of realistic needs, the construction of new urbanisation in the context of urban–rural integration currently requires the reconstruction of the urban–rural pattern. This issue is coupled with the fact that China is facing problems regarding the replacement of old growth drivers with new ones, the construction of industrial zones for the purpose of upgrading industrial chains and increasing added-value, and the construction of urban renewal for the purpose of improving the quality of urban services requiring tract-scale land supply. However, land resources remain scattered, and the market entry of land for collective management and construction is faced with many difficulties, such as collective bargaining and "nail households". In terms of legal interpretation, Article 45 of the Land Administration Law was established with a bottom-up clause (Article 45 of the Land Management Law of the PRC: Expropriation of land collectively owned by peasants may be carried out in accordance with the law if, for the sake of public interest, one of the following circumstances really requires expropriation: . . . (5) Where land is required for the development and construction of land expropriation for tract development of urban construction land determined by the overall land use plan and approved by the people's government at or above the provincial level for implementation by the local people's government at or above the county level; (6) In other cases where expropriation of land collectively owned by peasants is required by law for the public interest.). If the expropriation of a tract of land includes only public interest construction projects, the subordinate clause is directly applicable, and a separate clause need not be created. The expropriation of tract development, which includes commercial development, is a logical consequence of the "enumeration + underwriting" of the provisions. For example, Article 8 of the Regulations on the Expropriation and Compensation of Houses on State-owned Land includes "old city reconstruction" in the category of "public interest".

From the literature review, most of the articles discuss the criteria for expropriation and compensation for expropriation from the perspective of the economic value of the land, resulting in a lack of analysis of the ecological and social value of the land. This trend has led to a lack of consideration of the multiple values of land, farmers' rights, and interests in development and other aspects of "Good Land Governance". The key to judging the public interest of the expropriation of land for development is whether the comprehensive social benefits generated meet the needs of public interest and whether the negative effects of expropriation are mitigated through regulatory mechanisms, such as the land benefit sharing mechanisms, to ensure that the land rights of farmers, the collective, and the state are realised. The essence of the study is whether the effect is to achieve "Good Land Governance".

In this regard, the current research endorses an expansive interpretation of the public interest to examine the embodiment of the risk of standard failure in the current expropriation of tract developments through the lens of "Good Land Governance". Moreover, the study seeks to deconstruct the key factors from the value–function–subject level in a multi-dimensional manner to provide new ideas for the regulation of standard failure in the expropriation of land in a tract development through the reinforcement of public interest actualisation and public interest sharing. It also provides a mechanism for the state to use private and social capital to assist in the sustainable development of land expropriation for tract development on the basis of ensuring that the public interest is realised.

This study will provide an empirical and cross-disciplinary perspective on how to prevent misconduct in land acquisition standards. The rest of the paper is structured as follows: Section 3 is a typological analysis of the risk of standard failure in the expropriation for tract developments; Section 4 is a deconstruction of the main causes of the risk of standard failure in the perspective of Good Land Governance; Section 5 is a new way of thinking about the prevention and resolution of the risk of standard failure; Section 6 is the main conclusions and outlook.

3. Empirical Analysis of the Risk of the Failure Standards of Land Expropriation for Tract Development in the New Situation of Tract Development

In conjunction with the analysis of typical cases and schemes of land expropriation for tract development, such as "urban renewal", the "transformation of urban villages", and the construction of "industrial zones", the land expropriation for tract development faces problems on mixed public and private interests in the rapid promotion of the system. In the rapid implementation of the expropriation system, a double structural risk of mixing public and private interests emerges, and a conflict occurs among administrative, autonomous, and judicial powers in the implementation of the system. As shown in Figure 1, a number of factors have led to a dilemma in the standard of expropriation of tract developments, which has resulted in the deflation of public interest and has not fulfilled the regulatory function of the standard mechanism.

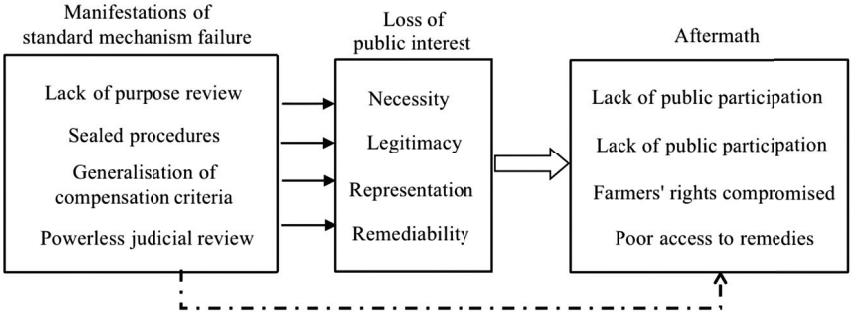


Figure 1. New risks arising from the failure of levy standards for tract development.

3.1. Lack of Purpose Review and Insufficient Justification for Land Expropriation for Tract Development Resulting in the Risk of Public Interest Being Squeezed

The public interest purpose is a prerequisite for the exercise of the state's right of expropriation [29]. From the analysis of the current state of judicial practice, commercial development and market-oriented operation cannot be the direct reason for denying the public interest purpose of the act of expropriation (In the Supreme Court Administrative Ruling No. 612(2015) on Administrative Supervision, the Supreme People's Court held that "in the process of renovation of old urban areas, municipal and county people's governments supplement the shortage of funds for renovation of old cities through commercial development, the purpose of which is still to improve the living environment and improve the quality of life of the expropriated people. Commercial development is only a means of land use after the expropriation of houses, and as long as the compensation and resettlement of housing expropriation ensures that the expropriated people get the option to move back, the public interest purpose of expropriation cannot be denied on this basis". Shandong Rizhao Intermediate People's Court Administrative Litigation Final Case No. 59 (2016) Administrative Judgment held that "the fact that the urban village renovation project in question is carried out in a government-led, market-operated and village-enterprise cooperation manner cannot be a reason to deny the public interest nature of the project, and the plaintiff's claim that the project is a commercial development and does not fall within the scope of public interest has no basis."). In the Supreme People's Court Administrative Cases Re-examination No. 7046 (2017), the Supreme People's Court held that "under the conditions of socialist market economy, it is an inevitable trend to establish a mechanism for social and market participation in the supply of public services, and the public interest cannot be defined by whether or not a market-oriented operation model is adopted". In this context, in the basic structure of "collective ownership - state expropriation - private use", whether the land expropriation for tract development is in the public interest depends to a large extent on the subsequent private use [30]. How to limit private use to ensure the key point in determining the legality of expropriation lies in how

to restrict private use to ensure the realisation of public interest. The current review of the purpose of land expropriation for tract development often presents a determination that "the expropriation is in accordance with the plan", which directly relieves or exempts the burden of proof of the substantive content of the public interest. For example, in Supreme Law Administrative Ruling No. 14185 (2020) and Supreme Law Administrative Ruling No. 2139 (2019), the courts in the "Xiaoliang Village Area Renovation Project" and the "Panlong District Old City Renovation Project" both stated that the projects were in the public's interest. This declaration reduces or dispenses with the purposive examination of public interest. This tendency to equate "compliance with planning requirements" with "satisfaction of the public interest element" is in fact based on the doctrine of "ensuring the public interest in accordance with planning". According to this doctrine, the public character of a specific urban project and the purpose of its implementation in the determination of the public interest need not be discussed because its public character is already ensured in the urban plan [31]. This trend towards judicial review has reduced the burden of proof for the government's argument that "land acquisition promotes the public interest". The combination of government dominance in land acquisition and the absence of purpose review has led to an expropriation practice characterised by a high degree of autonomy in government action and a low risk of illegality in the process of expropriating land for development. For example, in the case of urban village renovation projects, public interest has been established to maintain the order of urban land ownership and to promote the urbanisation process. The Regulations on the Expropriation and Compensation of Houses on State-owned Land also recognise the public interest nature of the situation (Article 8(5) of the Regulations on the Expropriation and Compensation of Houses on State-owned Land stipulates that "the reconstruction of old urban areas with a concentration of dangerous houses and poor infrastructure, etc., organized and implemented by municipal and county-level people's governments in accordance with the relevant provisions of the Urban and Rural Planning Law, falls within the scope of public interest".) . The established public interest causes difficulty for the courts to review the public interest and purpose of redevelopment proposals (In the Supreme People's Court of China Administrative Ruling No. 2826 (2017), the court of first instance held that the annual plan for national economic and social development was quasi-legislative in nature and that the expropriation decision for the old city renovation in question had been incorporated into the alteration and included in the annual plan for national economic and social development, which was considered by the municipal and county people's congresses to form a resolution, and that the people's courts did not have the power to change it through administrative trials. The Court of Re-examination also recognised its public interest nature on the grounds that it complied with procedural requirements, as well as Articles 8 and 9 of the Regulations on the Expropriation and Compensation of Houses on State-owned Land.), and the government lacks a clear explanation of the public interest and purpose of redevelopment proposals when formulating expropriation proposals for land expropriation for tract development (Public interest arguments are lacking for specific expropriation schemes for tract development, such as the Scheme for the Acquisition of Land for Tract Development in Xindian Area, Jinan District, Fuzhou City, and the Public Notice Scheme for the Acquisition of Land for Tract Development in Anyuan County.).

The issue of land in China has its own peculiarities. On the one hand, reviewing the purpose of relying solely on government planning to ensure the public benefit of land expropriation projects for tract development will undoubtedly squeeze out the space for collective business construction land to be marketed. A risk of institutional competition between the current expropriation of land for development and the market entry of collective business construction land emerges. On the other hand, the reasonableness of urban planning is a substitute for the public nature of expropriation projects, which will lead to the expansion of the government's administrative power and affect the development of the market system for the right to use construction land for business purposes; moreover, evident differences exist between expropriation projects for tract development, and planning

or regulatory restrictions often present weak constraints. The lack of a purposive review of planning or regulatory restrictions is likely to lead to the falsification of public interest and imbalance between public and private interests. In urban regeneration projects, such as urban village renovation and urban renewal, the land is relatively scattered, and the development of the project focuses on the rationality of urban planning and the orderliness of urban development (The scheme of land acquisition for tract development in the area around the Second Ring Road 1 in Cangshan District, Fuzhou City, and the scheme of land acquisition for tract development in the central area of Magzao Town, Jinjiang City, are mostly discussed in terms of the necessity of optimising urban planning and enhancing the urban landscape. The land is scattered, and the scale of acquisition is relatively small.). In the case of economic development projects, such as industrial parks and new urban areas, the expropriation of land for tract development is relatively concentrated, and project development focuses on the transformation of economic growth through comprehensive investment and development of land, industry, infrastructure, public services, and financial projects (For example, the Tianjin Jinan Economic Development Zone Industrial Area Land Acquisition and Piece Development Programme, the Huai'an Industrial Park Salt Chemical Industry North Area Land Acquisition and Piece Development Programme, and the Cangnan County 2021 Land Acquisition and Piece Development Programme are mostly discussed in terms of the necessity of facilitating economic development and expanding urban space. Features such as the concentration of land and the large area to be developed are present.). The criteria for determining the public benefit required for different types of land expropriation for tract development are difficult to harmonise. In the absence of a review of the purpose, a system that limits the size of expropriation may easily drive some governments to fall into the perception that they only need to meet a minimum percentage of land for public benefit to safeguard their public benefit, thus expanding the authority to exercise the right to expropriate for tract development. For example, urban residential and commercial construction projects easily become included in the land acquisition plans for tract development (In the "Fuzhou Jinan District Goose Peak Area Land Acquisition into Piece Development Programme" and the "Jishui County Land Acquisition into Piece Development Programme", commercial finance and commercial residential construction purposes are included in the tract development and acquisition projects.). In contrast, in the case of industrial upgrading, industrial zone construction, and other land expropriation for tract projects, excessive restrictions on the proportion of land for public benefit may lead to restrictions on the construction of parks, to the detriment of the realisation of the public interest.

3.2. The Procedure Is Relatively Closed, and the Mechanism for Expressing Public Interests Is Not Smooth, Which May Lead to Social Risks

Without procedural justice, no substantive justice can be achieved. The fairness and transparency of procedures in the process of expropriation of land for development is a necessary condition for the realisation of public interests and is also the focus of farmers' demands. In land expropriation, the right of collective land membership in China provides peasants the right to participate in the process of land expropriation [32]. In the judicial precedents, the expropriation cases, and legal regulations collected by the author, the degree of participation and the expression of the will of the expropriated peasants are gradually recognised as constitutive elements of public interest. For example, in Supreme People's Court Administrative Cases Re-examination No. 1960 (2018), the court, in arguing for the public interest, indicates that it should "respect the expressions of intent formed by the vast majority of expropriated people through due process, and construction projects to which the vast majority of expropriated residents agree should be considered to be in line with the needs of public interest". The Ministry of Natural Resources issued the "Standards for tract Land Acquisition and Development", and various local standard documents also include the villagers' voting procedure in the expropriation procedure (Article 4 of the Criteria for Land Acquisition for Tract Development stipulates that "the proposal for land acquisition

for tract development shall fully consult the rural collective economic organizations and farmers within the area of tract development and be agreed by two-thirds or more of the members of the villagers' meeting of the members of the collective economic organizations or two-thirds or more of the villagers' representatives. Without the consent of at least two-thirds of the members of the villagers' meeting of the collective economic organisation or at least two-thirds of the villagers' representatives, no application for land acquisition for tract development shall be made". Similar provisions are found in local documents such as the Guidelines for the Preparation of Land Acquisition for Tract Development in Yunnan Province and the Guidance on the Implementation of Standards for Land Acquisition for Tract Development of the General Office of the Jiangxi Provincial People's Government.). The current public participation of farmers in the expropriation procedures for tract development is mainly reflected in the "two announcements and one registration" system (The "two announcements and one registration" refers to the announcement of land acquisition, the announcement of the compensation and resettlement plan for land acquisition, and the registration of compensation.), the hearing procedures, and the voting system for land expropriation for tract projects. However, the expropriation system lacks the necessary procedural safeguards and remedies for the exercise of the expropriated farmers' rights to information and participation: at the level of system implementation, farmers' rights to information are limited in the land expropriation of tract developments. The announcement process is not in line with the regulations and is formalized. In addition, the content of the announcement is evasive, and necessary publicity work is lacking, thus resulting in a poor level of awareness of the content of the announcement (According to the research data in Wang Yakun, Zhao Heng, and Peter Ho's paper "A Study of Land Expropriation Procedures from the Perspective of Farmers' Rights and Interests—A Case Study of Five Construction Projects in Hebei Province", 70.8% of the expropriation announcements in the survey on the degree of regulation of the announcement procedure did not comply with the content and timing of the announcements. In the survey on the effect of public announcements, 89.4% of the farmers interviewed did not understand the statutory process of land acquisition at all, and 46.9% of the farmers interviewed understood little or nothing about the compensation scheme for land acquisition.). The announcement process can hardly achieve the information access required to protect farmers' right to know. The regulation of farmers' right to participate is mostly in principle, and concrete and enforceable mechanisms are lacking. Furthermore, among the aspects that remain insufficient are mechanisms to express farmers' views on the expropriation of land for development, a mechanism for consultation during the expropriation process, and a redress mechanism for violations of the right to information and participation (For example, the Fuzhou Jin'an District Ziyang Area Land Acquisition and Piece Development Programme, the Yongkang City 2021 Annual Land Acquisition and Piece Development Programme Public Notice, the Ganzhou Rongjiang New Area Land Acquisition and Piece Development Programme (2021–2022), the Yunnan Province Land Acquisition and Piece Development Programme Layout Guide, the General Office of the Jiangxi Provincial People's Government on the Implementation of Land Acquisition and Piece Development Standards, the Guidelines on the Implementation of Land Acquisition and Development Standards of the General Office of the Jiangxi Provincial People's Government, and other local tract development programmes and standards lack mechanisms for expressing farmers' views, consultation, and redress.). Poor mechanisms for the expression of public interests not only cause difficulty to achieve the objectives of public monitoring and public participation, but also tend to intensify farmers' resistance and rejection of expropriation, thus leading to confrontation among villagers, village committees, and the government.

In the process of demolition and development, the development and demolition behaviour of the government and developers is generally unmonitored, and the lack of public participation has led to a lack of proper supervision of the programme implementation process. This shortcoming is coupled with the influence of micro-corruption factors, which has led to the frequent occurrence of misconduct in development, such as renting instead

of expropriation (This is an unauthorised expansion of the scale of construction land by renting collective peasant land for non-agricultural construction. In essence, this is an act to circumvent the statutory approval for the conversion of agricultural land and land expropriation and to use land illegally.) and expanding the expropriation area. For example, the shantytown project on Lot 2A in Longshanzi, as indicated in Supreme Court Administrative Decision No. 13199 (2020), had irregularities in the development process, such as expanding the area of expropriation. In another example, in the Liujiaying Urban Village Renovation Project and the Mujwang Village Urban Village Renovation Project, some areas of the project were not developed in accordance with the expropriation plan, such as broken capital chains and illegal development. resulting in rotten buildings and farmers being unable to resettle after land expropriation. This scenario has led to the problem of farmers' rights being compromised (Reference "A bad specimen of "urban reform"! After the transformation of an urban village, 500 villagers have been rented out for up to seven years and are unable to move back in", available at http://m.news.cctv.com/2017/12/03/ARTIlOqEmsHT8T8L4ul7E21K171203.shtml, (accessed on 12 May 2022). Among them is the problem of landless farmers in Mu Zhuang Wang village due to a broken financial chain; Reference "Notice of the auction of the land use rights and ground attachments" of the Kunming. The auction project in the "Notice on Land Use Rights and Ground Attachments (Construction in Progress)" of Yunshan Community Neighborhood Committee, Qingyun Street Road Office, Panlong District (First Auction), is the stoppage project in the Liujiaying Urban Village Renovation Project due to the financial shortage of the project developer, Kunming Antai Real Estate Development Co.). The irregularities in the development behaviour not only lead to the defalcation of public interests, but also cause social problems such as difficulties in resettlement and stagnation of project development.

3.3. The Generalised Approach to Compensation for Land Acquisition Has Led to a Lack of Attention to Farmers' Rights to Development, Resulting in the Risk of Numerous Land Disputes

As the usual standard for compensation for expropriation, the fair market value compensation standard has revealed disadvantages such as social and ecological value neglect in today's land expropriation and use process. Scholars continue to suggest that fair market value is a desperate choice, and it is not uncommon for the literature to criticise the fair market value standard [33]. The U.S. Federal Supreme Court has very implicitly acknowledged the possible injustice implicit in the fair market value standard at the very beginning of its establishment. Compensation for land acquisition requires an equitable element to intervene to compensate for the current neglect of farmers' rights of development [34]. Against this backdrop, China's compensation for farmers has undergone a transition and exploration from a single monetary compensation to a diversified resettlement, social security stage [35]. The No. 1 central document of China (As the first policy statement released by Chinese central authorities each year, the document is seen as an indicator of policy priorities.) has repeatedly stressed the need to increase the proportion of farmers' share in the value-added proceeds of land and to ensure that the living standards of farmers whose land has been expropriated are improved and their long-term livelihood is guaranteed. Unlike the traditional method of expropriation, the land expropriation for tract development is characterised by high costs, a long payback cycle, difficulty, and a large number of subjects involved. In the development method, the government often adopts a market-based model of cooperation with social capital to develop and build the planned land (Documents such as the Notice of the General Office of the State Council on Further Strengthening the Renovation of Shantytown Areas and Several Opinions on Encouraging and Guiding the Healthy Development of Private Investment show the importance the state attaches to emphasising the cooperation between the government and social capital for tract development and expropriation. Local political documents such as the Office of the Xiangtan Municipal People's Government on the Implementation Opinions on Encouraging Social Capital to Participate in the Transformation and Development of

Shantytown Pieces in Urban Areas of the City and the Notice of the Wuzhou Municipal People's Government on the Issuance of the Implementation Opinions on the Introduction of Social Capital to Participate in Old Urban Area (Shantytown) Transformation Projects in the City also indicate the importance of local government and the use of social capital cooperation in the expropriation of tract development.).

Based on the financing burden of local finance, the profit-seeking nature of social capital, and the current financial structure and assessment mechanism of local governments, local governments have the direct goal of promoting "economic development" and "urbanization" in the process of land acquisition in a "low-cost" manner [36]. As a result, the compensation for the expropriation of land for tract development presents various risks and problems. On the one hand, the scope of compensation for the expropriation of land for tract development is generalised, thus causing difficulty to compensate for the losses caused by the expropriation. The former includes compensation for land, resettlement grants, land attachment, and seedling compensation, while the latter involves the resettlement of farmers who have lost their land. However, in practice, the loss of land values such as "sandwich land" and "flowering land" due to land expropriation for tract development, as well as the loss of attachments, rent, and business caused by land expropriation are difficult to compensate, and they lead to large costs of litigation to defend their rights (Reference Supreme People's Court Administrative Retrial Case No. 289(2019) in Lingchuan County Jinmangyuan Agricultural Science and Technology Development Co. v. Guangxi Zhuang Autonomous Region Lingchuan County People's Government Land Expropriation Compensation. The two parties who were the subject of litigation in the case disputed compensation for expropriation due to loss of production and business suspension, loss of land rent, worker training, and market development expenses. The case went through first instance proceedings, second instance proceedings, and re-trial proceedings, which eventually resulted in a re-trial ruling partially upholding the application for expropriation compensation. Similar cases still exist in Supreme People's Court Administrative Appeals Case No. 1511(2020), Supreme People's Court Administrative Appeals Case No. 3677(2017), and Supreme People's Court Administrative Appeals Case No. 12024(2020).). On the other hand, the current lack of secondary compensation for land value-added benefits from land expropriation causes difficulty for farmers to participate in the distribution of land value-added benefits. For example, in the design of the land expropriation for the tract development scheme of Qingjiang New Area in Lichuan City, the compensation method of expropriation in the scheme is still mainly monetary compensation, and the exploration of multiple compensation methods, such as land share settlement and land retention settlement, is lacking. The content of compensation for the land expropriation for tract development still focuses on compensation for land, resettlement grants, compensation for ground attachment and seedlings, and compensation for housing demolition and resettlement. Moreover, it lacks attention to the rights of expropriated farmers to labour, development, and social security. The compensation and resettlement measures also fail to reflect the participation of farmers in the distribution of the benefits of land appreciation (Reference "The Plan for Tract Development of Land Requisition in Qingjiang New Area of Lichuan City", "Notice of the People's Government of Hubei Province on Announcing the Implementation of the Comprehensive Land Value Standard for Tract Land Requisition in Hubei Province", "Notice of the Provincial People's Government on Announcing the Unified Annual Production Value Standard and Comprehensive Land Value for Tract Land Requisition in Hubei Province", "Notice of the Lichuan Municipal People's Government on the Announcement of Compensation Standards for Attachments and Seedlings on Requisitioned Land in Lichuan City", and "Implementation Measures for Compensation and Resettlement of Collective Land Requisitioned Houses in Lichuan City".).

3.4. It Is Difficult for Judicial Review to Intervene, and the Lack of a Supervision Mechanism Has Led to the Risk That It Is Difficult for Farmers' Rights and Interests to Be Remedied

In an analysis of the cases of land expropriation for tract development, the majority of the cases focus on the question of whether the expropriation decision is in the public interest. From the analysis of the data in Table 1, the courts tend to adopt a conservative stance in the judicial review process of land expropriation for tract development. On the one hand, the courts tend to consider land expropriation decisions as final and non-actionable. For example, in Supreme Court Administrative Ruling No. 3830(2017), the court held that the land expropriation decision of the Sichuan Provincial People's Government was an act of final adjudication by the administrative organ as stipulated in Article 30(2) of the Administrative Reconsideration Law of the People's Republic of China and did not fall within the scope of the court's jurisdiction. On the other hand, in cases where the expropriation procedure is indeed illegal, it is also difficult for the court to revoke the expropriation decision based on public interest considerations, such as in Supreme Court Administrative Ruling No. 13199(2020), where the court found that the expropriation decision was procedurally illegal, but held that if the expropriation decision in question was revoked, it would leave some of the acquired rights and interests and other rights and relationships derived from them in a new state of instability, which would also result in a waste and loss of public resources. The difficulty of judicial review in supervising the land expropriation for tract development is a reflection of the contradiction between judicial and administrative powers. This contradiction not only affects the supervision of the land expropriation for tract development, but also results in poor access to remedies for farmers' rights and interests.

Table 1. Distribution of data on the outcome of judicial decisions (N = 635).

	Overall Data Distribution of First Instance Adjudication Results (N = 351)			**Overall Data Distribution of Second Instance Decision Results (N = 284)**		
Judgement results	Claims dismissed in full	Prosecution dismissed	Claims supported/ Partially supported	Affirmed at first instance	Change the original sentence	Remanding the case
Quantity (pieces)	184	89	78	250	32	2
Percentage	52.4%	25.4%	22.2%	88%	11.3%	0.7%

Whether land expropriation decisions are actionable is controversial in theory and practice. Some scholars believe that land expropriation is not a strictly legal relationship between the expropriator and the expropriated, "but a political interaction in which the masses cannot resist and can only choose to cooperate from the perspective of obeying the general situation of the state". Decisions on land expropriation made by the government should be final as stipulated in Article 30(2) of the Administrative Reconsideration Law (Article 30(2) of the Administrative Reconsideration Law of the People's Republic of China provides that "According to the State Council or the people's governments of provinces, autonomous regions and municipalities directly under the central government's decision to survey, adjust or expropriate land in the administrative division, the people's governments of provinces, autonomous regions and municipalities directly under the central government's decision to confirm the ownership or right to use natural resources such as land, mineral deposits, water flows, forests, mountains, grasslands, wastelands, beaches and sea areas, the decision of administrative reconsideration shall be final".), which is not actionable per se, and a large body of jurisprudence in practice holds that land expropriation decisions are not within the scope of the courts (In addition to the aforementioned

Supreme People's Court Administrative Appeal Case No. 3830 Administrative Ruling, cases such as Guizhou High People's Court Administrative Cases Litigation Final No. 195 (2016), Qinghai Provincial High People's Court Administrative Litigation Final Case No. 4 (2014), and Gansu Provincial High People's Court Administrative Litigation Case No. 53 (2015) Final all hold that expropriation decisions do not fall within the scope of the court's jurisdiction.). The land expropriation for tract development is a complex act that includes a series of links such as land expropriation decision, compensation plan, and implementation plan. The decision to expropriate land is the original starting point for all the other actions that occur later in the process. Once a land expropriation decision is ruled illegal, it not only has an impact on the legality of subsequent acts, but also on the political content of local finances, officials' appraisal, and even local economic and social development planning. However, the political nature of land expropriation is not sufficient to justify or cause the court to entertain it. From a practical perspective, the absence of judicial review is not only a lack of supervision of land expropriation for tract development, but also a detriment to the smooth flow of rights remedies, which can easily lead to the alienation of public interest. From a contingent perspective, the addition of the "admission clause" in the Administrative Procedure Law also provides a legal basis for judicial review (Article 12(1)(5) of the Administrative Litigation Law states: "The people's courts shall accept the following lawsuits filed by citizens, legal persons or other organizations: ……(5) Those who are not satisfied with the decision on expropriation or requisition and its compensation decision……"). The decision on land acquisition as a final act is an analogous interpretation of Article 30(2) of the Administrative Reconsideration Law, which is difficult to reconcile with the basic jurisprudence on the establishment of final acts and should be removed as soon as possible after the addition of the "admission clause" [37].

4. A Multidimensional Deconstruction of the Risk of Misconduct of Land Expropriation Standards for Tract Development under the System of "Good Land Governance"

The land expropriation for tract development should promote the integrated development of urban and rural areas and the harmonious and sustainable development of human-land relations. The perspective of "Good Land Governance" takes the basic attributes of land as the starting point for analysis and good governance at the level of values, interests, and subjects in land governance. "Good Land Governance" is not an empty concept, but has a specific value core, a core argument, and a logic of analysis: The value core of "Good Land Governance" focuses on the analysis of the value core of land justice and the right to land development in order to respond to the basic attributes of land; the core argument of "Good Land Governance" lies more in the transformation of the government's monolithic management model in the history of land management, the synergistic management effect of non-governmental organisations, and the construction of a multi-level, multi-faceted, multi-directional grassroots governance system between the government and non-governmental organisations. Through this system of grassroots governance, the state achieves a positive interaction between the various elements of governance; the analytical logic of "Good Land Governance" focuses more on the following logical starting point of land value, through the compensation of land development rights and the establishment of a collaborative sharing mechanism to achieve normativism, through further implementation into the functional level of subject rights and interests, thus using the analytical framework of value–function–subject, through the mechanism of the balance of interests, as well as the mechanism of land value realisation, in order to change the traditional important relationships between central and local, farmers and government, and villagers and autonomous organisations, to achieve the implementation of land justice from the value level to the functional level to the subject level, to achieve a multi-level and multi-faceted land governance pattern between government and non-governmental organisations.

In practice, in the absence of a fair and effective mechanism for the distribution of benefits and collaborative management, the distribution of land appreciation benefits will

intensify the structural public interest crisis in the land expropriation for tract development, which will not only lead to the deflation of public interest in land expropriation, but will also easily lead to the loss of public interest during the benefit distribution stage. As shown in Figure 2, the dilemma of expropriation is essentially an imbalance among the value level, interest level, and subject level in the process of governance, and the concept of the coordination of interests and collaborative governance in "Good Land Governance" is the key to overcoming the structural risk of public interest in expropriation.

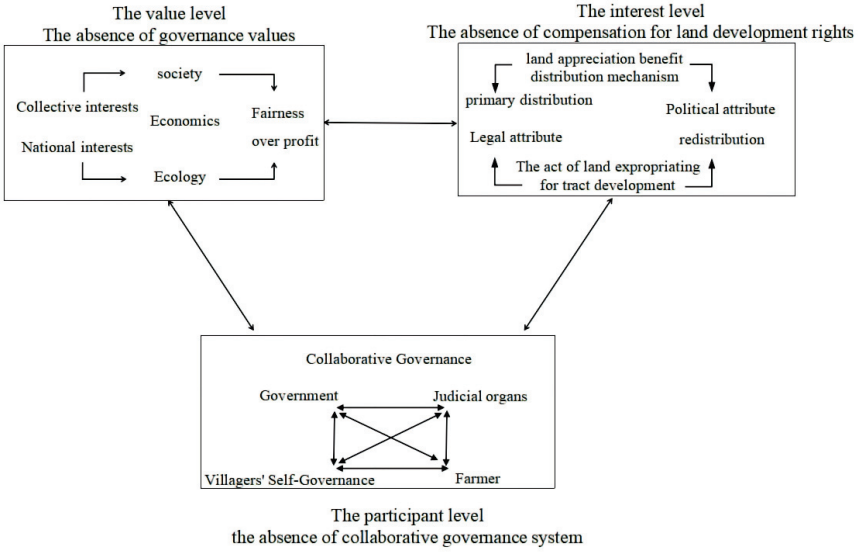


Figure 2. The logic of multiple deconstruction of the failure of land expropriation standards for tract development under the system of "Good Land Governance".

4.1. The Value Dimension: The Loss of the Element of Equity and the Disregard for the Ecological and Social Functions of Land under the "Paradox of Land Acquisition"

Good governance must be based on balancing the multiple value demands of land and maintaining the sustainability of land as a scarce resource. Both equity and efficiency are essential elements of good governance, and balancing them is an important aspect of thinking about how to achieve "Good Land Governance". The core issue of balancing the interests of the collective and the state in the land expropriation for tract development is the reconciliation of the concepts of equity and efficiency.

The establishment of the system of land expropriation for tract development reflects the conflicting values and contradictions in the implementation of state ownership in urban areas. A tension exists between Article 10(1) of the Constitution, which states that "urban land belongs to the State", and Article 3, which states that "the State may, in the public interest, expropriate or requisition land and pay compensation in accordance with the provisions of the law". This tension constitutes the "paradox of expropriation" in the current constitution, i.e., the newly created urban land does not automatically lead to the nationalisation of collectively owned land as a result of the provisions of Article 10(1) of the Constitution, and the traditional expropriation method, which is based solely on the premise of land for the public good, cannot support urban expansion and development. The contradiction between law and reality requires new expropriation systems to be explored to mitigate the conflict. One of the institutional values of the land expropriation for tract development, as a new model of expropriation that includes commercial development, is to attempt to break the "paradox of land expropriation" under the premise of ensuring the realisation of public interests to achieve a rebalance between national interests and

collective interests. However, in the process of implementing the system, the current trend of land expropriation for tract development, where the public interest is judged solely on the basis of the efficiency of land use, has not only led to the frequent occurrence of short-sighted land development, but has also deflated public interest. The reason for this trend is the lack of a structure and reconstruction of the value dimension of the land expropriation for tracts' development in terms of their nature. In addition to its economic function, land also carries social and ecological multi-functional values such as local culture, farmers' rights and interests, and ecological regulation [38]. The Supreme People's Court Act Administrative Appeal Case No. 13199(2020) Administrative Ruling is a ruling in which the shantytown project of Lot 2A of Longshanzi, the urban village renovation project of Liujiaying, and the urban village renovation project of Mujhongwang Village, caused by the procedural closure and lack of supervision, resulted in the misconduct of expropriation such as multiple expropriations and occupations, forced demolition and illegal demolition, procedural violation, and failure to resettle farmers. This issue also reflected the excessive pursuit of the economic value of land and disregard for ecological and social functions of land in the expropriation of tract development under the current administrative power. At the value level, the many procedural violations in the approval of shantytown renovation projects in Shaanxi Province Administrative Judgment No. 58(2019) reflect the traditional development mindset of grassroots governments to achieve economic interests through the sacrifice of collective peasant interests, the continuation of which has led to the transfer of risks shared by society to specific peasant collective economic organisations or individuals, resulting in the loss of the element of equity. As the process of urban–rural integration accelerates, the state is bound to strengthen the expropriation and development of rural land. The expropriation of land in pockets of development will balance the paradox of land expropriation and will also lead to the expropriation of rural construction land in pockets. The realisation of the public interest in the expropriation of land in pockets requires attention to the multiple values carried by the land, and the application of the governance concept of "fairness first, efficiency in mind" to increase the adaptability of the system, thus enabling a soft landing.

4.2. Interest Level: The Dispute between the "Political Price" and the "Legal Price" in Compensation Standards, which Hinders the Formation of a Good Governance Pattern for the Distribution of Land in the Realization of the Right to Development

The trade-offs in "Good Land Governance" are measured in terms of maximising the public interest and meeting the requirements of social equity. Tract development expropriation not only provides public good, but also enhances the value of land. As a land acquisition method that includes both public and private interests, a reasonable division of public and private interests is an important prerequisite for the realisation of the public good of tract development expropriation. Under the land acquisition system, government action plays an important role in the social distribution of the benefits of land appreciation. However, the lack of land value sharing mechanisms makes it difficult to share the huge land premiums held by the government through government policy instruments, thus leading to the phenomenon in which the standard of the expropriation system for tract development is out of line with the original design of the system.

The realisation of the land benefit distribution pattern requires that farmers enjoy not only equal compensation for expropriation based on their land rights and interests in the initial distribution, but also compensation for land development rights in the redistribution. However, the inequality in the distribution of benefits in the process of expropriation and the absence of a sharing mechanism in the area causes difficulty for farmers to enjoy the institutional dividends arising from the reform of land expropriation for tract development based on compensation for land development rights. On the one hand, the prominence of the political nature of the land expropriation of tract development makes the compensation for expropriation generalised, thus depriving the peasant groups of the prerequisite for equal compensation in the land benefit sharing mechanism: against the background of the difficulty of judicial review and the closed nature of the procedure of expropriation of tracts,

the administrative power shows a strong autonomy in the land expropriation for tract development. The prominence of political attributes makes expropriation compensation more of a "political price" than a "legal price" [39], as reflected in the Supreme People's Court Administrative Judgment No. 289(2019), which shows that compensation for land expropriation is mostly a choice of last resort in the process of land acquisition, rather than based on the protection of farmers' land rights, not based on the protection of farmers' land rights. Just compensation from the perspective of political action does not mean full compensation for losses or rights and interests. Furthermore, the realisation of farmers' rights and interests in land development by political means is challenging to ensure, which is likely to result in the neglect of interests such as the expected value-added and selective value of land in the formulation of compensation standards [40]. On the other hand, the absence of a mechanism for the land benefit sharing leads to the difficulty of realising compensation for land development rights. The realisation of the benefits of land appreciation is not only derived from land control, but also from the transfer of land values based on land control. The government, as the leader of the land sharing mechanism, has to capture part of the land appreciation benefits and compensate for the land development rights through policy instruments and government actions. However, the government's neglect of the ecological and social functions of land development rights, such as farmers' development rights and interests and ecological compensation for land, has led to an imbalance in the mechanism for sharing land value, thus resulting in a lack of mechanisms for realising compensation for land development rights. The neglect of farmers' development rights and interests in the land expropriation plan for tract development for the Qingjiang New Area in Lichuan City is a manifestation of the lack of compensation mechanisms for land development rights in the current pattern of the distribution of land value-added benefits, i.e., the lack of compensation mechanisms for land development rights in the secondary distribution of land value-added benefits, thus causing an imbalance in the adjustment mechanisms for benefits in the process of land expropriation for tract development.

4.3. Subject Level: The High Cost of Communication and Management among Stakeholders and the Imbalance between Administrative and Judicial Power Reduce the Effectiveness of Multi-Subject Cooperation and Shared Governance

The state-led approach of development means that the government can plan and manage urban development, and one of the priorities in the defence of the public interest is the distribution of the roles and responsibilities among the judiciary, the executive, the semi-autonomous public sector institutions, and the peasant community [41,42]. The core of "Good Land Governance" lies in transforming the government's unidirectional management model, bringing into play the effectiveness of collaborative dynamic management among governance subjects and building a multi-level, multi-faceted network of management among governance subjects. The definitions of "public interest" and "land expropriation for tract development" are not simple judgements. They require dynamic management among the stakeholders to ensure that the structural risks of public interest can be overcome in the process of land expropriation for tract development. The overlap of the public participation dilemma, the overlapping roles of villagers' self-governing organisations, and the imbalance between administrative and judicial powers has hindered the construction of a collaborative governance mechanism for land expropriation for tract development.

Firstly, the lagging transformation of the relationship between the government and farmers has exacerbated the policy risks for farmers in land expropriation for tract development. The government–farmer relationship is highly contemporary. For a long time, urban-biased development strategies and citizen-biased distribution systems have deepened the unequal relationship between the government and farmers, as exemplified by the Henan Province Administrative Judgment of Final Administrative Litigation Case No. 3392(2019), an urban village transformation project in which the expropriated farmers did not obstruct the demolition of the expropriated houses based on their trust in the compensation commitment of the relevant heads of administrative organs. Meanwhile, the administrative organs and their heads did not acknowledge the commitment after

the demolition and the compensation. This new type of violent demolition reflects the dysfunctional relationship between the government and farmers. Land expropriation projects of tract development are characterised by strong policies and high technicality. Meanwhile, villagers' autonomous organisations and villagers, as the subject of demolition and renovation, lack knowledge and experience and have little information, thus resulting in the vulnerable position of farmers in the expropriation process. With the significant increase in China's economic strength and comprehensive national power, we have reached a stage of development where industry feeds agriculture and cities support the countryside. The realisation of "Good Land Governance" in this context requires the promotion of a new model of public participation, i.e., strengthening the role of individuals and groups with a stake in the public interest in participating in, influencing, and monitoring the formulation and implementation of land expropriation plans for tract development, as well as strengthening the expression of the will of disadvantaged farmers [43]. The current trend of increasing awareness of farmers' rights has exacerbated the contradiction between farmers' disadvantaged position and their need for the right to information and participation. In the Administrative Judgment No. 34(2015) of the High People's Court of Yunnan Province on the final adjudication of administrative litigation cases, Li Yundi's demand for the disclosure of government information on land expropriation for tract development also reflects from the side the unfavourable position of farmers' right to information in the current land expropriation for tract development.

Secondly, the overlapping roles of villagers' self-governing organizations limit the development of farmers' public participation in the shared governance pattern. In the relationship between farmers and villagers' self-government organisations, villagers' self-government organisations play a crucial role in the development of farmers' public participation. The maintenance of public interests under the perspective of "Good Land Governance" requires villagers' self-government organisations to play a compatible role in coordinating farmers' groups with government agencies [44]. At present, villagers' committees not only play the role of assisting the government in the process of land expropriation by public announcement and registration, carrying out ideological work and mediating disputes over expropriation and development, villagers' autonomous organisations also play an important role in the realisation of villagers' land rights by providing feedback, negotiating agreements, and organising guidance. Under the current system of land expropriation for tract development dominated by administrative power, villagers' self-governing organizations are faced with conflicting roles in the land expropriation for tract development. In the case of Li Sande v. Weibin District People's Government of Baoji, the Chenjia Village Committee carried out the forced demolition of Li Sande's house for the progress of the Chenjia Village urban village transformation project, which directly reflects the overlapping roles of villagers' self-governing organizations and the blurred powers and responsibilities of villagers' self-governing organizations, thus increasing the likelihood that the government and farmers' collective interests are in conflict and reflecting the dislocation of functions such as regulating interests and expressing farmers' rights and interests. The increasing risk has also increased management conflicts and costs in the process of expropriation for large-scale development, and it is not conducive to the maintenance of public interests (Reference Supreme People's Court Releases Three Typical Cases of Administrative Litigation on Property Rights Protection: Li Sande v. People's Government of Weibin District, Baoji City, Administrative Compulsion Case, https://www.chinacourt.org/article/detail/2020/07/id/5378768.shtml, (last accessed 12 May 2022.).

Finally, the imbalance between the executive and the judiciary leads to the lack of supervision and the remedy of rights in the pattern of shared governance. The current dilemma of the difficulty of judicial intervention in the land expropriation of tract developments and the lack of review of the purpose lies in the contradiction and conflict between the co-rule of judicial power and administrative power. The lack of judicial review reflects the current trend of "promoting public interests and suppressing private interests"

in judicial practice and the strong administrative dominance of the expropriation of tract developments. The blurring of the responsibilities and boundaries of judicial review in relation to the land expropriation for tract development causes difficulty for the judicial power to form effective supervision over the administrative power of expropriation. The contradiction between the co-rule of the executive and the judiciary and the high degree of autonomy of the executive in the process of land expropriation for tract development together lead to a tendency to expand the public interest, thus causing difficulty to form a situation of co-rule between the executive and the judiciary in land expropriation for tract development.

5. Binary Public Good Reinforcement: A New Way of Regulating the Risk of Misconduct in the Land Expropriation Standard for Tract Development under "Good Land Governance"

The essence of expropriation is the social redistribution of the benefits of land appreciation resulting from social progress. Based on the analysis of the many risks of land expropriation for tract development, the involvement of private development and the lack of supervision prevent the standard mechanism of land expropriation for tract development from playing a proper role in regulating the expropriation, thus resulting in the double dilemma of the falsification of public interest and the difficulty of realising public interest in land expropriation for tract development, which determines the duality of public interest reinforcement. The development of infrastructure and construction projects can increase the supply of public goods and generate value-added land. The current lack of a purposive review has led to the falsification of the public interest, thus resulting in the risk of its being squeezed out. To address this risk, the principle of proportionality should be used in a disaggregated manner to ensure the public interest of the expropriation through the review of the purpose to realise the public interest. On the other hand, public interest is not only derived from the land value increase resulting from land use, but also from the transfer of land value due to the surrounding land restrictions. To resolve this risk, the concept of land justice must be drawn, and a public interest sharing pattern must be built through the collaborative governance of the participating parties to ensure that the ecological and social functions of land development rights are manifested and to realise social compensation for the public interest.

5.1. Reinforcing the Materialisation of the Public Interest: Applying the Principle of Proportionality in a Categorical Manner to Ensure that Expropriation Is Carried Out in the Public Interest to Mitigate the Risk of the Public Interest Being Squeezed

Under the current system of land expropriation for tract development, the state has given provincial governments greater autonomy in land expropriation for tract development, which also requires a corresponding review and restraint mechanism to prevent the alienation of power. As the binding effect of planning is often of a principled nature, at present, the restriction mechanism of the law that the land acquisition plan is incorporated into the "overall plan for land use" or the "annual plan for national economic and social development" has a weak binding effect on the public interests in the land expropriation for tract development. Compared with traditional land expropriation methods to alleviate the risk of public interest being squeezed in the expropriation of tract development, public interest can be reinforced through the construction of a purpose review system by means of the principle of proportionality: drawing on the principle of necessity in the principle of proportionality, the purpose of expropriation is justified in order to prevent the falsification of the public interest in the land expropriation for tract development; drawing on the principle of appropriateness in the principle of proportionality, the public interest of land expropriation for tract development is ensured through the certainty of the scope of the act of expropriation; drawing on the principle of least damage, the damage of the act of land expropriation for tract development is ensured through the appropriateness of the means of expropriation.

5.1.1. To Strengthen the Comprehensive Judgement of the Purpose of Expropriation, to Break the Dilemma of Falsifying the Public Interest of Land Expropriation for Tract Development and to Ensure the Legitimacy of Expropriation

Establishing the proper purpose of expropriation is a requirement of the principle of necessity. In the process of land expropriation for tract development, the legitimacy of the purpose is the basis and premise of the decision to expropriate in line with the public interest. It is also the starting point of the purpose review. The current trend of reviewing the legitimacy of the purpose of land expropriation for tract development by simply replacing it with the public interest of urban planning will easily lead to the deflation of the public interest and will hardly limit the administrative power of local expropriation. On the one hand, the review of the purpose of expropriation should be based on a comprehensive assessment of economic, ecological, and social factors. In addition, the government, as the maker of the policy plan, should undertake the obligation to specify the justification of the purpose of expropriation, instead of just stating "promoting industrial development" or "promoting economic and social development" in general, and should strengthen the government's responsibility and obligation in the process of purpose review through institutional construction. The government's responsibilities and obligations in the process of purpose review should be strengthened through institutional development, and the corresponding supervision of the government's powers and responsibilities should be strengthened through the supervision of villagers' self-governing organizations, villagers' voting procedures, and judicial review. On the other hand, the judgement of the validity of the purpose of land expropriation for tract development must be strengthened, according to which the risk assessment before expropriation should be performed properly. A risk assessment system should be established with legal risk assessment, social risk assessment, economic risk assessment, and ecological risk assessment as the main contents to ensure that the government can scientifically assess and prevent the risk factors of the land expropriation for tract development before the expropriation decision is made.

5.1.2. Internal Control of the Scope of Expropriation Is Clarified to Address the Imbalance between Public and Private Interests in the Expropriation of Tract Development and to Ensure Certainty of the Scope of the Act

The principle of appropriateness aims to ensure that the public interest is proportionate to the private interest in the structure of expropriation, and the review of the scope of expropriation is the key to ensuring the dominance of the public interest in the binary structure of expropriation. The public interest is closely related to the scope of expropriation, and the "need" for public interest is the only criterion for the scope of expropriation for tract development. Meanwhile, the size of the scope of expropriation for tract development directly affects the public interest output. If the expropriation area is too large, development and construction may be difficult to carry out due to a lack of funds. A land area that is too small may lead to the loss of land assembly effect, thus resulting in the loss of public interest. Given the inconsistency of China's current economic development and the different types of development projects that can be land expropriated for tract development, merely stipulating a lower limit or range of area leaves too much room for discretionary land expropriation for tract development, thus creating obstacles in achieving the policy's objective. Therefore, the discretionary factors of the scope of expropriation must be further improved through the construction of a purpose review system to achieve internal control over the scope of expropriation. On the one hand, the area of "tracts" should be based on the planning restrictions and spatial limitations stipulated in the Land Administration Law and should not exceed the total number of tract development expropriation targets within the terms of the overall land use planning. On the other hand, the government should follow a cost–benefit analysis to quantify the input cost and future output revenue of each unit of land. The government should consider and prove the comprehensive factors. These factors include the construction period of the tract development expropriation, the compensation and resettlement cost of land expropriation, the investment and development capacity of private developers, the specific requirements of the land use plan,

the specific content of the construction project, the overall supply and demand of land, and the development conditions of the land itself. Through internal control of the scope of expropriation, the dominance of the public interest in the land expropriation for tract development is guaranteed.

5.1.3. The Establishment of a Pre-Marketing Transaction Procedure to Break through the Difficulty of System Convergence between the Land Expropriation for Tract Development and the Market Entry of Collective Construction Land, Ensuring the Appropriateness of the Means of Land Acquisition Practices

The principle of minimal damage requires that the public good be achieved at minimal cost. As a means of realising the state ownership of urban land, the appropriateness of the means of expropriation can be ensured by setting up pre-marketing procedures in the review of the purpose of expropriation to prevent the overly broad definition of public interest from crowding out the space for the market of collective business construction land. From the analysis of land reform, the reform of expropriation is not the only way to realise state ownership of urban land. The market-oriented land reform requires that the reform of the expropriation system for tract development pay added attention to the coordination with the reform of the market entry system for collective business construction land. Compared with the expropriation of land for tract development, the process of putting collective business land on the market is decided and carried out by the peasants themselves, without the government taking the lead, which can better reflect the expression of the peasants' wishes in the process of expropriation and the realisation of their land rights. In contrast, as part of the reform of the land system, if economic construction is treated as a public interest without restriction, the government is given the right to expropriate for the purpose of economic construction. This scenario will not only lead to institutional conflicts and confusion in the application of the market system for collective economic construction land, but will also harm farmers' land rights and interests. Thus, effectively limiting local expropriation rights becomes difficult. To prevent the abuse of the government's right of expropriation and to prevent the transfer of risks that should be shared by the community to specific farmers, a pre-marketing procedure must be adopted to achieve "the lesser of two evils and the greater of two advantages".

5.2. Reinforcing Social Sharing of Public Benefits: Strengthening the Ecological and Social Functions of Land Development Rights under the Land Justice Logic of "Value-Function-Subject" to Prevent Social Risks, Risks of Disputes, and Risks of Rights and Remedies in the Long Term

The process of land acquisition is also a process of social sharing of the benefits of land appreciation. Moreover, ensuring the realisation of public interest in the process of land acquisition requires social sharing on the basis of the realisation of public interest. The logic of land justice is based on "value-function-subject": land value appreciation comes not only from the increase in land value brought about by land development, but also from the transfer of value brought about by land use control. The dualistic value attribute of land development rights necessitates the consideration of maintaining the ecological and social functions of land through compensation for land development rights to manifest the pluralistic attributes of land and realise land justice. The theory of land value transfer also determines that the realisation of public interest needs to change from negative protection to positive protection. In the formulation of programme standards, attention needs to be paid to the risk of damage to the ecological and social functions of land development rights and the reconstruction of the pattern of expropriation subjects to realise the sharing of public interest. Through the construction of a compensation mechanism for the benefits of land development rights, we can realize the sharing of land and provide a pattern of benefit distribution for the social sharing of public interests.

5.2.1. Equality of Land Rights: Refining the Construction of Farmers' Rights Subjects, Activating the Endogenous Dynamics of Public Interest Sharing and Reinforcement, and Effectively Preventing Risks of a Social Nature

The institutional realisation of equal land rights requires that everyone enjoy an equal need for land. Peasants are the endogenous driving force behind the formation of a pattern that breaks the closure of expropriation procedures for tract development and realises the sharing of public benefits. The stability of the internal environment is what stimulates the growth of the effectiveness of land management. As an important endogenous driving force for the reinforcement of the sharing of public interests, the farmers' need to participate in the expropriation process for tract development is driven by a preference for fairness or an aversion to inequality. At the same time, realising the premise of compensation for land development rights also requires breaking the existing procedural closed-loop, resulting in a single government management pattern by refining the construction of farmers' rights subjects and resolving social risks to achieve procedural fairness in land acquisition. On the one hand, the institutional construction of farmers as rights subjects should be strengthened. The status of farmers as owners of contracted land management and use rights must be highlighted, and the implementation of farmers' rights must be ensured through the development of supporting mechanisms. An agreement mechanism on farmers' rights and interests, compensation, and other issues, led by villagers' self-governing organizations, should be established. In addition, farmers' opinions and the results of agreements should be kept in writing by means of negotiated agreements, which should be used as an important basis for the examination of public opinions. Doing so helps to avoid the abuse of the right of expropriation and generalisation of public interests and to make changes in the nature and use of land by planning fully justified. On the other hand, the right of farmers to be informed, their right to participate, and their right to supervision should be effectively safeguarded, and the disadvantage of farmers in the process of expropriation should be compensated thorough institutional development. The government should expand the scope of active disclosure in accordance with regulations and implement functions such as the publication of government land prices and public enquiries into land information to expand information on peasant expropriation and ways to participate in decision-making on land expropriation for tract development, thus ensuring the operability of the right to supervision. It should also involve the public in the main stages of the expropriation system for tract development, such as agreement price purchases, public hearings, and audits, through various forms of agreement negotiation and capital and political hearings.

5.2.2. Sharing of Land: Implementing the Principle of "Land Appreciation Benefits Belong to the State", Realising the Function of Compensation for the Sharing of Public Benefits, and Continuously Preventing the Risk of Disputes over Land

Justice in the distribution of land revenue is an important part of highlighting the properties and functions of land and realising the sharing of public interests. The dualistic value of land development rights determines the legitimacy of the "public benefit". in the pattern of land appreciation benefits, new land rights holders can not only obtain benefits through land development, but also earn additional value-added benefits based on the transfer of land value. The allocation of additional value-added benefits to land rights holders disregards the consensus that land value-added benefits are generated by social progress and contributes to the imbalance in the distribution of land value-added benefits. The regulation of the risk of disputes over land profits requires the activation of a compensation mechanism for the distribution of the ecological and social functions of land, based on the principle of land appreciation benefits belong to the state. The construction of this distribution and compensation mechanism should not only focus on the initial compensation received by farmers based on the transfer of land rights, but also pay more attention to the compensation for farmers' development and social rights and interests in the secondary compensation stage based on the right to land development. In the initial compensation stage, a market-based distribution mechanism based on land rights should

be established to realise the initial distribution of the benefits of land appreciation. A compensation mechanism for expropriation based on land loss must be built by strengthening the construction of multiple compensation methods, refining the types of compensation, and raising the standard of compensation. Moreover, the compensation measures for items such as residual land and business losses must be improved, and the construction of a multi-faceted compensation mechanism in the form of monetary compensation and social security resettlement must be strengthened as well. At the same time, measures can be taken to leave land for resettlement by allowing farmers or rural collective economic organisations to own part of the land for a certain period in the form of usufruct rights. In doing so, they can participate in the initial distribution pattern of land appreciation benefits to promote the realisation of incentive governance effects. In secondary compensation, a mechanism for returning land appreciation benefits for the social and ecological functions of land should be established. On the one hand, the regulatory role of taxation in the maintenance of social benefits and the sustainable development of land should be brought into play so that the value-added benefits flow into the ecological and social benefits of land through taxation and provide a financial basis for the realisation of public interests. On the other hand, more attention should be paid to the consideration of farmers' employment training, social resettlement, and other development rights in the compensation and resettlement measures. At the same time, the resettlement compensation scheme should also include sustainable use mechanisms such as compensation for ecological restoration of land and compensation for restrictions on land development intensity from the perspective of inter-generational and inter-regional equity to guide the allocation of land development rights and ecological functions to ensure the realisation of public interests.

5.2.3. Land to the Fullest Extent of Its Benefits: Clarifying the Content and Boundaries of Judicial Review, Facilitating the Remedy of the Right to Share and Strengthen Public Interests, and Precisely Solving the Problem of Remedying Farmers' Rights and Interests

The prerequisite for the realization of public interest sharing and strengthening is to ensure the normal exercise of land rights on the basis of guaranteeing the smooth flow of rights remedies, to resolve the risky dilemma of rights remedies. Judicial review is not only an important channel for the redress of land rights, but it is also an important factor in breaking the self-imposed limitations of the current standards for the procedure of land expropriation for tract development. To avoid the arbitrary expansion of "land needed for the implementation of land expropriation for tract development" in practice, the reform of the litigability of tract development expropriation must be actively promoted. Moreover, among the other actions that must be taken include expanding the authority of the judicial review, including the tract development expropriation plans and decisions in the scope of the judicial review, strengthening the judgement of public interest in tract development expropriation, and refining the elements of judgement of public interest in tract development expropriation. A system of judging public interest with multiple elements, such as procedural elements, democratic elements, compensation elements, and benefit distribution elements, has been established to achieve innovation in judging methods and elements. Secondly, on the basis of expanding the litigability of expropriation standards for tract development, the responsibilities and boundaries of judicial review should also be clarified. Judicial review is conducted from the standpoint of ex post facto judgement, and the local government has incomplete information and urgency in making decisions on the expropriation of tract development. If the court is overly critical of the local government's decision, it will make judicial review difficult, which will result in the usurpation of judicial power over administrative power. Therefore, the principle of judicial modesty should be adopted as the principle of judicial review. Thirdly, the burden of proof for the land expropriation for tract development can be refined. By refining the burden of proof on the government and the developer for the public interest of the development of the expropriation project, the government can compensate for the difficulty of judicial intervention due to the professional nature of administrative decisions and development.

6. Conclusions

At this critical stage of China's socio-economic transformation and development, how to smoothly advance the relationship between urban and rural development and promote the sustainable development of the relationship between people and land is a key proposition that needs to be addressed in land acquisition research in the new era. Although land expropriation for tract development is an important initiative in land acquisition reform, in the process of institutional implementation, there are problems such as insufficient purposive review, insufficient public participation, compensation for land acquisition with unspecific criteria, and insufficient judicial review intervention, resulting in the existing institutional design's lack of control over land acquisition. This is due to the lack of respect for the multiple values of the land, the poor land benefit sharing mechanisms, and the failure to establish a synergistic mechanism between subjects, combined with the presence of commercial interests to create the risk of alienation and diversion of the functions of land acquisition.

In this paper, we followed the theory of "Good Land Governance" and advocated that, on the basis of respecting the multiple values of land, the strengthening of public interests and the sharing of public interests should be ensured under the framework of dualistic public interest reinforcement, so as to achieve the control of the risk of land acquisition for piecemeal development. Of course, it should be noted that its perfection requires the implementation of specific systems, and this paper only presents a framework analysis of the current risks based on relevant regulations and judicial practice. As a new system, it is necessary to conduct further research on issues such as "how to control the limits of judicial review" and "how to operate social resettlement" in order to prevent and control risks.

Author Contributions: Conceptualization , L.L. and Y.H.; methodology, L.L., Y.H., and C.L.; validation, L.L., Y.H., and C.L.; formal analysis, L.L., Y.H., and C.L.; investigation, L.L., Y.H., and C.L.; resources, L.L.; data curation, L.L. and Y.H.; writing—original draft preparation, L.L. and Y.H.; writing—review and editing, L.L. and Y.H. All authors have read and agreed to the published version of the manuscript.

Funding: The research was supported by The National Social Science Fund of China (Grant No. 18ZDA166).

Informed Consent Statement: Not applicable.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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

References

1. Ghatak, M.; Ghosh, P. The land acquisition bill: a critique and a proposal. *Econ. Political Wkly.* **2011**, *46*, 65–72.
2. Nguyen, H.L.; Duan, J.; Zhang, G.Q. Land Politics under Market Socialism: The State, Land Policies, and Rural–Urban Land Conversion in China and Vietnam. *Land* **2018**, *7*, 51. [CrossRef]
3. Liu, Y.; Li, Y. Revitalize the world's countryside. *Nature* **2017**, *548*, 275–277. [CrossRef]
4. Tu, S.; Long, H. Rural restructuring in China: Theory, approaches and research prospect. *J. Geogr. Sci.* **2017**, *27*, 1169–1184. [CrossRef]
5. Chen, K.; Long, H.; Liao, L.; Tu, S.; Li, T. Land use transitions and urban–rural integrated development: Theoretical framework and China's evidence. *Land Use Policy* **2020**, *92*, 104465. [CrossRef]
6. Shee, S.P.; Maiti, R. Land acquisition, livelihood and income: the case of JSW Bengal Steel Plant at Salboni Block, Paschim Medinipur, West Bengal, India. *Environ. Dev. Sustain.* **2019**, *21*, 2997–3014. [CrossRef]
7. Ding, C. Policy and praxis of land acquisition in China. *Land Use Policy* **2007**, *24*, 1–13. [CrossRef]
8. Zhu, J.; Zhu, M.; Xiao, Y. Urbanization for rural development: Spatial paradigm shifts toward inclusive urban–rural integrated development in China. *J. Rural. Stud.* **2019**, *71*, 94–103. [CrossRef]
9. Liu, Y. Research on the urban–rural integration and rural revitalization in the new era in China. *Acta Geograph. Sin.* **2018**, *73*, 637–650.
10. Yin, X.; Chen, J.; Li, J. Rural innovation system: Revitalize the countryside for a sustainable development. *J. Rural Stud.* **2022**, *93*, 471–478. [CrossRef]

11. Wang, L. On the Public Interest in Expropriation Systems. *Trib. Political Sci. Law* **2009**, 13.
12. Yu, F. Judicial Review of the Public Purpose of the Expropriation Decisions for Tract Development: The Application of Principle of Proportionality. *J. CUPL* **2019**, 12.
13. Xiao, C. Rethinking the Public Interest in the Legal Regime of Land Acquisition. *Rurml Econ.* **2020**, 8.
14. Merrill, T.W. Economics of public use. *Cornell L. Rev.* **1986**, *72*, 61.
15. Fang, S. Legal Perfection of Land Expropriation System: Taking the Draft Amendment of Land Administration Law as the Object of Analysis. *Law Sci. Mag.* **2019**, *40*, 12.
16. Morris, S.; Pandey, A. Towards reform of land acquisition framework in India. *Econ. Political Wkly.* **2007**, *42*, 2083–2090. [CrossRef]
17. Chen, X. Amendments to the Land Administration Law and the new round of land reform. *China Law Rev.* **2019**, 10.
18. Olsson, L. The neoliberalization of municipal land policy in Sweden. *Int. J. Urban Reg. Res.* **2018**, *42*, 633–650. [CrossRef]
19. Cheng, X. Expropriation of tract developments and its standard determination from the perspective of constitutionality. *Chin. J. Law* **2020**, *42*, 15.
20. Huang, Z. Tract development and land acquisition. *Chin. J. Law* **2020**, *42*, 18.
21. Yu, F. Systematic Interpretation of the Standards of Land Expropriation for Tract Development in Land Management Law. *China Land Sci.* **2020**, *34*, 18–25.
22. Hua, Z. Institutional Structure and Risk Control of Land Expropriation for Integrated Development. *China Land Sci.* **2022**, *36*, 28–35.
23. Shi, J.; Li, J. Identification of Public Welfare in Tract Development Expropriation. *J. Beijing Inst. Technol. (Social Sci. Ed.)* **2022**, *24*, 116–126.
24. Liu, Y. A Review on Zonal Expropriation of Taiwan and Its Implications. *China Land Sci.* **2020**, *34*, 17–23.
25. Bishop, P.; Jenkins, V. Planning and nuisance: revisiting the balance of public and private interests in land-use development. *J. Environ. Law* **2011**, *23*, 285–310. [CrossRef]
26. Svensson, J.; Neumann, W.; Bjärstig, T.; Zachrisson, A.; Thellbro, C. Landscape approaches to sustainability—Aspects of conflict, integration, and synergy in national public land-use interests. *Sustainability* **2020**, *12*, 5113. [CrossRef]
27. Gebremichael, B. Public purpose as a justification for expropriation of rural land rights in Ethiopia. *J. Afr. Law* **2016**, *60*, 190–212. [CrossRef]
28. Wang, L. Improvements to the Expropriation and Expropriation Regime in the Draft Property Law. *China Leg. Sci.* **2005**, 11.
29. Jin, X. Dissecting the mainstream thinking on land acquisition system reform. *China Rural. Econ.* **2008**, *28*, 11–17.
30. Liu, Y. Zone Development and Construction as the Purpose of Land Expropriation -WithComments on Article 45(1) (5) of the Land Management Law. *North. Leg. Sci.* **2021**, *15*, 12.
31. Huang, Y. The Legal Practice of Land Acquisition in Japan and Implications for China -Focusing on Public Interest and Damage Compensation. *Glob. Law Rev.* **2015**, *37*, 25.
32. Zhao, J. A preliminary study on farmers' participation in land acquisition procedures. *Rural. Econ.* **2012**, 4.
33. Lee, B.A. Just undercompensation: The idiosyncratic premium in eminent domain. *Colum. L. Rev.* **2013**, *113*, 593.
34. 339 US 121 United States v. Commodities Trading Corporation Commodities Trading Corporation. 1950. Available online: https://www.loc.gov/item/usrep339121/ (accessed on 12 May 2022).
35. Guo, S.; Dong, Y. The Development and Evolution of China's Rural Land Acquisition Compensation and Distribution System from the Perspective of Policy Tools: Analysis Based on 55 Policy Texts(1978–2019). *Econ. Manag.* **2021**, *35*, 10.
36. Wen, G.J. The Land Tenure System and its Saving and Investment Mechanism: The Case of Modern China. *Asian Econ. J.* **1995**, *9*, 233–260. [CrossRef]
37. Xiong, Z. Land acquisition decisions are not final - centered on Article 30(2) of the Administrative Review Law. *Chin. J. Law* **2017**, *39*, 15.
38. Li, L.; He, Y. Necessary Restriction and Reasonable Expansion of Homestead Use Rights Circulation in Integrated Urban and Rural development. *J. Northwest Univ. Soc. Sci. Ed.* **2022**, *22*, 8.
39. Cheng, X. Land development rights and the distribution of land appreciation gains. *Chin. J. Law* **2014**, *36*, 22.
40. Wang, X. Fair compensation for land acquisition and market opening. *China Rural. Surv.* **2007**, 10.
41. Rakodi, C. Politics and performance: the implications of emerging governance arrangements for urban management approaches and information systems. *Habitat Int.* **2003**, *27*, 523–547. [CrossRef]
42. A, M.M.M.; B, Y.A. The role of NGOs in public and private land development: The case of Dhaka city. *Geoforum* **2015**, *60*, 4–13.
43. Wang, J.; Zhang, Z. The Discussion on New Public Participation Boundary of Land Expropriation: Based on the Typical Case Study of Land Expropriation in Taiwan. *China Land Sci.* **2016**.
44. Gan, Z.; Zhu, D. Study on Good Land Governance. *China Land Sci.* **2021**, 34.

land

MDPI

Article

Evaluation Method of Composite Development Bus Terminal Using Multi-Source Data Processing

Tao Zhang [1], Yibo Yan [2], Qi Chen [2] and Ze Liu [3,*]

[1] Enrollment and Employment Division, Henan College of Transportation, Zhengzhou 450001, China
[2] College of Civil Engineering, Henan University of Technology, Zhengzhou 450001, China
[3] Faculty of Architecture, Civil and Transportation Engineering, Beijing University of Technology, Beijing 100124, China
* Correspondence: liuze@bjut.edu.cn; Tel.: +86-136-6138-2836

Abstract: Given the accelerating speed and scale of urbanization in China, a rational formulation of a composite development plan to increase the vitality and value of various areas is required. Thus, this study proposes a method for evaluating the spatial relationship among facilities around bus terminals by combining urban points-of-interest data and street view image data from two perspectives: the current level of development and potential of the terminals, and an evaluation of the surrounding pedestrian environment. This is in response to the lack of quantitative descriptions of the composite development of existing bus terminals. The validity and applicability of the methods are verified using the samples of five planned composite development bus terminals in the city of Zhengzhou. These results offer strategic suggestions for the composite development of the Zhengzhou bus terminals. This study demonstrates innovation in integrating geographic information data and street view image data. It reflects the spatial characteristics of the built environment using geographic information data and the visual characteristics of the built environment using street view images.

Keywords: bus terminal; composite development; built environment; spatial relationship; machine learning; semantic segmentation

Citation: Zhang, T.; Yan, Y.; Chen, Q.; Liu, Z. Evaluation Method of Composite Development Bus Terminal Using Multi-Source Data Processing. *Land* **2022**, *11*, 1757. https://doi.org/10.3390/land11101757

Academic Editors: Pasquale de Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 22 August 2022
Accepted: 7 October 2022
Published: 9 October 2022

1. Introduction

With the accelerating speed and scale of urbanization in China, the increasing numbers of motor vehicles, wastage of land resources, and environmental pollution have become serious problems and major obstacles to sustainable urban development. Many cities have responded to this problem by implementing traffic control measures such as vehicle restrictions and congestion pricing. Based on practical experience from some cities, the vehicle restriction policy can indeed reduce people's tendency to choose motor vehicle travel in the short term, but the continued rapid growth of the number of motor vehicles leads to a gradual weakening of this measure, especially in the long run [1–3]. Furthermore, the implementation of a congestion pricing policy can cause disputes in social fairness. In practice, targeted control measures for urban traffic problems can only temporarily alleviate congestion, whereas the long-term contradiction of a mismatch between supply and demand of traffic trips remains difficult to solve. Therefore, many scholars advocate the model of "transit-oriented development (TOD)", hoping to improve the urban environment through a combination of land-use and transportation planning, expecting to promote the integrated development of transportation and land, and fundamentally solving the problem of the gap between the supply and demand of transportation and travel [4–6].

TOD is widely regarded as an effective way to integrate transportation and land use. Its primary significance lies in the high-intensity and multi-functional development around public transportation stations, complemented by the design of a pleasant pedestrian environment to reduce people's dependence on private motor vehicles [5]. Since the 1990s, research on TOD has become a topic of interest for governments and research institutions [7].

Considerable empirical evidence suggests that TOD not only increases the frequency of walking and transit trips but also significantly reduces the willingness of people to choose motorized trips. For example, Nasri and Zhang (2014) found that TOD areas in Washington and Baltimore in the United States had approximately 38% and 21% lower motor vehicle miles traveled, respectively, compared with non-TOD areas [8]. Tian et al.'s (2017) survey found 1.7 times more walking trips around Seattle TOD areas than in non-TOD areas, and motor vehicle miles and parking demand were significantly lower than previously recorded [9]. Most existing studies on TOD development models focus on rail transit stations [5,10,11]. However, the high construction costs of rail transit systems are not suitable for all cities. Hence, it is necessary to consider all possible means for urban public transport [12].

The city bus network and the bus terminal are the core of a bus network and constitute critical infrastructure in the entire bus system. China's current government-led bus terminal construction and operation model often stands in contrast to the surrounding land and facilities, resulting in a disconnect between the bus terminal and the development of the surrounding land and facilities, preventing the former from playing a central role as a hub [13]. As an emerging model for solving such problems, the compound development of bus terminals has been widely supported by relevant national and local policy documents. Some cities' bus groups and real estate developers have also begun to explore this mode of construction and operation by introducing a mix of multiple businesses, improving the road environment, and optimizing bus routes and stations, among other measures, to enhance the bus terminal's attractiveness for passengers, increasing passenger flow, and thereby the area's commercial value [14]. Therefore, objectively measuring the spatial relationship of the facilities around the bus terminal from the perspective of public transportation is a basic prerequisite for the rational formulation of a composite development plan and for increasing the vitality and value of the area. Simultaneously, the bus terminal, the organizational core of the city's public transport system, should be fully considered in terms of the interrelationship between public transport and facilities within its radius. This will provide the appropriate mechanism and planning basis for promoting public transport development and improving land utilization.

Hence, combined with existing research, this study uses spatial syntax, network analysis, and machine-learning semantic segmentation to investigate the spatial relationship between bus terminals and surrounding facilities from two perspectives: the development level and potential, and the pedestrian environment. Specifically, this study aims to: (1) construct descriptive indexes of the spatial relationship of the facilities around the bus terminal from the perspective of public transportation; (2) verify the rationality of the composite development plan of the bus terminal; and (3) propose an optimization strategy for the composite development of the bus terminal and an improvement strategy for pedestrian environment.

The remainder of this paper is organized as follows. Section 2 reviews the literature. Section 3 explains the method and data. Section 4 provides the case analysis. Finally, Section 5 concludes the study and presents its contributions to the literature.

1.1. Bus Terminal Optimization Strategies

Numerous scholars have extensively discussed the land resource allocation scheme for developing bus terminal complexes. He and Yang (2019) believed that to solve the shortage of land for bus terminals, cut down on operating losses, and address other problems proposed in the application of the land planning of bus terminals, the ideas of both the land planning department and bus operating company should be considered [15]. This includes applying for more land for bus terminal development in the remote areas of the city and initiating new routes for the newly developed bus station. Given the current situation of limited land for bus terminals in Shenzhen, Lin et al. (2013) proposed an implementation mechanism for the transformation and upgrading of the secondary development of bus terminal land in the future, drawing on the experience of the comprehensive development

of bus terminals in Hong Kong. In contrast, the study of bus terminal optimization is mainly from the perspective of the transportation network, which is through the optimization of routes, station locations, and other measures to increase their utilization efficiency, thereby improving operational efficiency [16]. For example, Mahadikar et al. (2015) optimized the bus routes operated by the Bangalore Metropolitan Transport Corporation to reduce the number of empty miles [17]. Nasibov et al. (2013) proposed four optimization models for different types of bus routes in Izmir to reduce empty miles [18]. Chen et al. (2021) developed a queuing-siting-assignment model that optimizes the bus garage system and planning entry and exit routes to and from the garage for different buses, thereby reducing operating costs [19].

The existing research on bus terminals reveals that the composite development strategy of bus terminals and the optimization of bus routes have achieved certain results. In particular, more sophisticated research has been conducted on the optimization of bus routes and stations [17,20,21] using topological and spatial analyses and nonlinear programming models. The bus terminal, as the organizational core of the bus network, connects the surrounding areas and facilities via the road system, bus line network, and bus station, serving as the central driver of transportation. However, existing studies continue to focus on the traffic properties of the bus terminal itself, with insufficient attention paid to the spatial relationship between the facilities around the bus terminal. This is reflected in the current planning and construction process, which results in wasted transportation resources and the unrealized value of land resources [13].

1.2. Built Environment Measurement Methods

The built environment, as a spatial reflection of urban design, is an important vehicle influencing the activities of residents. The 3D concept of built environment evaluation proposed by Cervero and Kockelman (1997), which categorizes the built environment into the three dimensions of density, diversity, and design, is the more classic approach [22]. They believe that the higher density, richer diversity, and better-humanized design of the built environment can reduce motorized travel mileage and inspire people to choose more public transport for travel. Later, the built environment framework of 3D was expanded to 5D, adding two more features, destination accessibility and distance to transit, to further enrich the quantification and evaluation dimensions of the built environment [23]. With the continuous use of urban big data and open data in recent years, research on the quantification of the urban built environment using spatial geographic information data analysis has been increasing based on 5D [24–26]. Zhong et al. (2020) analyzed the convenience of living within a 15-minute walk of different communities from a spatial scale, using urban points of interest (POI) as well as street network data [27]. To understand the land-use characteristics of rail transit stations in Singapore, Niu et al. (2019) used six rail transit stations in Singapore as the research objects and the ArcGIS spatial analysis. This allowed Niu et al. (2019) to study the differences in rail transit station development patterns under different TOD modes. They point out that TOD mode development should be adapted to local conditions and suggest that the composite development of rail transit stations should ensure a certain proportion of public service facilities, parks, and open spaces to achieve sustainable development of the land economy, environment, and society [28]. Moreover, it has been explained that pictures with spatial geographic information are more intuitive than data or text with only point information and can reflect the human landscape of different areas [29]. Therefore, research using street view images, combined with geographic information data, is also increasing. For example, Zhang et al. (2019) combined ArcGIS spatial analysis and street image segmentation technology from the 5D framework to quantitatively analyze the street quality in Shanghai and classified the streets into different types using the hierarchical clustering method [30]. Long and Liu (2017) used urban street view image data to compare and analyze the variability between vegetation indices of cities in different regions and at various development levels [31].

1.3. Summary

Bus terminals, like urban rail transit stations, benefit from high passenger flow and easy accessibility, and thus have the potential to be developed into TOD regions. However, the current research on TOD or land-use composite development focuses on rail transit stations rather than bus terminals. Scholars appear to be more interested in the operational efficiency of the bus terminal itself than in the land use and facilities surrounding the bus terminals. This study attempts to fill this gap. Moreover, while many empirical studies have investigated the built environment using the 3D/5D framework, the dimension of design is always critical due to the difficulty in quantifying. In this study, we aimed to measure the built environment surrounding the bus terminal, including the dimension of design, using multi-source data combined with geographic information and street view images.

2. Methods and Data

2.1. Study Area and Data

Zhengzhou, Henan Province, is an important city in the central region of China and a prominent nationally integrated transportation hub, with a resident population of about 6.5 million in its central urban area. Due to the city's flat topography, clear road network, and high building and population density, bus lines in Zhengzhou cover a wide range of the city's built-up area, and bus travel is an essential mode of daily travel for its citizens.

In the planning background of creating a "public transportation city", Zhengzhou issued successive ordinances in 2021 to effectively promote the construction, renovation, and composite development of bus terminals. In the ordinance "Zhengzhou City to promote the comprehensive development of public transport terminals in the implementation of the views", it is clearly stated that the project aims "to moderately increase the development level of the bus terminal, by the principle of balanced investment and revenue, strengthen the composite use of public transport terminals and comprehensive development, and improve land-use efficiency." According to the document "Zhengzhou City to accelerate the construction of bus terminals implementation plan", the city is planning to compound the development of a part of the bus terminals, gradually expand its scope, and eventually achieve the creation of all proposed bus terminals to complete the development. In Zhengzhou, the plan specifies the compound development of five pilot bus terminals: High-speed Railway Station bus terminal, Huxi Road bus terminal, Mingli Road bus terminal, Changjiang Road bus terminal, and Tengfeijie Road bus terminal. The locations of the bus stations and facilities kernel density are shown in Figure 1.

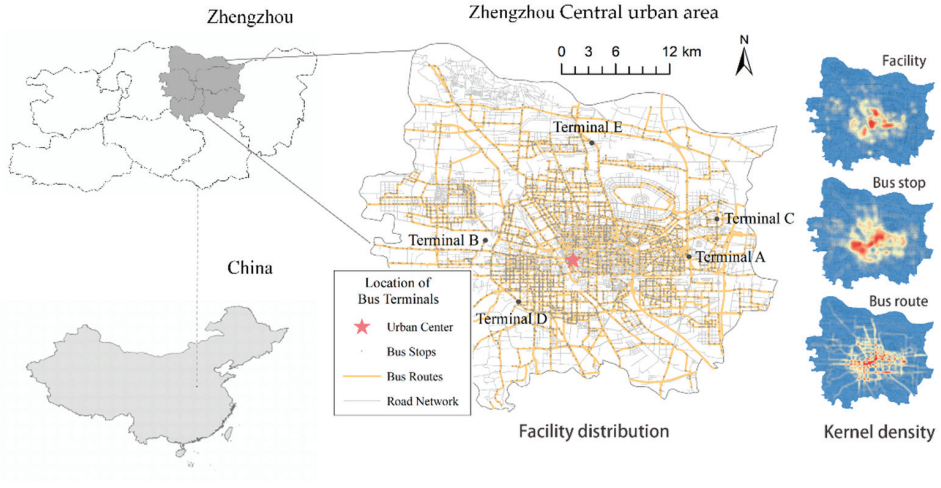


Figure 1. Location of bus stations and facilities.

The research data were obtained in December 2021 using the Gaode Map API and the Baidu Map API. The data on nine types of POI for restaurants, entertainment, education, and the urban road network within Zhengzhou, as well as the data of the urban road network and bus lines were obtained using the Gaode Map. The city street view image data were obtained using the Baidu Map. The basic planning information of each terminal is shown in Table 1.

Table 1. Construction plan of the five composite development bus terminals.

Bus Terminal Name	Completion Time (Year)	Planning Area (km^2)	Encoding
High-speed Railway bus terminal	2022	0.03	Terminal A
Huxi Road bus terminal	2022	0.03	Terminal B
Mingli Road bus terminal	2023	0.02	Terminal C
Changjiang Road bus terminal	2023	0.06	Terminal D
Tengfeijie Road bus terminal	2024	0.02	Terminal E

2.2. Research Ideas

Based on the 5D design concept, this study proposes a method that combines ArcGIS spatial analysis and machine learning semantic segmentation to measure the development environment around a bus terminal from the perspective of public transportation, focusing on two dimensions: (1) the development level and potential of the area around the bus terminal, and (2) the pedestrian environment. This study identifies seven indicators to describe the terminal's compound development level: facility point density, functional diversity, bus route coverage, road connectivity, walking score, vegetation coverage, and road separation. The density of the first four indicators describes the level of development and development potential around the terminal. The last three indicators describe the walking environment around the terminal. The framework of the study is shown in Figure 2. Facility point density, functional diversity, bus route coverage, road connectivity, and walking scores are measured by ArcGIS spatial analysis. Vegetation coverage and road separation are obtained by element extraction of street view image data using a convolutional neural network tool (PSPnet) with a machine learning algorithm [32]. The PSPnet algorithm is one of the more widely used semantic segmentation algorithms, and this study uses a model trained by GluonCV on the Cityscapes dataset, making it more suitable for semantic segmentation of street view images.

2.3. Establishment of an Evaluation System

The scope of the study encompassed the environment within walking distance around the bus terminal. A widely accepted consensus on the definition of the walkable range for residents is the coverage of a 10-min walking time. A general walking speed of 4–5 km/h is calculated, which is equivalent to a walking distance of about 650 m–830 m. The 800 m walking distance is also commonly used as the scope of investigation in many studies on urban built environments [33,34]. Therefore, in this study, the maximum walkable range was defined as 800 m in terms of the extraction and quantification of built environment elements. The evaluation index system of this study is shown in Table 2.

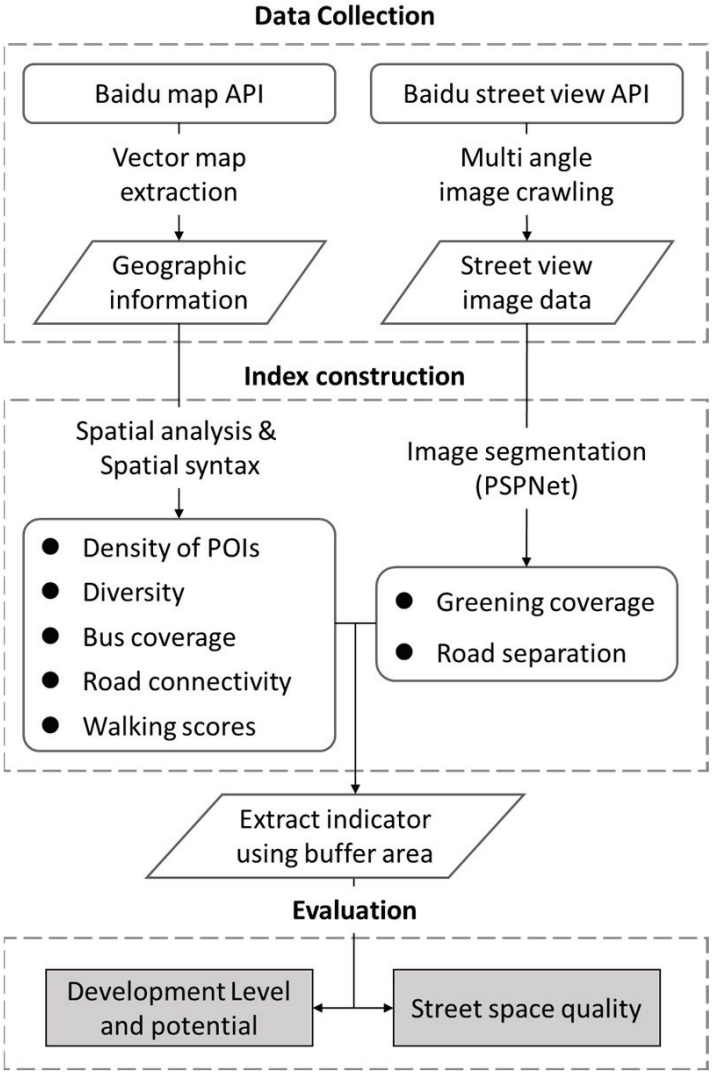


Figure 2. Conceptual framework.

Table 2. Evaluation system.

Perspective	5D	Index
Development level and potential	Density	Facility density [30]
	Diversity	Diversity of facility types [25,35]
	Destination accessibility	Bus route coverage [11]
		Road connectivity [36,37]
Pedestrian environment	Distance to transit	Walking score [38,39]
	Design	Vegetation coverage [40,41]
		Road separation [40,42]

2.3.1. Density

The facility density is calculated by using ArcGIS to establish an 800-m buffer zone centered on the terminal location and calculating the number of POI facility points within it. POI facility points include catering services, shopping services, companies and enterprises, science, education and culture, accommodation services, healthcare, living services, business and residential, and sports and leisure. The density of facility points around a terminal reflects its current development intensity and potential, and priority should be given to low-density terminals when planning the terminal's development.

2.3.2. Diversity

The calculation of diversity is based on the concept of "information entropy" that is used to solve the problem of quantifying information. It is now widely used to quantify land-use portfolio diversity [30,43]. The diversity is calculated by using ArcGIS to establish a buffer zone within an 800-m radius of each bus terminal and using the nine types of POI facility points mentioned above, as well as calculating the number of POI facility points within it as the research objects. The functional diversity of POI facility points around each bus terminal is then calculated. The diversity of facility points around the terminal reflects the functionality of the current surroundings of the terminal. The development should focus on the less functional terminals to improve their attractiveness.

2.3.3. Destination Accessibility

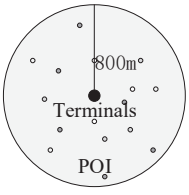
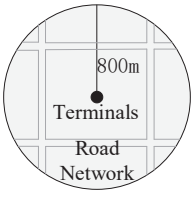
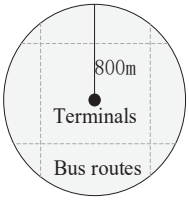
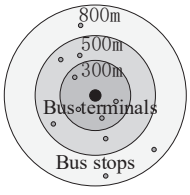
Destination accessibility is measured by the road connectivity around the bus terminal and the coverage of all the bus routes from it. Road connectivity around the bus terminal reflects the service coverage of a terminal station, while bus route coverage determines its reachability. The three indicators of the space syntax method, which are global integration, control value, and road connectivity, are used to represent road connectivity, which was calculated using Axwoman in ArcGIS [37]. The amount of POI within an area of a 500-m buffer zone along the bus route is used to depict the bus route coverage. It is calculated by using ArcGIS to calculate the number of POIs within the buffer zone of the operating routes around the yard, and then calculating the entropy of each POI and aggregating it.

2.3.4. Distance to Transit

Distance to transit can be reflected by the number of bus stops around a terminal station. The presence of several bus stops around the bus terminal indicates a more convenient bus travel environment. To evaluate the distance to transit, a conception of a walking score is introduced in this study [44]. In China, the Urban Comprehensive Transportation System Planning Standard notes that residents are more likely to accept a walking distance of 5 min or at most 10 min, and uses this as a benchmark to propose corresponding requirements for 300 m and 500 m service coverage land for public bus stops. Based on this requirement, this study determines that the best service radius for bus stops is 300 m, the effective service radius is 300–500 m, and the maximum service radius for bus stops is 800 m. The walking score of bus terminal is determined by the number and distance from the nearest bus stops. The greater the number of bus stops around the terminal and the closer the walking distance, the higher the walkability. A bus terminal with a low walking score needs to enhance the planning and management of its bus system, thus improving its development level and potential to achieve composite development.

The description of each indicator calculated using the analysis method of ArcGIS space is shown in Table 3.

Table 3. Calculation method for ArcGIS spatial analysis.

Selected Indicator	Schematic Diagram	Indicator Description	Calculation Method
Facility density		The density of facility points around a terminal reflects its current development intensity and potential.	Measured by ArcGIS Buffer Analysis
Road connectivity level		Information entropy was used to measure functional diversity. The information entropy of the number of POI in nine categories is calculated to reflect the level of functional diversity in the terminal.	$E_i = -\ln(n)^{-1} \sum_{j=1}^{n} p_{ij} \ln p_{ij}$ $Q_i = \frac{E_i}{k \times 1 - \sum_{i=1}^{n} E_i}$
Level of functional diversity		Space syntax was used to describe three indicators: road network's holistic concentration, control value, and connectivity. The indicators' information entropy was used to describe the road network's spatial relations, as well as calculate and obtain the road connectivity variable.	
Route coverage		The number of lines operated and the coverage of the lines reflect the destination accessibility of the yard station. This requires calculating the information entropy of the number of facility points covered by each line, and aggregating the lines around each field station.	
Walking scores		The greater the number of bus stops around the terminal and the closer the walking distance, the higher the walkability. The distance from terminals to bus stops is calculated by ArcGIS network analysis.	$w = \Sigma w_i$ $l \leq 300$ m $\quad w_i = 1$ $300 < l \leq 500$ m $\quad 0.5 \leq w_i < 1$ $500 < l \leq 800$ m $\quad 0 \leq w_i < 0.5$

In which i is the index of sample attribute; j is the index of sample; p_{ij} is the proportion of attribute j in sample i; n is the number of samples; E_i is the information entropy of the i^{th} index; k is the number of indicators; Q_i the weight of the i^{th} indicator. w_i is the walking score from a single bus stop to the terminal; w is the total walking scores for that terminal.

2.3.5. Design

The design dimension should be reflected through the visual landscape of the street space, including the indicators of vegetation coverage, sky visibility, and spatial openness. Existing studies have provided evidence that more plant and sky can make people more willing to stay outdoors. As a component of quality of life, vegetation coverage is vital for oxygen production, pollutant absorption, and urban heat island effect mitigation [2]. Further, better road separation is good for better pedestrian safety, and it improves people's pleasure when walking [45].

Street view images are collected from Baidu LBS. Firstly, the locations where to grab the street view image are generated along the road network within the buffer area surrounding the bus terminals at an interval of 150 m. Then, images are acquired for each point at four angles (90°, 180°, 270°, 360°) at one location, with a specific latitude and longitude. Finally, a total of 2508 street view images were extracted within an 800-m coverage scope of five

bus terminals. Then, the machine vision technology is adopted to analyze the street view images. The flowchart of data collection and analysis is shown in Figure 3. In this study, we used the PSPnet model, which is a semantic segmentation algorithm, to extract details in street view images. Two indicators of vegetation coverage and road separation are constructed to represent the design dimension. The performance of the two indicators in actual scenarios is shown in Table 4. The vegetation coverage is obtained by calculating the percentage of vegetation coverage in the image. The road separation coverage is calculated as the sum of the percentages of buildings, walls, and fences in the image.

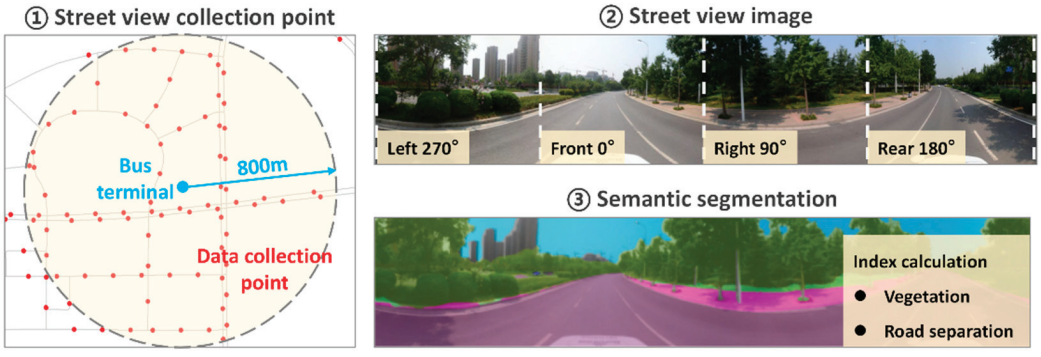


Figure 3. Flowchart of street view image collection and analysis.

Table 4. Comparison of different street scenes.

Index	Example	Vegetation Coverage	Road Separation
More vegetation		0.454	0.014
Less vegetation		0.134	0.096
Better road separation		0.221	0.133
Worse road separation		0.184	0.019

3. Results

The calculation results of the evaluation index based on the 5D framework are shown in Table 5. The index of facility density reflects the density dimension. Terminal C has the highest facility density index, indicating that its surroundings are more developed than those of the other terminals. The Terminal B area is still being developed, as evidenced by the index of facility density.

Table 5. Calculation of evaluation index.

Index (5D Framework)		Terminal A	Terminal B	Terminal C	Terminal D	Terminal E
Density	Facility density	450	82	1151	486	618
Diversity	Functional diversity	0.28	0.05	0.89	0.32	0.19
Destination accessibility	Bus route coverage	18.95	1.52	3.35	6.03	3.91
	Road connectivity	7.05	0.51	2.95	5.61	2.61
Distance to transit	Walking score	23.39	3.53	14.14	18.99	3.09
Design	Vegetation coverage	0.08	0.22	0.23	0.12	0.17
	Road separation	0.23	0.15	0.10	0.17	0.12

The functional diversity index of facilities described the diversity dimension of the built environment. Terminal C has the highest diversity index, while Terminal B has the lowest. The development level of station C is referred to as being relatively higher than other terminals, and as a result, the potential demand for bus travel is higher; however, the nearby facilities of station B are not only low in density but also less in type, and there is still a gap from compound development.

The dimension of destination accessibility is represented by two indexes: bus route coverage and road connectivity. The findings show that Terminal A is more accessible than the others, while Terminal B is the least accessible. The dimension of destination accessibility represents the foundation of transportation infrastructure, which is an important factor in determining the potential of future compound development.

The walking score, or distance to transit index, reflects the convenience of pedestrians walking to transit. Bus terminals A, C, and D provide superior walkability for bus passengers, implying greater potential for use of facilities surrounding the terminals.

The design dimension includes two indexes of vegetation coverage and road separation in this study, which describe the quality of walking space and the walking safety, respectively. Terminal A has the highest road separation value but the lowest vegetation coverage, whereas Terminal C has the highest vegetation coverage but the lowest road separation. Terminals B and C have more vegetative cover than the other three terminals.

Terminal A's bus route coverage and road connectivity are significantly greater than those of other terminals. This indicates that Terminal A has a significant impact within the city of Zhengzhou, despite the fact that the current facility density and functional diversity are not significantly greater than those of other field stations; hence, the potential for development is large. At the same time, the area's vegetation coverage is poor, and further development will exacerbate environmental pollution. Thus, Terminal A exhibits a perceived weakness in walking quality, implying that more attention should be paid to the walking space to attract more pedestrians and increase the potential for composite development.

There is still a gap in compound development in Terminal B, because the nearby facilities are not only low in density but also in type. Furthermore, Terminal B's road connectivity, bus route coverage, and walking score are all poor, which is a significant factor in the terminal's development potential. Therefore, from the perspective of area planning, Terminal B should first improve its road network in order to prepare for intensive development.

The facility density and functional diversity in Terminal C were higher than in the other terminals, indicating that the facilities surrounding it are already relatively well-developed. However, the bus route coverage and road connectivity around Terminal C are inadequate, and more road and route improvements are required to improve Terminal C's attractiveness. Meanwhile, we discovered that Terminal B's road separation is inadequate, and there is a need to improve Terminal C's walls and fences to improve people's perception of walking safety.

Terminal D and Terminal A developed in a similar manner. However, Terminal D's bus route coverage and road connectivity are not as good as Terminal A's. As a result,

further bus route planning in Terminal D is required to increase its attractiveness within Zhengzhou. After construction is completed in 2023, this terminal is expected to open in 2024. Once operational, the development intensity of the surrounding area is expected to increase further as urbanization progresses.

Terminal E had higher facility density but lower functional diversity, indicating that it only has a single functional structure and that the terminal requires further functional improvement. It also has a low walking score and road connectivity; as a result, the land-use development strategy should be given more attention during the planning and construction processes, balancing the spatial distribution of various land-use functions.

4. Discussion

Using a quantitative analysis of the spatial relationships of the facilities surrounding these public terminals, this study proposed an index system to effectively evaluate the compound development of bus terminals. This was a new exploration in the context of digital urban design from the perspective of public transit and land utilization. Unlike previous terminal optimization studies, this study focused on the built environment surrounding bus terminals rather than bus route planning and bus operation efficiency [20,21]. This study analyzed the inadequacy in bus terminal composite development from the perspectives of the current situation, composite development potential, and pedestrian friendliness, and also put forward suggestions for future development. This study deviated even further from previous studies by employing both geographic information and street view images to evaluate the bus terminal and the surrounding built environment [10,46,47]. In addition, to quantify the pedestrian environment, this study used machine vision semantic segmentation.

In the context of rapid urbanization, urban public transportation is a key concern of the government to serve and promote the efficient development of the urban economy and society, as well as to provide residents with an economical and convenient mode of transportation. Currently, the terminal construction model in China can be described as a government-led model: the government allocates land to bus companies for the construction of terminals at no cost, and, in many cases, with certain subsidies. The bus company is then in charge of building the terminals, and once completed, the admission of vehicles operating on all bus routes is reallocated to achieve the lowest total cost vehicle admission scheme. Despite these conditions, the station is still operating at a loss. Meanwhile, the construction of the terminal requires encroaching on a large amount of urban land, resulting in a large amount of wasted land resources.

The significance of strengthening the compound development and construction of terminals is fivefold. It reduces the government's financial allocation that is constantly allocated to terminals and relieves financial pressure. The TOD used in the terminal's construction increases the land value of the area where the terminal is located as well as the terminal's financial revenue. The wider coverage of the bus line network improves travel convenience for city residents, while the accessibility of residential housing developed around the terminal based on bus-oriented development is good and less expensive than the central area, providing new residential options. Improving land use around Zhengzhou can also effectively relieve agglomeration pressure in the city center in terms of urban planning. In terms of the built environment, an effective assessment of a terminal's development potential and development environment based on the terminal itself, as well as a refined optimization strategy for the terminal environment, can assist the government and transit authorities in proposing various development options for different terminals.

5. Conclusions

This study's innovation is the effective integration of machine-learning technology and geographic information technology, which expanded and enriched the built environment evaluation. This study proposed a method for evaluating the spatial relationship among facilities surrounding bus terminals by combining urban points-of-interest and street

view image data from two perspectives: the terminals' current level of development and potential, and an evaluation of the surrounding pedestrian environment. The results showed the composite development status and potential of the planned bus terminals in the city of Zhengzhou, and the discussion of the results provided practical implications to support the bus terminal composite development strategy.

The following are the main contributions of the study. First, this study presents an applicable method to evaluate transportation terminal areas based on open data and government-issued documents. Second, the study demonstrates how basic geographic information and street view image data can be used to study the three-dimensional spatial characteristics of specific urban areas. Third, this study proposes an evaluation method from two perspectives: the current development level and potential of the composite development bus terminal, and the pedestrian environment surrounding the bus terminals. This evaluation is expected to support the bus terminal composite development strategy.

From the results, the quantitative evaluation can truly and accurately reflect the current situation, but some technical aspects still need to be improved. For instance, the street view image is only one component of an indication of the walking quality of a street; other factors such as voice and air quality also influence walking quality. Furthermore, only quantifiable physical characteristics were analyzed in this study. The perspective and willingness of the travelers were not considered. Based on the quantitative evaluation, willingness surveys and behavior data collection may help improve the evaluation. To improve accuracy and comprehensiveness, more multi-source data can be incorporated into future assessments of composite development regions. As information technology advances, aspects related to environmental quality, such as user perception, preference, willingness, and other qualities, can also be taken into account.

Author Contributions: Conceptualization, T.Z. and Q.C.; methodology, Z.L. and Q.C.; software, Y.Y.; validation, Q.C.; resources, T.Z.; writing—original draft preparation, Y.Y.; writing—review and editing, T.Z. and Z.L.; supervision, T.Z.; project administration, T.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the National Natural Science Foundation of China, grant number 51808010.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The POI data that support the findings of this study are openly available through Gaode Map at https://lbs.amap.com/ by the date of 15 December 2021. The street view images that support the findings of this study are openly available through Baidu Maps at https://lbsyun.baidu.com/ by the date of 15 April 2022.

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

References

1. De Grange, L.; Troncoso, R. Impacts of Vehicle Restrictions on Urban Transport Flows: The Case of Santiago, Chile. *Transp. Policy* **2011**, *18*, 862–869. [CrossRef]
2. Gallego, F.; Montero, J.P.; Salas, C. The Effect of Transport Policies on Car Use: Evidence from Latin American Cities. *J. Public Econ.* **2013**, *107*, 47–62. [CrossRef]
3. Cantillo, V.; de Ortúzar, J.D. Restricting the Use of Cars by License Plate Numbers: A Misguided Urban Transport Policy. *DYNA* **2014**, *81*, 75–82. [CrossRef]
4. Cervero, R.; Day, J. Suburbanization and Transit-Oriented Development in China. *Transp. Policy* **2008**, *15*, 315–323. [CrossRef]
5. Peng, Y.T.; Li, Z.C.; Choi, K. Transit-Oriented Development in an Urban Rail Transportation Corridor. *Transp. Res. Part B Methodol.* **2017**, *103*, 269–290. [CrossRef]
6. Papa, E.; Bertolini, L. Accessibility and Transit-Oriented Development in European Metropolitan Areas. *J. Transp. Geogr.* **2015**, *47*, 70–83. [CrossRef]
7. Ibraeva, A.; Correia, G.H.D.A.; Silva, C.; Antunes, A.P. Transit-Oriented Development: A Review of Research Achievements and Challenges. *Transp. Res. Part A Policy Pract.* **2020**, *132*, 110–130. [CrossRef]

8. Nasri, A.; Zhang, L. The Analysis of Transit-Oriented Development (TOD) in Washington, D.C. and Baltimore Metropolitan Areas. *Transp. Policy* **2014**, *32*, 172–179. [CrossRef]
9. Tian, G.; Ewing, R.; Weinberger, R.; Shively, K.; Stinger, P.; Hamidi, S. Trip and Parking Generation at Transit-Oriented Developments: A Case Study of Redmond TOD, Seattle Region. *Transportation* **2017**, *44*, 1235–1254. [CrossRef]
10. Yang, L.; Song, X. TOD Typology Based on Urban Renewal: A Classification of Metro Stations for Ningbo City. *Urban Rail Transit* **2021**, *7*, 240–255. [CrossRef]
11. Xiao, L.; Lo, S.; Liu, J.; Zhou, J.; Li, Q. Nonlinear and Synergistic Effects of TOD on Urban Vibrancy: Applying Local Explanations for Gradient Boosting Decision Tree. *Sustain. Cities Soc.* **2021**, *72*, 103063. [CrossRef]
12. Chen, J.; Chen, Q.; Li, H.P. Psychological Influences on Bus Travel Mode Choice: A Comparative Analysis between Two Chinese Cities. *J. Adv. Transp.* **2020**, *2020*, 8848741. [CrossRef]
13. Lin, Y. Research on planning and construction of public transport stations under urban redevelopment in Fuzhou. *Fujian Archit. Constr.* **2020**, *05*, 13–17.
14. Yang, J.; Chen, J.; Le, X.; Zhang, Q. Density-Oriented versus Development-Oriented Transit Investment: Decoding Metro Station Location Selection in Shenzhen. *Transp. Policy* **2016**, *51*, 93–102. [CrossRef]
15. He, Y.; Yang, Z. Location and Scale Optimization of a Bus Depot Based on Asymmetric Information of the Transit Operator and Landowner in Dalian, China. *J. Urban Plan. Dev.* **2019**, *145*, 04018046. [CrossRef]
16. Norhisham, S.; Bakar, M.F.A.; Syamsir, A.; Zaini, N.; Baharin, N.L.; Shkuri, N.S.M.; Saad, N.M. Evaluating the Quality of Services for Bus Performance in Alor Setars. *IOP Conf. Ser. Earth Environ. Sci.* **2021**, *708*, 012038. [CrossRef]
17. Mahadikar, J.; Mulangi, R.H.; Sitharam, T.G. Optimization of Bus Allocation to Depots by Minimizing Dead Kilometers. *J. Adv. Transp.* **2015**, *49*, 901–912. [CrossRef]
18. Nasibov, E.; Eliiyi, U.; Ertaç, M.Ö.; Kuvvetli, Ü. Deadhead Trip Minimization in City Bus Transportation: A Real Life Application. *Promet-Traffic Transp.* **2013**, *25*, 137–145. [CrossRef]
19. Chen, C.; Yao, B.; Chen, G.; Tian, Z. A Queuing–Location–Allocation Model for Designing a Capacitated Bus Garage System. *Eng. Optim.* **2021**, *54*, 709–726. [CrossRef]
20. Huang, Z.; Ren, G.; Liu, H. Optimizing Bus Frequencies under Uncertain Demand: Case Study of the Transit Network in a Developing City. *Math. Probl. Eng.* **2013**, *2013*, 375084. [CrossRef]
21. Wagale, M.; Singh, A.P.; Sarkar, A.K.; Arkatkar, S. Real-Time Optimal Bus Scheduling for a City Using a DTR Model. *Procedia-Soc. Behav. Sci.* **2013**, *104*, 845–854. [CrossRef]
22. Cervero, R.; Kockelman, K. Travel Demand and the 3Ds: Density, Diversity, and Design. *Transp. Res. Part D Transp. Environ.* **1997**, *2*, 199–219. [CrossRef]
23. Ewing, R.H. Characteristics, Causes, and Effects of Sprawl: A Literature Review. *Urban Ecol.* **2008**, *21*, 519–535. [CrossRef]
24. Qiang, D.; Zhang, L.; Huang, X. Quantitative Evaluation of TOD Performance Based on Multi-Source Data: A Case Study of Shanghai. *Front. Public Health* **2022**, *10*, 820694. [CrossRef]
25. An, R.; Wu, Z.; Tong, Z.; Qin, S.; Zhu, Y.; Liu, Y. How the Built Environment Promotes Public Transportation in Wuhan: A Multiscale Geographically Weighted Regression Analysis. *Travel Behav. Soc.* **2022**, *29*, 186–199. [CrossRef]
26. Lucas, K.; Phillips, I.; Mulley, C.; Ma, L. Is Transport Poverty Socially or Environmentally Driven? Comparing the Travel Behaviours of Two Low-Income Populations Living in Central and Peripheral Locations in the Same City. *Transp. Res. Part A Policy Pract.* **2018**, *116*, 622–634. [CrossRef]
27. Zhong, T.; Lü, G.; Zhong, X.; Tang, H.; Ye, Y. Measuring Human-Scale Living Convenience through Multi-Sourced Urban Data and a Geodesign Approach: Buildings as Analytical Units. *Sustainability* **2020**, *12*, 4712. [CrossRef]
28. Niu, S.; Hu, A.; Shen, Z.; Lau, S.S.Y.; Gan, X. Study on Land Use Characteristics of Rail Transit TOD Sites in New Towns—Taking Singapore as an Example. *J. Asian Archit. Build. Eng.* **2019**, *18*, 19–30. [CrossRef]
29. Ying, L.; Yin, Z. Pictorial Urbanism: A New Approach for Human Scale Urban Morphology Study. *Planners* **2017**, *33*, 54–60.
30. Zhang, L.; Ye, Y.; Zeng, W.; Chiaradia, A. A Systematic Measurement of Street Quality through Multi-Sourced Urban Data: A Human-Oriented Analysis. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1782. [CrossRef]
31. Long, Y.; Liu, L. How Green Are the Streets? An Analysis for Central Areas of Chinese Cities Using Tencent Street View. *PLoS ONE* **2017**, *12*, e0171110. [CrossRef] [PubMed]
32. Zhao, H.; Shi, J.; Qi, X.; Wang, X.; Jia, J. Pyramid Scene Parsing Network. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, Honolulu, HI, USA, 21–26 July 2017; pp. 6230–6239. [CrossRef]
33. Bivina, G.R.; Gupta, A.; Parida, M. Walk Accessibility to Metro Stations: An Analysis Based on Meso- or Micro-Scale Built Environment Factors. *Sustain. Cities Soc.* **2020**, *55*, 102047. [CrossRef]
34. Lu, Y.; Sun, G.; Sarkar, C.; Gou, Z.; Xiao, Y. Commuting Mode Choice in a High-Density City: Do Land-Use Density and Diversity Matter in Hong Kong? *Int. J. Environ. Res. Public Health* **2018**, *15*, 920. [CrossRef]
35. Chen, F.; Wu, J.; Chen, X.; Zegras, P.C.; Wang, J. Vehicle Kilometers Traveled Reduction Impacts of Transit-Oriented Development: Evidence from Shanghai City. *Transp. Res. Part D Transp. Environ.* **2017**, *55*, 227–245. [CrossRef]
36. Liuqing, Y.; Jingwen, A.; Yangchi, G.; Fengfei, C. Street Greening Quality of Fuzhou City Based on Multi Source Data. *J. Fujian Agric. For. Univ. Nat. Sci. Ed.* **2022**, *51*, 123–130. [CrossRef]
37. Jiang, B. Axwoman: An ArcView Extension for Urban Morphological Analysis. In Proceedings of the Geoinformatics'98 Conference, Beijing, China, 17–19 June 1998; pp. 394–401.

38. Mu, T.; Lao, Y. A Study on the Walkability of Zijingang East Campus of Zhejiang University: Based on Network Distance Walk Score. *Sustainability* **2022**, *14*, 11108. [CrossRef]
39. Koohsari, M.J.; McCormack, G.R.; Shibata, A.; Ishii, K.; Yasunaga, A.; Nakaya, T.; Oka, K. The Relationship between Walk Score® and Perceived Walkability in Ultrahigh Density Areas. *Prev. Med. Rep.* **2021**, *23*, 101393. [CrossRef]
40. Ye, Y.; Richards, D.; Lu, Y.; Song, X.; Zhuang, Y.; Zeng, W.; Zhong, T. Measuring Daily Accessed Street Greenery: A Human-Scale Approach for Informing Better Urban Planning Practices. *Landsc. Urban Plan.* **2019**, *191*, 103434. [CrossRef]
41. Jiao, J.; Rollo, J.; Fu, B.; Liu, C. Exploring Effective Built Environment Factors for Evaluating Pedestrian Volume in High-Density Areas: A New Finding for the Central Business District in Melbourne, Australia. *Land* **2021**, *10*, 655. [CrossRef]
42. Yin, L.; Wang, Z. Measuring Visual Enclosure for Street Walkability: Using Machine Learning Algorithms and Google Street View Imagery. *Appl. Geogr.* **2016**, *76*, 147–153. [CrossRef]
43. Jiao, J.; Fu, B. Overview and Applicability of Land Use-Mixed Indices in the Smart City. In Proceedings of the 2020 4th International Conference on Smart Grid and Smart Cities, Osaka, Japan, 18–21 August 2020; pp. 118–123. [CrossRef]
44. Hirsch, J.A.; Moore, K.A.; Evenson, K.R.; Rodriguez, D.A.; Roux, A.V.D. Walk Score® and Transit Score® and Walking in the Multi-Ethnic Study of Atherosclerosis. *Am. J. Prev. Med.* **2013**, *45*, 158–166. [CrossRef] [PubMed]
45. Junyan, Y.; Dian, S.; Xiuzhang, F.; Hequn, M. Progressive Optimization of Urban Design Based on the Digital Map of Physical Environment: Process Exploration. *Urban Des.* **2022**, *46*, 64–80. [CrossRef]
46. Gutiérrez, J.; Cardozo, O.D.; García-Palomares, J.C. Transit Ridership Forecasting at Station Level: An Approach Based on Distance-Decay Weighted Regression. *J. Transp. Geogr.* **2011**, *19*, 1081–1092. [CrossRef]
47. Schlossberg, M.; Brown, N. Comparing Transit-Oriented Development Sites by Walkability Indicators. *Transp. Res. Rec.* **2004**, *1887*, 34–42. [CrossRef]

land

MDPI

Article

Space Reproduction in Urban China: Toward a Theoretical Framework of Urban Regeneration

Yafei Liu

Shanghai Tongji Urban Planning and Design Institute, 1111 Zhongshan North Second Road, Shanghai 200437, China; liuyafei@tjupdi.com

Abstract: As China's urbanization enters the middle and late stages, urban regeneration has risen to the strategic level of building a new national development pattern and promoting high-quality urban development. Due to the wide range of disciplines and content involved in urban regeneration, there remains a lack of systematic and comprehensive theories and frameworks to lay a theoretical foundation for academic research and provide guidance for renewal practice. Therefore, this paper aims to construct a systematic and comprehensive theoretical framework of urban regeneration from the perspective of space reproduction, by employing the theory of the production of space as the basis of interdisciplinary research, and integrating related theories and research. The current paper proposes a theoretical framework that includes four core elements, namely the government, the market, society and space reproduction. Subsequently, the paper summarizes the subject, power, capital and interest of the three types of stakeholders (government, market, and society), their different emphases in the reproduction mechanism, and their various cooperative modes in practices. Meanwhile, under the concept of sustainable development and "people-oriented" approach, this paper emphasizes the importance of social factors and the suitability of the multi-stakeholder co-governance model of government, market and society.

Keywords: urban regeneration; space reproduction; theoretical framework; capital proliferation; multi-stakeholder co-governance

Citation: Liu, Y. Space Reproduction in Urban China: Toward a Theoretical Framework of Urban Regeneration. *Land* **2022**, *11*, 1704. https://doi.org/10.3390/land11101704

Academic Editors: Pasquale de Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 23 August 2022
Accepted: 28 September 2022
Published: 30 September 2022

1. Introduction

China's reform and opening up policy, launched in 1978, introduced private business and market incentives to what was a state-led communist system, bringing about an unprecedented economic boom. The speedy growth of China's economy has also driven the rapid construction and development of cities [1]. In just 40 years, the urbanization rate has risen from 17.9% in 1978 to 51.2% in 2011 and 64.7% in 2021. China has entered the middle and late stages of urbanization, and stepped into a transition period. With the transformation of China's economy from high-speed growth to high-quality development, the urban development mode has also shifted from extensive and extensional to intensive and connotative development, and gradually from large-scale incremental construction to the improvement of existing urban quality and urban regeneration. National ministries and local governments, such as Shanghai, Shenzhen and Guangzhou, have successively issued a number of laws and regulations to guide urban regeneration in recent years [2–4]. The Fifth Plenary Session of the 19th Central Committee of the Communist Party of China in 2020, and the National Two Sessions in 2021 and 2022, have clearly put forward the "implementation of urban regeneration actions", which has raised urban regeneration to the strategic level of building a new national development pattern and promoting high-quality urban development.

Urban regeneration is a comprehensive and integrated vision and action which seeks to resolve urban problems and continuously improve the economic, physical, social and environmental condition of an area that has been subject to change or offers opportunities

for improvement [5]. Recent years have witnessed many studies and discussions on the concept and connotations, dynamic mechanism, stage characteristics, stakeholders, targets and principles, planning implementation, operation, and performance of urban regeneration in Chinese and international academic circles [6–12]. The essence of urban regeneration can be understood as the re-creation of space value and the redistribution of new benefits through the readjustment of space resources. The stakeholders who promote urban regeneration usually include the central and local governments, developers, and the occupiers and users of the renewal space. The spatial resources and specific objects involved in urban regeneration commonly comprise old residential areas, old industrial areas, old commercial areas, shanty areas, urban villages, and historical districts. Regarding the stage characteristics of urban regeneration in the past 100 years, Chinese and Western cities have generally experienced a transformation process from focusing on the reconstruction and renewal of the physical environment to also taking into account economic, social and environmental goals and urban governance [13,14]. Through urban regeneration, the re-creation of spatial value is realized. For instance, the quality of the living environment has been improved, urban brand and competitiveness have been strengthened [15], industrial upgrading and economic revitalization have been promoted, and the value of land and real estate has increased. With regard to the redistribution of new benefits, the international regeneration practice in the past 100 years has also shown a certain regularity, from the model of the government leading reconstruction and renewal and citizens enjoying the improvement of the living environment, to the government and enterprises forming an urban growth alliance under the neoliberal or market economy period and jointly promoting urban regeneration and sharing value-added benefits [16,17], and then to a mode of advocating humanism, sustainability, "government-enterprise-society" multi-cooperation and benefit sharing [18–20].

It can be seen that the content and scope of urban regeneration has been quite extensive, and involves many disciplines, such as institutional economics, sociology, public management, law, geography, urban planning and architecture. However, this also reflects some bottlenecks faced by the current research and practice. First of all, regarding the academic research, although there are many related theories involved in urban regeneration, such as sustainable development theory, urban marketing theory, social justice theory, space production theory, differential land rent theory, etc., a recognized theory of urban regeneration that can comprehensively explain its rich connotations and complicated mechanism has not yet been developed [5]. Without a systematic and integrated theoretical framework as a basis, academic research might encounter difficulties in comprehensively investigating the complex regeneration mechanism, and might draw very partial, one-sided, and even wrong conclusions. Secondly, for the renewal practice, the lack of a systematic and comprehensive theoretical framework could jeopardize the soundness of the science and effectiveness of the top-level renewal policies [6], which might in turn introduce errors in goal-setting and benefits distribution or weaken the performance of implementation and operation in practice.

Therefore, this paper aims to integrate the relevant theories and research studies on urban regeneration, and construct a systematic and comprehensive theoretical framework. Since urban regeneration refers to the improvement of physical space and its attached economic and social environment, space plays a crucial role not only as the direct object of urban regeneration, but also as the product and carrier of economic and social activities. Hence, space can be employed as a core element in the theoretical framework of urban regeneration and as a link to integrate other elements. Since the theory of the production of space, originating from political economy, provides a unified perspective for complex urban social science research (including urban sociology, urban geography, urban planning, etc.), it has gradually received more attention in urban regeneration research [13,21–23]. Therefore, the current paper takes the theory of the production of space as the basis of this interdisciplinary research, and constructs a theoretical framework of urban regeneration from the perspective of space reproduction by studying related theoretical frameworks

and renewal practices. Finally, the theoretical and practical implications of this framework are discussed.

2. Methodological Approach

In accordance with the aim of this paper, a literature review is employed as the major methodology to overview relevant research fields, to track the research development over time, and to identify key components for building a new theoretical model. To fulfill the various needs of this paper, a mixed literature review approach is utilized which consists of the following two broad types: the semi-systematic (or narrative) review approach, and the integrative (or critical) review approach [24]. Firstly, considering the interdisciplinary characteristics of urban regeneration, the semi-systematic review approach is chosen which is especially designed for the topics that have been studied by researchers from diverse disciplines [24,25]. The semi-systematic review approach is used to synthesize the state of knowledge of urban regeneration, to detect its themes and theoretical perspectives, to identify key components, and to provide a historical overview or timeline. Secondly, rather than simply providing an overview, this paper aims to generate a new comprehensive theoretical framework. Therefore, the integrative review method is used to critically analyze and examine the key components of urban regeneration and their relationships, and to eventually promote the advancement of this theoretical framework [24,26].

In the first section of this paper, the state of knowledge of urban regeneration is reviewed, and the research gap is identified. The third section reviews the theory and relevant research of space production and reproduction, including the key theoretical components, (re)production mechanism, (re)produced built environment, etc. Then, a historical overview of urban regeneration in Western and Chinese cities from a space reproduction perspective is provided, including the background, goals, key stakeholders, cooperating mechanism, reproduced urban space, benefit distribution, etc. Thereafter, the fourth section reviews the literature particularly focused on a theoretical framework with a space reproduction perspective. The review of the literature identifies the key components, stakeholders, powers and capital, interests, operating mechanisms, game relationship, etc., within the theoretical framework. Meanwhile, using an integrative or critical review style, some drawbacks of existing theoretical framework are suggested. By synthesizing and integrating all the relevant knowledge and information, the fifth section suggests a systematic and comprehensive theoretical framework.

The literature review was conducted by searching for peer-reviewed articles in search engines of Scopus and CNKI (China National Knowledge Infrastructure). To synthesize the literature, a broad range of keywords from diverse disciplines are used to identify relevant papers, including the following: urban regeneration, urban renewal, urban redevelopment, production of space, space reproduction, theoretical framework, conceptual framework, etc. These search terms are closely associated with the purpose, scope, gap and research question the review aims to address, which act as the inclusion criteria. Moreover, regarding other inclusion criteria, special attention is paid to the theoretical and conceptual articles, existing review articles, articles published in recent years, journal articles, and articles focused on the Chinese context.

3. Understanding Urban Regeneration from the Space Reproduction Perspective

In general, the connotation of space production in this paper is similar to urbanization, while space reproduction is closely associated with urban regeneration. More importantly, the theory of space (re)production provides a systematic and appropriate perspective to help us understand the complex mechanism of urbanization and regeneration. This part firstly discusses urban space and its changes driven by the underlying capital and power from the space reproduction perspective. Thereafter, such a perspective is employed to re-analyze and re-understand the urban regeneration process in Western and Chinese cities over the last century.

3.1. Space Production and Space Reproduction

Space production can be understood as a perspective or way of thinking about and analyzing urban space. Different from only emphasizing the materiality of space and treating it as a container and site, the theory of the production of space explores the social and dynamic nature of space, arguing that space is the product of social production, and space production is a dynamic process in which political and economic elements, such as capital and power, shape and transform urban space [27–30]. The French Marxist thinker Henri Lefebvre first proposed the theory of the production of space in the 1970s, and constructed a theoretical framework including spatial practice, representations of space, and representational spaces [27]. Among these concepts, spatial practice, focusing on the perceived physical space, refers to the social production and reproduction practice in daily life implemented by the socio-spatial unity of social groups and their spatial carriers. Examples, in this regard, include the formation of suburban middle-class neighborhoods, and the gentrification of old central cities. The representations of space, focusing on the conceived abstract space, are the abstract, conceptualized spatial order and system dominated by the knowledge and ideology of politicians, scientists, planners, and technologists, e.g., the urban development blueprints and spatial system schemes proposed by urban planners for the government. The representational spaces, focusing on the intentional space in life, refer to the symbolic, imaginary, emotional, and historical and cultural space superimposed on the physical space by the space users, with an example being the urban image in citizens' minds about city centers, landmarks, childhood homes, historic districts, etc. In the process of space production, the participating social groups and stakeholders use the capital and resources at their disposal to carry out spatial practice based on their conception, planning and control of the representations of space, and eventually shape the representational spaces in people's imagination [23].

Marxist scholars such as David Harvey, Edward Soja, and Manuel Castells have further enriched the connotations of the theory of the production of space in their urban and geography studies [31–33]. Harvey combined the theory of capital accumulation with the theory of urbanization, and discussed the mechanism of capital's accumulation, circulation, proliferation and spatialization in the process of urban space production and reproduction [34]. He put forth the belief that capital continues flowing, circulating and proliferating through three circuits in space (Figure 1), in order to alleviate the crisis of over-accumulation and obtain more surplus value [35–37]. First, the primary circuit of capital is mainly based on direct production and consumption, which creates the foundation of capital accumulation. Capital flows into the factories, shopping malls and other spaces to promote the production and consumption of products, and to generate surplus value with which the scale of production can be continuously expanded and capital proliferation can be realized constantly. Subsequently, when overproduced products surpass consumers' demand, and the rate of return on capital falls to unprofitable levels, surplus capital enters the secondary and tertiary circuits. The secondary circuit consists of fixed capital that supports the production and consumption fund which in turn supports consumption. In the field of production, surplus capital flows into fixed capital such as the producer durables (e.g., machines, equipment, etc.) and the associated built environment (e.g., factories, warehouses, roads, ports, etc.). This prolongs the period of return on investment, alleviates the crisis of excess capital, and improves labor productivity through investment. In the consumption field, surplus capital flows into the consumption fund to create consumer durables (e.g., TVs, refrigerators, cars, etc.) and related built environments (e.g., stores, supermarkets, houses, etc.). While delaying the cycle of return on investment and the crisis of over-accumulation, this also promotes the reproduction of labor power (that is, the laborers meet their daily needs through consumption, which helps to maintain and reproduce their capabilities to perform paid work). In the tertiary circuit, capital also flows into fields with a longer period of return on investment, primarily composed of technology and science expenditures supporting the production and social expenditures which support consumption. In the field of production, the state functions drive capital

to invest in scientific research, technology research and development, and relevant built environments (e.g., scientific research centers and buildings) to enhance the innovation capability and long-term competitiveness in production. Within the field of consumption, state functions drive capital to invest in the fields of collective consumption and social expenditures, including education, health, welfare, public security, national defense, and related built environments (e.g., schools, hospitals, parks, welfare institutions, police stations, etc.), in order to promote the reproduction of labor power. It can be seen that capital's three circuits in space promote capital accumulation not only by producing, circulating and consuming commodities in space, but also by continuously creating new spaces and built environments. The continuous and periodic process of capital to create the built environment and physical infrastructure for production, circulation, exchange, and consumption is actually the process of urban space production as well as the process of urbanization [35–37].

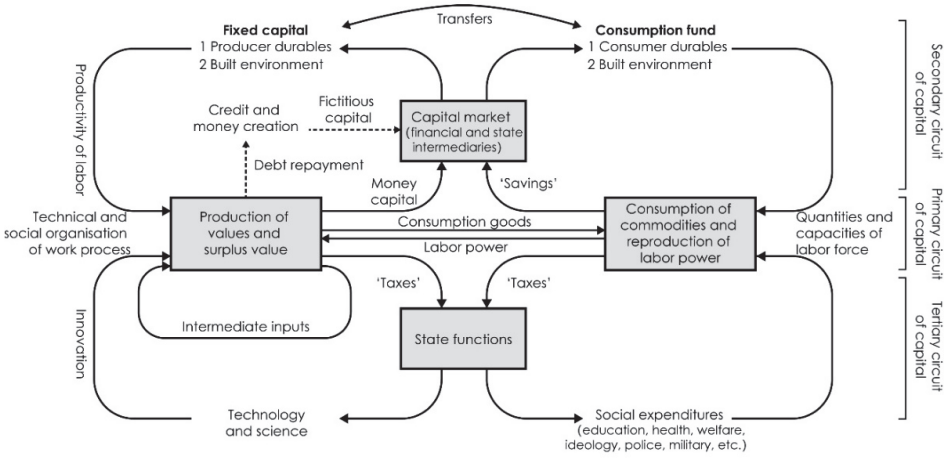


Figure 1. The primary, secondary and tertiary circuits of capital in space. Author's illustration based on David Harvey's research.

Harvey used the concept of the "temporal-spatial fix" to explain and summarize the mechanism of the three circuits of capital in absorbing excess capital and labor. The temporal-spatial fix can be understood as the transfer of excess capital to the interrelated temporal and spatial dimensions to temporarily prolong the return cycle of capital and alleviate the crisis of over-accumulation [38]. In the temporal dimension, excess capital is continuously transferred to long-term investment projects or social expenditures. In the spatial dimension, excess capital is constantly being transferred to urban built environments, such as new factories, houses, shops, roads, and even to new towns and new districts around the city, promoting continuous urban growth and expansion. However, Harvey put forward the belief that the effects of the temporal-spatial fix on alleviating the crisis of capitalism are also limited, especially when investment exceeds a certain critical point, at which point obtaining returns will become more difficult. At that time, the exchange value attached to the built environment is bound to depreciate, decrease, or even disappear completely [35]. For example, when a large amount of capital pours into cities and is directed to new built environments, such as excessive or more productive factories and offices, this leads to a depreciation of the exchange value of existing fixed capital, such as the old built environments. However, the old built environments still have different degrees of use value according to their construction year, quality and maintenance level. As a result, these old material environments can be traded continuously in the market as depreciated capital, and after different degrees of renewal in terms of material and function, they become the material carriers that promote the accumulation and proliferation of

new capital. Such a phenomenon, i.e., that the urban built environment continues to experience the process of devaluation, transaction, renewal and appreciation after space production, can be understood as the reproduction of urban space. Space reproduction is often accompanied by the circular flow of capital and the inherent material and economic life cycle of the built environment, showing periodic laws and characteristics. Due to the cyclical depreciation of the built environment as fixed capital, the cyclical input of new capital and space reproduction can be promoted, which curbs the decline in profit margins, accelerates a new round of capital value growth, and reshapes the urban landscapes and built environment.

Space reproduction is also a persistent game and competition for the built environment, between old and new capital as well as the powers, stakeholders and production methods behind it. The old capital produces and shapes the physical space that represents its own image and accumulation logic, and drives the continuous accumulation of capital. Although the built environment faces cyclical depreciation, the process or logic of capital accumulation has been solidified within it, becoming a long-standing spatial barrier that prevents and restricts new capital–representing higher productivity–from reshaping and replacing it. When the new capital and its stakeholders have a greater advantage in the game, they will carry out the "spatial practices" of urban regeneration, such as renovation and reconstruction. Additionally, by planning the "representations of space", or spatial order, which represents their interests, they shape new "representational spaces", and finally realize the reproduction of urban space. As a result, capital promotes space production and the reproduction of cities through continuous circulation, fluctuations, and games in time and space.

3.2. Space Reproduction and Urban Regeneration

Some Chinese scholars have attempted to analyze urban regeneration in Chinese and Western cities from the perspective of space reproduction [13,21–23,28,39]. According to the aforementioned perspective, urban regeneration refers to the situation whereby the city government, as well as industrial and commercial capital, pursue the appreciation of spatial assets and the income derived from differential land rent while also realizing the proliferation and accumulation of capital, by the upgrading or replacement of spatial intensity, environmental quality, land use type, geographical location, etc. [13,40,41]. Since the twentieth century, both Chinese and Western cities have been promoting urban regeneration. The forms and emphasis of space reproduction exhibit differences in diverse historical periods and backgrounds.

3.2.1. Space Reproduction in Western Cities

Since the twentieth century, Western cities have roughly undergone three different stages of space reproduction [13]. The first stage began in the 1930s. The cities that developed and expanded after the Industrial Revolution carried out large-scale urban regeneration due to the periodic decline of the physical environment and the destruction caused by war. The practice of space reproduction in this stage was led by the government, with the means of demolishing slums and rebuilding houses on a large scale, and with the aim of improving the quality of the urban environment and living. By demolishing the built environment whose use and exchange value have been severely depreciated, and investing capital to produce new, higher-quality housing and other kinds of built environment for consumption, the government achieved the stimulation and supply for collective consumption demand and the proliferation of capital. The second stage began in the 1960s. With the increasing economic prosperity and the growing middle class after World War II, Western cities also faced social crises such as the movements of social democracy and civil rights, as well as large-scale riots, while a series of urban regeneration practices were launched in response to those social problems. Regarding space reproduction in this period, the government introduced a public participation mechanism, using the means of neighborhood restoration and renewal, and aiming to improve the quality of life

of existing communities, ameliorate the quality of social services, and solve social problems. Through consultation with citizens, the government invested capital to improve and upgrade the depreciated and problematic living environment, which not only promoted the appreciation of living space, but also solved social problems to a certain extent, optimized social capital, and ensured the continuous reproduction of labor power. The third phase began in the 1970s and continues to this day. Influenced by the economic crisis, the urban regeneration model under Keynesianism, dominated by the government and supported by public finance, became unsustainable, and began to transform into a market-oriented model under neoliberalism [42]. The form of space reproduction in this stage primarily adopted the public-private partnership mechanism, which was led by the urban growth alliance, composed of the public sector of the government and the private sector of the market. Such space reproduction practices focused on the spatial redevelopment of the city center (e.g., old city center gentrification, old waterfront revival), with the goal of promoting investment and consumption, increasing local taxes, improving environmental quality, enhancing the city's brand image and reputation, and other sustainable development goals. The government was responsible for creating favorable policies and institutional conditions, while the private enterprises, as the main investors and implementers, usually renovated or demolished and rebuilt the depreciated built environment in the city centers, by transferring production places (e.g., old docks and factories) into new consumption and production places (e.g., shopping malls, residences, art galleries, parks, office buildings, etc.), or by upgrading the old residences to commodity housing with higher quality and increased cost. Through the redevelopment and reproduction of space, the re-accumulation and proliferation of excess capital in the built environment was realized.

3.2.2. Space Reproduction in Chinese Cities

Since the twentieth century, Chinese cities have also experienced multiple rounds of urban regeneration [2,3,6], which can be roughly broken down into four stages of space reproduction. The first stage spanned from 1949 to 1977. After the founding of New China, the cities that had experienced many years of war became increasingly dilapidated, finding themselves in urgent need of renewal. However, due to the lack of financial resources, the government prioritized investing capital in production areas (e.g., the construction of new industrial zones, etc.); as a result, the funds invested in the renovation of the old city were very limited. Therefore, the practice of space reproduction at this stage was led by the government, using small-scale repairs and maintenance of the old city as mechanisms, focusing on repairing typical shanty towns and dilapidated old houses, and aiming to improve the basic environment and living conditions. In other words, the government reproduced only a few spaces, whose use value had been severely depreciated, in order to maintain the operation of basic urban functions. Against the background of socialist public ownership and the planned economy at that time, land and the buildings it carried were all public assets. The renovated and newly-built houses constituted only a welfare product provided by the government and had no exchange or investment value.

The second stage spanned from 1978 to 1989. This was a transitional period when China was promoting reform and opening up and transforming from a planned economy to a market economy. Urban regeneration was also explored and attempts in this regard were made. The practice of space reproduction at this stage was also led by the government, which used large-scale urban renovation as a means, and aimed to solve the problems of housing shortages and infrastructure insufficiency. The content of space reproduction practice was more diverse, including not only the overall functional adjustment, structural optimization, and beautification of the old cities in Hefei and Shenyang, but also the renewal of the commercial districts in Shanghai and Nanjing, as well as the traditional neighborhoods in Beijing and Suzhou, alongside the "public-private co-construction" of the old city in Guangzhou. The 1988 Constitutional Amendment officially allowed local governments to transfer land-use rights through public auctions, on the premise that urban land ownership belongs to the state. This endowed the land with exchange value and

investment potential, and the government was able to attract market capital and social funds to participate in old city renovation. On the one hand, this alleviated the problem of government fund shortages, and improved housing and infrastructure conditions as well as urban functions. On the other hand, under the socialist system, the above-mentioned amendment also explored the market-oriented circulation mechanism of land, which represents the core element of spatial production.

The third stage spanned from 1990 to 2011. At this stage, China's market economy transformation was further deepened, and China joined the World Trade Organization in 2001 to fully integrate into the global economy. In this context, industrialization and urbanization also entered a period of rapid development, and a large amount of capital flowed into the development and space production of various new cities and new districts [43]. At the same time, with the maturation of the land market, the gradual termination of the welfare housing system, and the continuous advancement of housing commercialization reform, the mobility of major spatial elements (e.g., land and housing) in markets gradually increased, enhancing the attractiveness of market investment, and providing a strong political and economic stimulus for old city regeneration. At the same time, with the reform of the tax-sharing system in 1994 and the "Decision on Deepening Reform and Tightening Land Administration" issued by the State Council in 2004, local governments gradually gained the power to share the profits from land sales and urban renewal, which greatly enhanced their enthusiasm in participating in urban redevelopment practices. Therefore, the practice of space reproduction at this stage was mainly led by local governments and market players (e.g., real estate developers, financing platforms, etc.), forming a Chinese-style "urban growth alliance". By means of large-scale old city renovation and old area redevelopment, the goal of space reproduction was to promote rapid economic growth, upgrade the industrial structure, and enhance the city's brand image. Specifically, local governments and their platform companies usually focused on the early phases of space reproduction, such as site selection, planning and design, land preparation, demolition and resettlement, etc., while market players paid more attention to the later phases, such as land auctions, development and construction, and operation. Local governments often obtained initial financing by selling the land, which was used to pay for the space reproduction costs of public built environments (e.g., land preparation, infrastructure and public facilities). With the capital and technology of domestic and foreign market players, space reproduction practices in depreciated areas (e.g., old industrial areas, old cities and towns, old villages, etc.) usually promoted the appreciation of spatial capital and benefits generation. During this period, the renewal of production space was often associated with industrial structural upgrading ("suppress the second industry and develop the third industry"), the outward relocation of traditional industries from the central city, and the transformation of the industrial space. For example, the World Expo Park project in Shanghai gradually renovated the old waterfront industrial area into a new urban space covering both production and consumption functions (e.g., office, exhibition, culture, commerce, training, residence, leisure, etc.); the 798 Art District project in Beijing transformed the old industrial area into a cultural and creative industry cluster. The renewal of consumer space was mainly reflected in the renewal and value enhancement of old residential areas, urban villages, and old commercial areas. For example, in the Zhongyuan Liangwan Town project in Shanghai, the largest dilapidated urban area at that time was demolished and rebuilt into a new commercial residential area; in Guangzhou and Foshan's "three-old reconstruction" (i.e., old town, old factory and old village), urban villages were demolished and reconstructed into commercial housing of a higher quality and price.

The fourth stage spans from 2012 to the present. In this stage, China's urbanization rate exceeded 50%, and urban development gradually shifted from large-scale incremental construction to high-quality urban development and regeneration. Against the background of increasing emphasis on urban governance modernization and public participation, the space reproduction practices at this stage involve local governments, market players and social groups, while they also formed cooperation modes with differential degrees

and types [2]. The means of space reproduction become more diversified, refined and progressive as a result, including not only the renovation of old industrial areas, shanty towns and old communities, but also ecological restoration and urban repair, community micro-regeneration, and the transformation of creative industrial parks. Under the guidance of the country's "five-in-one" overall strategic layout, the goals of space reproduction also become more diversified. Besides emphasizing economic benefits, the layout also pays more attention to the social and ecological dimensions of sustainable development goals, such as people-oriented, social equity, happiness, livability, ecological preservation and low carbon values. The specific practice is similar to the third stage. Local governments and their platform companies mainly invest in land preparation, public facilities, and environmental quality improvement. The said governments obtain economic benefits through land transfer and future taxation, and pursue the goals of improving the space value, the city image, the environmental quality and the life quality of citizens. Market players mainly invest in the renovation, development and operation of real estate, and obtain economic benefits by selling, leasing and operating properties. Relevant social groups seek a more reasonable redistribution of renewal interests (e.g., economic compensation, improvement of living environment) through public participation and social co-governance.

4. Researching Relevant Theoretical Framework

From the perspective of space reproduction, the urban regeneration of Chinese and Western cities since the twentieth century has generally focused on urban spaces whose use value or exchange value has depreciated, and carries out different degrees of spatial reproduction practices ranging from repairs and small-scale renovation, to large-scale demolition and reconstruction in order to enhance the value of space. The improved space value includes not only the use value related to the environmental quality, and the exchange value of the built environment as fixed capital and commodities, but also the brand value of the spatial image, the cultural value of historical space, the social value of public space, and the ecological value of natural and green space, etc. Hence, the values, interests and goals pursued by space reproduction have exhibited diversified and comprehensive characteristics, while the stakeholders, cooperation mechanisms, regeneration objects, and benefit distribution have also become complicated. Therefore, it is necessary to build a systematic and integrated theoretical framework to provide theoretical support for a more accurate and comprehensive understanding and analysis of urban regeneration practices.

Some scholars have discussed the theoretical framework of urban regeneration from the perspective of space reproduction [22,23,44–46]. These discussions refer to diverse types of urban space reproduction, for instance, industrial space, cultural space, residential space and commercial space (Figure 2), and mainly involve the stakeholders, game relationships, and operating mechanisms of space reproduction.

4.1. Framework on Industrial Space Reproduction

For example, Li Zhigang et al. studied the space reproduction process of the "Chu Milky Street" project in Wuhan from an old factory area to a commercial district, and established an analytical framework composed of the following three types of stakeholders: the government, the market, and society [22]. Among them, the government (Hubei province, Wuhan city, and Wuchang district), as the project initiator and interest coordinator, occupies a dominant position, and is responsible for land preparation and management (land acquisition and storage, land transfer, demolition and resettlement), planning and design, project supervision, etc. Finally, the government realizes the improvement of the project area in terms of taxation, employment, urban quality, ecological environment, cultural brand and other aspects. For the market players, namely the original land holder (Wuzhong Group) and the developer (Wanda Group), the former increases the land area of the new factory, the upgrading funds for equipment and technology, and the competitiveness of the enterprise, by returning the land and coordinating the relocation. The latter obtains the property rental and sales profits and brand reputation by being responsible for the

investment, design, execution and management of the project. The social subjects include the original residents (Wu Zhong's staff) and related citizens and tourists. Among them, the original residents obtain resettlement houses with higher prices, as well as better living environments and service facilities, through cooperative relocation. Citizens and tourists become the consumer groups of the new space.

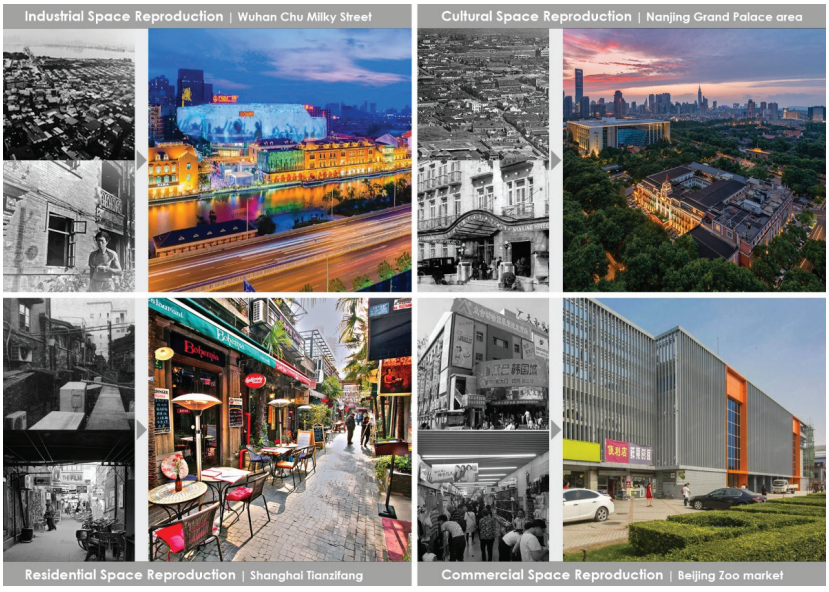


Figure 2. Examples of industrial, cultural, residential and commercial space reproduction. Author's illustration based on online images.

4.2. Framework on Cultural Space Reproduction

Sun Shijie et al. constructed an analytical framework for the reproduction of the old city space, and analyzed the process of cultural space reproduction in the Nanjing Grand Palace area [23]. In this analytical framework, social groups include stakeholders such as government officials, developers, land occupiers and native residents, as well as technical service providers such as planners and architects, and space users and consumers such as operators, citizens, and tourists; these stakeholders are not only the subjects and key actors in the process of space reproduction, as well as the owners and users of power and capital, but also the seekers and gainers of interests. Interests, such as economic or non-economic, public or private, material or spiritual, are the goals pursued by various social groups using the capital and power they control. During the process of space production, capital, such as finance, land, technology, cultural and social capital, etc., acts as an instrumental factor that promotes accumulation and proliferation, while power, such as political, economic and social power, is manifested as the dominance, profit and discourse power obtained by stakeholders through competition and games. In the case of the Grand Palace, due to the significant cultural value of the area, the government is leading a multi-party cooperation mode of development. This area is reproduced as a cultural space that brings together libraries, art galleries, museums and traditional commercial streets. Economic capital and cultural capital are embedded into the material space carriers, such as exhibition halls and commercial streets, which can be spatialized, solidified and accumulated, while the consumption of cultural space and the proliferation of capital can be realized by citizens and tourists visiting the exhibition halls and commercial streets.

4.3. Framework on Residential Space Reproduction

In addition, Zhou Yu studied the renovation process of Shanghai Tianzifang from a traditional lilong dwelling to a cultural, artistic and creative economy area, and constructed a research framework for space reproduction [44]. The research framework reflects the power relations of the following three types of stakeholders in Tianzifang's space reproduction: the government (Administrator, local committee, sub-district office), market enterprises (businessmen, agencies, artists, investors, operators), and the public (landlords, left-behind residents, tourists, and the media). Under the domination of consumer culture, various stakeholders have formed a network of power, capital and culture around the use value, cultural value, and especially the brand and symbolic value, of the Tianzifang Lane space. These stakeholders also rely on the production and consumption of symbolic value to accelerate the circulation of capital.

4.4. Framework on Commercial Space Reproduction

Furthermore, Shen Haojing et al. constructed an analytical framework including government, market, society, and culture based on the theory of space production, and explained the reproduction process of the transformation of Beijing's old commercial market into an industrial space of technological innovation [45]. This framework adopts the analytical perspective of "power-capital-daily life", and explains the interrelationships between key factors formed in the space reproduction process, including "government" as the main controller of power, "market" as the main owner of capital, and "public" and "culture" as the main components of daily life. In the case study, the government uses power to guide the upgrading of industry, and the market invests new capital to pursue profit maximization. The two together promote the replacement of traditional low-value-added production space with high-value-added and high-profit space, while the participation of the public in this process is fairly limited. At the same time, the culture accumulated in the space, especially after the formation of cultural symbols and brands, also plays an important role in enhancing the capital value of the space as well as the cultural identity of society.

In general, the current analytical or theoretical frameworks based on the perspective of space reproduction include the following three categories of stakeholders: the government, the market, and society. Various stakeholders use the numerous types of powers and capital under their control to compete, cooperate and play games in the process of space reproduction, in order to pursue and obtain their own interests. On the basis of summarizing and integrating the existing knowledge, there is still some content that can be further optimized and supplemented in order to form a more systematic and comprehensive theoretical framework. First, the current theoretical framework usually treats space or space production as a single element and explores its relationship with various stakeholders. However, some key concepts and mechanisms in the theory of the production of space constructed by Lefebvre and Harvey are not included and expressed, such as spatial practice, representations of space, representational spaces, and capital circulation. Secondly, the current research on space reproduction practice and the theoretical framework mainly focuses on the roles and functions of the government and the market, while the cognition and analysis of the roles, functions, and importance of social subjects are relatively weak. In today's world of pursuing sustainable economic, social, and environmental development, and considering China's emphasis on people-oriented governance modernization, further discussion and research are needed on social subjects and social dimensions. Thirdly, most frameworks are established on the basis of summarizing or guiding a single specific case, and their comprehensiveness and generality still need to be enhanced. Combining existing regeneration practice and research, we can further summarize and classify the composition of each subject and element in the framework, as well as the different cooperation mechanisms between them.

5. Constructing the Theoretical Framework of Urban Regeneration

This part will build a systematic and comprehensive urban regeneration theoretical framework from the perspective of space reproduction on the basis of the research concerning the theory of the production of space, space reproduction practice, and related theoretical frameworks, combined with other related theoretical works (Figure 3).

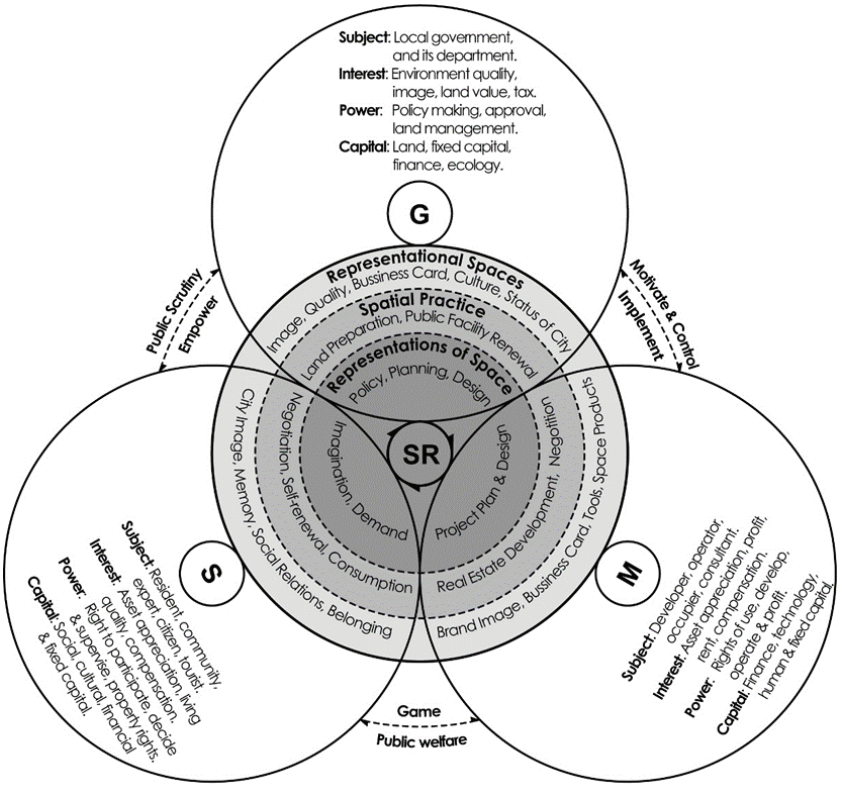


Figure 3. The theoretical framework of urban regeneration from the perspective of space reproduction. SR represents Space Reproduction, and G, M and S represent the Government, the Market and the Society, respectively.

The framework contains the four following core elements: the government, the market, society, and space reproduction. The first three elements are the three types of stakeholders in the process of space reproduction, and the last element reflects the internal mechanism and process of space reproduction. The overlap between the first three elements and space reproduction reflects the planning, practice and focus of various stakeholders in the process of space reproduction. At the same time, the three types of stakeholders are interrelated, and different types of co-opetition and game relationships have been formed in practice.

5.1. The Government

The government, especially local governments at the provincial and urban levels, and their related departments, usually plays an important role as initiators, leaders and coordinators in the process of space reproduction. Local governments use their functions and powers in policy formulation, land management, planning and design approval, and project supervision to promote a series of tasks, such as setting goals, clarifying requirements, selecting subjects, promoting implementation, safeguarding public interests, and supervising operations during urban regeneration [47]. The main types of capital used

by local governments for space reproduction include land capital, fixed capital, financial capital and ecological capital. Among them, land capital is the core capital of space reproduction, and is divided into the following two categories under China's public land ownership system: state-owned land and collective land. Urban regeneration normally involves developed state-owned land located in urban areas (e.g., urban construction land). Under the authorization of the central government (as the sole representative of state-owned land), local governments can dispose of state-owned land (e.g., land acquisition and storage and transfer), and exercise the right to benefit from it. In addition, local governments can also expropriate developed collective land in urban and suburban areas (e.g., urban villages) due to public interests, and convert it into state-owned construction land for urban redevelopment and space reproduction. Fixed capital mainly refers to the dilapidated or depreciated public built environment occupied by local governments and involved in space reproduction, including infrastructure such as roads and docks, and public service facilities such as schools, hospitals, museums, and parks. Financial capital involves funds used by local governments for urban regeneration, including central policy funds and special bonds, local financial funds (including land transfer fees), and local government bonds. Ecological capital primarily includes ecological resources and an ecological environment that can bring about economic, social and ecological benefits in urban regeneration, such as rivers, mountains, green spaces, etc. As an important public form of capital and resource of a city, ecological capital is increasingly valued by governments in the era of ecological civilization. For example, in the practice of "ecological restoration and urban repair", the value of ecological capital is restored and enhanced through the ecological restoration of urban ecological elements and systems. Overall, local governments use their power to invest all kinds of capital in the reproduction of urban space in order to seek the growth of interests. These interests are mainly public and economic interests, involving the improvement of the urban living environment, ecological environment amelioration, urban image enhancement, land value increase, and corporate tax increase.

5.2. The Market

The market generally refers to the relevant subjects and enterprises in the market economy, which often play an important role as responders, investors and implementers in the process of space reproduction. These market players mainly include developers, investors, operators, space occupiers and consulting companies. Among them, real estate developers are the main executors of space reproduction, responsible for the renovation and redevelopment of residential buildings, shopping malls, factories, warehouses, office buildings and other real estate, as well as for supporting ground roads and underground infrastructure and other real estate, in order to create higher-value spatial products. A developer can also be an investor or operator at the same time. Investors are market entities that provide funds for the whole process of demolition, renovation, construction, operation, etc., including not only developers and strategic investors, but also policy banks (e.g., China Development Bank), commercial financial institutions, such as banks (e.g., China Construction Bank), trust companies, security companies, and fund companies. Operators refer to enterprises that provide operation management and other services for the renovated spatial products, including operators of shopping malls, industrial parks, long-term rental apartments, and property companies in commercial housing communities, etc. Space occupiers, as key stakeholders, include both the occupiers of the original land or building space and new space occupiers after renewal, such as newly-settled enterprises. Consulting enterprises are those enterprises and institutions that provide professional technical solutions and consulting services for the whole process of space reproduction, including planning and design companies, architectural design companies, law firms, real estate consulting companies, etc. The main capital controlled by the market players includes financial capital, technological capital, human capital and fixed capital. Among them, financial capital is the core capital controlled by the market to promote space reproduction and capital proliferation, including

self-owned funds, bank loans (e.g., CDB, CCB urban regeneration loans), non-standard financing (e.g., trust, private financing), bonds funds (e.g., urban investment bonds), urban regeneration funds (e.g., Shanghai Urban regeneration Guidance Fund), REITs real estate investment trust funds (e.g., urban regeneration REITs), etc. Technological capital, human capital, and fixed capital involve various technical processes, professionals, equipment, and real estate (e.g., factories and office buildings held by space occupiers), that various market enterprises direct towards space reproduction. Numerous types of market players have used their capital and acquired spatial development rights of development, operation, use, and profit to promote capital investment, planning and consulting, scheme studies, development and operation; these players have obtained various benefits, such as the asset appreciation of real estate, an increase in capital profits, an increase in space rent, compensation for demolition or renovation, improvement of the operating environment, and an increase in the brand and market value of the enterprise, etc. It is worth noting that some state-owned enterprises supervised by the central or local governments, such as state-owned developers, local investment and financing or development platform companies, often take into account both economic and public interests, participating in public renewal projects with long payback periods. Therefore, the attributes and roles of state-owned enterprises that assist the government in providing urban public goods and services are more akin to those of the government.

5.3. Society

The term society mainly refers to the social public with relevant interests in the process of space reproduction, who usually play the role of cooperators and participants, and include local residents, community organizations, surrounding residents, experts and scholars, as well as other citizens, migrants and tourists. Among them, local residents refer to the aborigines or villagers living on the renewed land. They are the most important stakeholders in the regeneration, and the main users and consumers of residential and living spaces such as houses and communities. Community organizations, e.g., homeowners' councils, are the main representatives of the rights and demands of local residents. The surrounding residents of the renewal area are also influenced by external effects such as environmental improvement and increases in house prices brought about by the renewal, and become stakeholders of relevance. Experts and scholars participate in the space reproduction mainly by means of expert review and public participation in regeneration planning. Other citizens, migrants, and tourists are often involved in the role of users and consumers of the regenerated urban space, i.e., the consumers of new commercial centers, commercial housing, art galleries or urban parks. Compared with the government and the market, the public has less power and capital, including the right to participate, to know, to make decisions and to supervise, and the right to occupy, use, and benefit from their own property, as well as social capital, cultural capital [48], fixed capital, and financial capital. Regarding capital, social capital here refers to the social relationship network and human network resources formed by local residents around their living space. These kinds of social capital are conducive to promoting mutual understanding, mutual trust, mutual cooperation, identity, social norms and common values, etc., thereby contributing to the more harmonious operation and development of society. Cultural capital involves the tangible historical and cultural relics, resources, features and textures of the renewed space, as well as the intangible cultural traditions, activities and brands, which together maintain and illuminate the spatial image of the urban historical space in the public's collective memory. Fixed capital primarily refers to residents' real estate, which has both consumption and investment attributes, and can create economic benefits in terms of rent or asset appreciation after renewal. Financial capital relates to the financial capital invested by the public in self-renewal, such as deposits and loans. Using their power and capital, the social public participate in the formulation of renewal plans, project implementation and supervision in order to obtain real estate value enhancement (or house price increase),

compensation for demolition, and the improvement of housing conditions, service facilities and living environment.

5.4. Space Reproduction

Space reproduction is actually a circular game and competition between old and new capital as well as the powers and subjects behind them vying for spaces with higher investment value. There exist three major elements in Lefebvre's theoretical framework of space production, namely representations of space, spatial practice, and representational spaces, which also implies the internal mechanisms of the planning, developing and experiencing of urban space. The government, the market, and society have their own emphasis on the planning, practice, and experience of space reproduction.

5.4.1. Representations of Space

Concerning the representations of space, the government usually plans the "representations of space" or spatial order, which reflects their interests by formulating urban regeneration policies and organizing renewal plans and designs. For example, the government guides the main objects, goals, principles, methods and strategies of space reproduction by formulating policies such as "three-old reconstruction" and "ecological restoration and urban repair". In addition, by organizing the preparation of urban planning and design, the government controls the consumption pattern, land-use layout, industrial function, land ownership, road network system, spatial form, landscape features, etc. Enterprises in the market usually lead, or participate in, the specific project planning and product design based on their own developmental strategies and profit models. Their plans and designs are most suitable for the economic interests of enterprises, and represent the higher-profit spatial products in the future. For example, a regenerated space planned by a developer, investor or operator actually represents a spatial product with a higher, faster, and longer-lasting return on investment. The public, mainly through the public participation mechanism of planning, put forward proposals and demands for the future space that represents their vital interests. For example, residents can put forward demands and ideas for space reproduction for future residential spaces, such as housing, public squares, green spaces, parking spaces, etc. In general, the government, the market, and society as three types of stakeholders, exhibit a kind of large-to-small and macro-to-micro characteristics in terms of the degree and scope of their influence on the "representations of space".

5.4.2. Spatial Practice

Secondly, in terms of spatial practice, the local government or the local state-owned platform company is mainly responsible for the preliminary urban land preparation or land development, including land acquisition, demolition, resettlement, compensation, financing, municipal facilities construction, land reserve and transfer, as well as the renewal work of existing public facilities and environments, such as the renovation of municipal and public service facilities, and ecological restoration. Market enterprises are mainly engaged in real estate (such as residences, shops, factories, warehouses, office buildings, etc.) investment and financing, renovation and development, product rental and sales, and operation services, as well as the construction of affordable housing and public service facilities. Among them, state-owned enterprises usually cooperate more deeply with the government to participate in projects associated with strong policy preference, high investment, public welfare, and people's livelihood, while privately- and foreign-funded enterprises pay more attention to those projects with higher return on investment and larger profit margins. The enterprises as original space occupiers mainly participate in the spatial practice by negotiating renovation or cooperating with relocation. Additionally, the spatial practices of the public involve negotiating renovation or relocation, resettlement and compensation, self-renewal practice, and the use and consumption of regenerated space by residents, citizens and tourists. In general, the three types of stakeholders have different

emphases in "spatial practice". The government focuses more on the reproduction of land space and public space, the market focuses on the reproduction of architectural space and commercialized space, and society mainly participates in the reproduction of residential architectural space and the consumption of renewal space.

5.4.3. Representational Spaces

Finally, the representational spaces reflect the symbolic, imaginary, emotional, and historical and cultural intentional spaces of various stakeholders superimposed on the renewal material space. For the government and officials, the reproduced space not only has material and functional attributes, but also symbolizes the image and quality of the city, the city's business card, the strength and status of the city, and the city's history and culture. For example, the Huangpu riverside space, renovated under the leadership of the Shanghai municipal government, has become a "world-class urban meeting room" and a city business card for the government to display and represent the image of Shanghai. For market enterprises, the reproduction space symbolizes the brand image of the enterprise, the business card, the production tools that create value, and the consumable spatial products. For example, from the perspective of developers, the renovated or redeveloped building spaces, such as long-term rental apartments, commercial buildings, and commercial centers, not only represent the spatial products that can be rented, sold, and consumed, but also symbolize, to a certain extent, the brand image of the company. The regenerated workshops and office buildings become the production tools in which the territorial enterprises can use to create value more efficiently or lastingly. For the public, the regenerated material space still superimposes and represents people's cognition and intention of the city (e.g., city centers, landmark buildings, main streets, etc.), as well as the memory of historical culture (e.g., traditional buildings, historical neighborhoods, custom activities, etc.), perception of social relations (e.g., neighborhood space, unit compound, clan settlement, etc.), and personal emotional belonging (e.g., childhood home, urban space with a sense of belonging or emotional connection, etc.). The greater the change in the urban material space, the greater the change in the representational spaces for the public, and the greater the loss of social and cultural capital, and emotional memory accumulated in space. In general, the "representational spaces" of three types of stakeholders also have differing emphasis. The government focuses more on the public symbolized image of renewal space, while the market focuses more on the production and consumption attributes superimposed on the renewal space, and the public pays more attention to the social, cultural and emotional connotations of spaces.

5.5. Co-opetition between Stakeholders

The three types of stakeholders are interrelated, and the space reproduction practices of Chinese and Western cities in different periods have formed several main co-opetition models. The first is the government-led model, in which the government uses its power and capital to dominate and promote the practice of space reproduction. This model has appeared in post-war Western cities and Chinese cities. The urban material environment is in urgent need of renewal, and the capital strength of the market and social subjects is still weak, thus meaning that the government has to lead urban regeneration. The second is the model of government domination and public participation. This model appeared in Western cities in the 1960s. Cities faced not only physical spatial problems, but also social problems such as social unrest and the intensification of contradictions. Therefore, with enhancing capital strength and awareness of rights, the social subjects, as key stakeholders of spatial and social problems, participate in government-led urban regeneration practices. The third is the growth alliance model formed by the government and the market. This pattern emerged in Western cities after the 1970s, and in Chinese cities after the 1990s. In addition to the problem of spatial decay, cities were also faced with economic problems such as economic crisis and government financial difficulties. Therefore, the government and market players have formed an alliance to jointly promote urban regeneration based on the

consensus of using the financial capital from the market and sharing the benefits of renewal. However, under this model, the government and the market tend to place more emphasis on political performance and economic benefits, and pay attention to the exchange value of urban space, but ignore the actual use value and reasonable demands of the aborigines for space to some extent. Indeed, this results in the emergence of spatial injustice, such as the injustice of the mechanisms for expressing demands and the distribution of spatial benefits, all of which normally force residents to move to the urban fringes and suburbs [49]. At the same time, the social capital, cultural capital and emotional memory attached to the built environment that the public can enjoy, are easily ignored and destroyed by the economic interest-oriented urban growth alliance in the process of space reproduction. For instance, demolition and relocation bring about the collapse and loss of traditional social network, the destruction of historical and cultural relics, the disappearance of traditional spatial features and patterns, and the loss of place memory and sense of belonging, etc.

The interests of society and the social dimension of development have received increasing attention in recent decades. Since the United Nations published the Brundtland Report in 1987, the concepts and theories of sustainable development, including the three dimensions of economy, environment and society, have been widely recognized and gradually become the standard to guide sustainable urban regeneration. Among them, social sustainability addresses the key qualities and goals of a society's long-term development, and covers numerous scientific and policy topics, including basic needs, well-being, social justice, social inclusion, social capital, public participation, employment, income and security [50]. Well-being and social justice are the two crucial themes. Well-being, as the ultimate goal of human behavior, can be roughly understood as a good life. The theory of social production functions proposed by Siegwart Lindenberg integrates well-being and various related goals, needs, activities, and resources into a hierarchical theoretical framework [51]. According to this theory, human beings improve their ultimate well-being by continually optimizing two universal goals of physical well-being and social well-being. These two universal goals can be achieved by meeting the lower-level five instrumental goals or basic needs, including two types of physical needs–namely comfort and stimulation–as well as the following three types of social needs: status, behavioral confirmation and affection. These five basic needs can then be met by the lower-level activities and the resources at the bottom. Therefore, the resources at the bottom can be understood as the key basis and raw materials for well-being production layer by layer, which include funds, housing, living environment, food, and health for physical needs satisfaction, as well as education, talents, social networks, cultural practices, and relatives for social needs fulfillment [52]. In addition, social justice, a key issue in John Rawls's theory of justice, emphasizes the need for a fair and just distribution of resources, powers, and opportunities that promote or produce well-being. Combined with the theory of spatial production, the labor force that promotes production activities in most cities also needs to own and consume various resources under the principle of fairness to meet the physical and social needs of daily life, so as to enhance happiness and maintain work capability, while also promoting the reproduction of the labor force and realizing the successful circulation of capital. When space reproduction undermines the happiness foundation of the labor, this may lead to lower labor productivity, or even social unrest, stagnation of production, and the blockage of capital circulation. Therefore, in the context of China's emphasis on people-oriented and happiness, the public, as the main stakeholder in space reproduction, need further attention; especially, the important resources used by the public to create well-being and happiness (e.g., housing, living environment, financial resources, social networks, cultural customs, etc.) need to be given more attention and protection, and the principle of fairness and justice should also be upheld in the modification and redistribution of related resources, as well as the distribution of renewal benefits.

The government's emphasis on social interests and governance modernization, coupled with the improvement of the public's awareness of rights, personal wealth, and game-playing ability, has led China to explore and study the fourth model of space re-

production in recent years: the multi-stakeholder co-governance model of government, market and society. This model focuses on the collaborative participation of multiple subjects in decision making and implementation, as well as the multi-party sharing of new benefits after the regeneration. Under this model, the government has moved from "multiple-departments management" to "coordinated governance", and directs more effort towards coordinating the demands and wishes of all parties, empowering the public to participate through institutional design, using policies and regulations to motivate and constrain market players, and coordinating public and private interest and interests distribution. Indeed, market enterprises have changed from "seeking profit only" to "taking into account public welfare", not only to ensure reasonable profitability of investment implementation, but also to rationally share the value-added benefits of land and space, and to take into account more public interests; the public have moved from "expressing demands" to "in-depth participation", and participate in more in-depth interest-related processes, such as regeneration plan evaluation, implementation, public supervision, compensation or game negotiation of benefits [47,49]. Ultimately, this promotes the realization of the multidimensional goals and interests of the government, the market and society.

6. Discussion

Due to the wide range of disciplines and content involved in urban regeneration, there remains a lack of systematic and comprehensive theoretical frameworks to lay a theoretical foundation for academic research and provide guidance for renewal practice. Therefore, based on a mixed literature review approach, this paper employs the theory of the production of space as the interdisciplinary basis to integrate related theoretical components [22,23,44–46], and constructs a systematic and comprehensive theoretical framework for urban regeneration from the perspective of space reproduction. The proposed theoretical framework includes four core elements, namely the government, the market, the society and space reproduction. The subject, power, capital and interest of three types of stakeholders (government, market, and society), as well as their differential emphases and various co-petition relations in the reproduction mechanism are suggested.

This paper makes certain new theoretical explorations and contributions on the basis of previous research. First of all, by studying and integrating the theory of the production of space, sustainable development, social production function, social justice, and many other related theoretical and empirical studies, this paper constructs a more systematic, comprehensive and universal theoretical framework of urban regeneration. The framework can be used as a research basis for further in-depth discussions or feedback corrections in related theoretical or empirical research. Secondly, this paper incorporates certain core concepts and mechanisms derived from the theory of the production of space into the theoretical framework, including the representations of space, space practice, representational spaces, and the spatialization and circulation of capital, etc. The differential emphases of various stakeholders in the space reproduction process are discussed, and the understanding and cognition of the urban regeneration mechanism are enriched and expanded. Thirdly, regarding the construction of theoretical framework, the current paper strengthens the importance of social subjects and social dimensions. With the help of a series of related theories, this paper expounds that the protection or fair distribution of important resources or new benefits that create people's well-being is not only conducive to the realization of people-oriented sustainable renewal, but also conducive to continuous and stable space reproduction and capital circulation.

Nevertheless, as the proposed theoretical framework in this paper is primarily based on relevant theoretical literature, its application value for supporting the top-level policy making of urban regeneration and guiding city-level regenerative urban planning and project-level regenerative practices still remains unknown and needs further explorations. Moreover, as the cities in contemporary China continue to face a changing and complex developmental circumstance both domestically and internationally, the validity of this

theoretical framework in explaining urban regeneration mechanism in future still remain unknown and requires further studies to investigate more changing and dynamic factors.

To overcome the above mentioned limitations, future research can be conducted to examine and improve the application value of this theoretical framework. By applying this framework, future research could attempt to address several more practical questions in the space reproduction process regarding "Where, What, Who, How, and When". "Where" involves the site selection issues of investment and renewal. Combining the interests, the bottom line requirements, and the "representational spaces" of the three types of stakeholders, a target system can be formulated and further decomposed into urban regeneration assessment indicators to assess and identify areas with renewal potential and value. "What" refers to the planned functions and spatial form. On the one hand, this refers to what functions and physical form can promote the content of "representations of space" such as capital proliferation, asset appreciation, tax increase, housing improvement, and environmental improvement, while, on the other hand, it also involves "spatial practice" content such as specific land preparation, real estate investment, construction, and operation. "Who" refers to the stakeholders in charge of the implementation. One can refer to the composition of the three types of stakeholders, and combine the relevant subjects and content of the regeneration space to clarify the specific stakeholders. "How" involves the division of labor and distribution of interests. One can refer to the content of space reproduction that each stakeholder focuses on, as well as the inter-subject relationship, to build a multi-coordinated co-governance model and an interest negotiation mechanism. Finally, "when" refers to the investment timing and regeneration timing. Choosing good investment timing and regeneration timing will mean that each subject can reap better benefits, capital can flow and circulate better within the primary or secondary land development, and the spillover effect of space appreciation can better increase the prices of surrounding lands and housings.

Further research can also investigate the changing and dynamic developmental circumstances of Chinese cities in future and their influences on the space reproduction mechanism. Since 2012, China's economy has moved from a stage of external circulation, after the reform and opening up, to a period of international and domestic dual circulation dominated by internal circulation. At the same time, urban development has also moved from the stage of rapid development and expansion to the stage of urban regeneration, which emphasizes connotative high-quality development. It can be seen that the main circulation field of capital is shifting from abroad to domestic, and from urban space production to urban space reproduction. On the one hand, the state is guiding capital into the new economic fields that determine future competitiveness, such as new infrastructure, new energy, digital economy, and high-end manufacturing, as well as the production of related spaces. On the other hand, more capital is being invested in the reproduction of urban space, especially in those urban agglomerations and metropolitan areas with more developmental momentum, higher spatial efficiency, and higher return on investment, thus promoting a new round of higher-quality space reproduction with the goal of higher efficiency. In the future, the reproduction of urban space will continue, similarly to the metabolism mechanism of the human body, constantly replacing old cells with new cells; new capital and power will continue to replace the depreciated and declining old capital and power, building a spatial landscape that represents their image and interests. From a broader perspective, space reproduction actually reflects the competition and reshaping of land space by all the new capital with higher profits and all the new subjects with greater power. Such mechanism has promoted the reshaping of natural space into agriculture, the replacement of agricultural space by industrial space, the transformation of industrial space to science and technology space, and the regeneration of consumer space (e.g., residential, business and leisure space, etc.) into higher-profit or higher-quality consumer space, etc. All these changes and replacements reflect the functioning of capital under the auspices of power, constantly circulating, fluctuating, and competing with each other in time and space.

Hence, it would be interesting and also challenging for future research to continuously reveal the underlying nature and rationales of space reproduction in urban China.

7. Conclusions

This paper aims to construct a systematic and comprehensive theoretical framework for urban regeneration from the perspective of space reproduction, by using the theory of the production of space as the interdisciplinary basis and integrating related theoretical components.

A more systematic, comprehensive and universal theoretical framework of urban regeneration has been proposed in this paper, which includes four core elements, namely the government, the market, society and space reproduction. The first three elements represent the most important types of stakeholders in urban regeneration, and the last element reflects the content and process of space reproduction. This theoretical framework further summarizes the specific subject, power, capital and interest of the three different types of stakeholders in the process of space reproduction.

Additionally, some core concepts and mechanisms of space production have been incorporated into the theoretical framework of this paper, such as the representations of space, space practice, representational spaces, the spatialization and circulation of capital, etc. It is found that the three types of stakeholders have differential emphases within the space reproduction process. Concerning the representations of space, the influence of the government, market and society vary differently from large to small and from macro to micro, in terms of the influential size and scope, respectively. With regard to spatial practice, the government, market and society focus, respectively, on the reproduction of land and public space, architecture and commercialized space, as well as residential building and consumer space. Regarding the representational spaces, the government, market and society focus, respectively, on the public image, production and consumption attributes, as well as social, cultural and emotional connotations superimposed on the space.

Furthermore, the importance of social subjects and social dimensions of the urban regeneration framework has been strengthened. Despite the various co-petition models formed among stakeholders in space reproduction practice, such as government-led mode and the government-market growth alliance model, the attention paid to social subjects and their interests seems relatively limited. Different models actually reflect the ability of three types of stakeholders to control power and capital, manipulate space reproduction and obtain their own interests in different eras. Against the background of the government's increasing emphasis on social interests and governance modernization, and the public's continuous improvement of rights awareness and game ability, increasing attention is now being paid to a multi-stakeholder co-governance regeneration model that promotes the collaborative participation of multiple subjects in decision making and implementation, as well as in sharing newly reproduced benefits in urban China.

Funding: This research was supported by the joint funding from National Natural Science Foundation of China (72061137072) and Dutch Research Council (482.19.607).

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

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

References

1. Chien, S.S.; Woodworth, M.D. China's urban speed machine: The politics of speed and time in a period of rapid urban growth. *Int. J. Urban Reg. Res.* **2018**, *42*, 723–737. [CrossRef]
2. Yang, J.; Chen, Y. Review on the development of urban regeneration in China from 1949 to 2019. *City Plan. Rev.* **2020**, *44*, 9–19+31.
3. Wang, J.; Bai, Y.; Song, J. The evolution, challenges and suggestions of urban renewal in China. *Planners* **2021**, *37*, 21–27.
4. Liu, H. Urban regeneration is always on the road-Huang Yan, deputy minister of the Ministry of Housing and Urban-Rural Development, talks about hot issues of urban regeneration. *China Eng. Consult.* **2021**, *10*, 8–9.

5. Roberts, P. The evolution, definition and purpose of urban regeneration. In *Urban Regeneration: A Handbook*, 2nd ed.; Roberts, P., Sykes, H., Granger, R., Eds.; SAGE Publications: London, UK, 2017; pp. 9–36.
6. Zhao, W.; Li, Z.; Li, Y. A review of researches on urban renewal in contemporary China and the future prospect: Integrated perspectives of institutional capacity and property rights challenges. *Urban Plan. Forum* **2021**, *5*, 92–100.
7. Liu, B.; Liu, J.; Wang, T.; Cheng, T. The theory and practice of urban renewal abroad and its enlightenment. *China Anc. City* **2022**, *36*, 15–22.
8. Shih, M.I. The evolving law of disputed relocation: Constructing inner-city renewal practices in Shanghai, 1990–2005. *Int. J. Urban Reg. Res.* **2010**, *34*, 350–364. [CrossRef] [PubMed]
9. Loftman, P.; Nevin, B. Prestige projects and urban regeneration in the 1980s and 1990s: A review of benefits and limitations. *Plan. Pract. Res.* **1995**, *10*, 299–316. [CrossRef]
10. Bernt, M. Partnerships for demolition: The governance of urban renewal in East Germany's shrinking cities. *Int. J. Urban Reg. Res.* **2009**, *33*, 754–769. [CrossRef]
11. Jones, P. *Urban Regeneration in the UK*; Sage: London, UK, 2008.
12. Henneberry, J.; Rowley, S. Development cultures and urban regeneration. *Urban Stud.* **2002**, *39*, 1181–1196.
13. Zhang, J.; Chen, H. Research on Western urban space renewal from the perspective of space re-production. *Hum. Geogr.* **2012**, *27*, 1–5.
14. Xu, Z.; Zhang, F.; Jiang, Y. On the status quo, problems and strategies of urban regeneration in China. *China Anc. City* **2014**, *4*, 4–13.
15. Friedmann, J. Place and place-making in cities: A global perspective. *Plan. Theory Pract.* **2010**, *11*, 149–165. [CrossRef]
16. Logan, J.R.; Molotch, H.L. *Urban Fortunes: The Political Economy of Place*; University of California Press: Berkeley, CA, USA, 2007.
17. Molotch, H. The city as a growth machine: Toward a political economy of place. *Am. J. Sociol.* **1976**, *82*, 309–332. [CrossRef]
18. Lin, J.; Ye, Z. Green urban renewal: An important direction for urban development in the new era. *City Plan. Rev.* **2019**, *43*, 9–12.
19. Tang, Y.; Fan, L. Diversified policy and institutional explorations of urban regeneration in Western European countries. *Urban Plan. Int.* **2022**, *37*, 9–15.
20. Liu, B.; Liu, J.; Cheng, T.; Wang, T.; He, Q. The theory and practice of urban renewal in China. *China Anc. City* **2021**, *35*, 1–10.
21. Zhao, Q.; Yang, C. Reproduction of urban production space: Some discussions after the enlargement of urban framework. *Urban Dev. Stud.* **2020**, *27*, 31–37.
22. Li, Z.; Sun, Y.; Lin, S.; Guo, Y. Spatial reproduction and place promotion in central China: A case study of Chu Milky street of Wuhan. *Urban Rural Plan.* **2019**, *2*, 60–69.
23. Sun, S.; Xiong, E. Regeneration process and mechanism of cultural space in old city from the perspective of space production: A case study of Daxinggong area in Nanjing. *City Plan. Rev.* **2021**, *45*, 87–95.
24. Snyder, H. Literature review as a research methodology: An overview and guidelines. *J. Bus. Res.* **2019**, *104*, 333–339. [CrossRef]
25. Ko, W.; Kent, M.; Schiavon, S.; Levitt, B.; Betti, G. A window view quality assessment framework. *Leukos* **2022**, *18*, 268–293. [CrossRef]
26. Berke, E.; Vernez-Moudon, A. Built environment change: A framework to support health-enhancing behaviour through environmental policy and health research. *J. Epidemiol. Community Health* **2014**, *68*, 586–590. [CrossRef]
27. Lefebvre, H.; Translated by Nicholson-Smith, D. *The Production of Space*, 1st ed.; Blackwell: Oxford, UK, 1991.
28. Ye, C.; Chai, Y.; Zhang, X. Review on studies on production of urban space. *Econ. Geogr.* **2011**, *31*, 409–413.
29. Brenner, N. *Implosions/Explosions: Towards a Study of Planetary Urbanization*; Jovis Verlag GmbH: Berlin, Germany, 2014.
30. Brenner, N. Between fixity and motion: Accumulation, territorial organization, and the historical geography of spatial scales. *Environ. Plan. D: Soc. Space* **1998**, *16*, 459–481. [CrossRef]
31. Soja, E.W. The socio-spatial dialectic. *Ann. Assoc. Am. Geogr.* **1980**, *70*, 207–225. [CrossRef]
32. Castells, M. *The City and the Grassroots: A Cross-Cultural Theory of Urban Social Movements*; University of California Press: Berkeley, CA, USA, 1985.
33. Gottdiener, M. *The Social Production of Urban Space*; University of Texas: Austin, TX, USA, 1985.
34. Zheng, J.; Yan, L. The analysis and enlightenment of David Harvey's theory of capital accumulation. *New Econ.* **2021**, *10*, 90–94.
35. Harvey, D. The urban process under capitalism: A framework for analysis. *Int. J. Urban Reg. Res.* **1978**, *2*, 101–131. [CrossRef]
36. Harvey, D. The social construction of space and time: A relational theory. *Geogr. Rev. Jpn.* **1994**, *67*, 126–135. [CrossRef]
37. Harvey, D. *Space of Capital: Towards a Critical Geography*, 1st ed.; Routledge: New York, NY, USA, 2001.
38. Li, X. A critical investigation of David Harvey's "global hegemony shift"—Based on the analytical perspective of "temporal-spatial fix". *Contemp. Econ. Res.* **2021**, *4*, 45–53.
39. Xie, D.; Fan, J.; Chang, J. From space reproduction to place-making: The new trend of China's urban regeneration. *Urban Dev. Stud.* **2017**, *24*, 110–115.
40. Zhao, Y.; Song, T. An analysis on the financial balance of urban renewal: Patterns and practice. *City Plan. Rev.* **2021**, *45*, 53–61.
41. Zhao, Y. Urbanization 2.0 and transition of planning: Explanation based on a two-phase model. *City Plan. Rev.* **2017**, *41*, 89–93+116.
42. Swyngedouw, E.; Moulaert, F.; Rodriguez, A. Neoliberal urbanization in Europe: Large–scale urban development projects and the new urban policy. *Antipode* **2002**, *34*, 542–577. [CrossRef]
43. He, S.; Lin, G. Producing and consuming China's new urban space: State, market and society. *Urban Stud.* **2015**, *52*, 2757–2773. [CrossRef]

44. Zhou, Y. A study on space reproduction of creative industries based on the perspective of consumer culture in transition period: A case study of Tianzifang. *Mod. Urban Res.* **2013**, *11*, 29–34.
45. Shen, H.; Jing, C. The spatial governance in regeneration of built-up areas: A study in background of relieving non-capital functions of Beijing. *Public Adm. Policy Rev.* **2021**, *10*, 128–138.
46. Yang, Z.; Yang, J.; Ren, K. The analysis of the spatial production mechanism and the coupling coordination degree of the Danwei compound based on the spatial ternary dialectics. *Processes* **2021**, *9*, 2281. [CrossRef]
47. Zhang, F.; Ge, Y. Research on the multi-players' concept and the role transformation in urban regeneration under the perspective of governance: A case study of Shanghai. *Shanghai Urban Plan. Rev.* **2019**, *5*, 57–61.
48. Bourdieu, P. The forms of capital. In *Handbook of Theory and Research for the Sociology of Education*; Richardson, J., Ed.; Greenwood Press: New York, NY, US, 1986; pp. 241–258.
49. Peng, K. A study on governance based urban renewal model from the perspective of new Marxism: Restructuring of the roles and partnership of different spatial stakeholders. *Planners* **2018**, *34*, 5–11.
50. Liu, Y.; Dijst, M.; Geertman, S.; Cui, C. Social sustainability in an ageing Chinese society: Towards an integrative conceptual framework. *Sustainability* **2017**, *9*, 658. [CrossRef]
51. Liu, Y.; Dijst, M.; Geertman, S. The subjective well-being of older adults in Shanghai: The role of residential environment and individual resources. *Urban Stud.* **2017**, *54*, 1692–1714. [CrossRef]
52. Liu, Y.; Dijst, M.; Faber, J.; Geertman, S.; Cui, C. Healthy urban living: Residential environment and health of older adults in Shanghai. *Health Place* **2017**, *47*, 80–89. [CrossRef] [PubMed]

land

MDPI

Article

The Multidimensional Evaluation of Cultural Heritage Regeneration Projects: A Proposal for Integrating Level(s) Tool—The Case Study of Villa Vannucchi in San Giorgio a Cremano (Italy)

Francesca Nocca [1,*] and Mariarosaria Angrisano [2,*]

[1] Department of Architecture, University of Naples Federico II, 80134 Naples, Italy
[2] Department of Civil Engineering, Pegaso Telematic University, 80143 Naples, Italy
* Correspondence: francesca.nocca@unina.it (F.N.); mariarosaria.angrisano@unipegaso.it (M.A.)

Abstract: The challenges of sustainable development are mainly concentrated in the cities. Therefore, they represent a key place for implementing strategies and actions to achieve (or not achieve) sustainable development objectives. In this perspective, the circular city model represents a new way of organizing the city. As demonstrated by a variety of best practices, the entry points for triggering circular processes at the urban scale are various. In this paper, cultural heritage is presented as the entry point for the implementation of this new urban development model. The focus here is on the implementation tools, with a particular emphasis on the evaluation tools for assessing the effectiveness and efficiency of this model, that is, the multidimensional benefits that it can produce. The Level(s) tool, proposed by the European Commission in 2017, is the only officially recognised assessment tool related to the circular economy at the European level. It aims to evaluate the performance of new buildings from a circular economy perspective. This paper intends to expand the field of action of the aforementioned tool to projects related to cultural heritage. Nevertheless, the Level(s) tool has some weaknesses in relation to values and attributes that need to be considered when dealing with cultural heritage. This paper proposes an evaluation framework for assessing cultural heritage renovation and reuse projects, considering all its values and the multidimensional impacts that they are able to produce (economic, social, environmental impacts) in the city. The starting point for the development of the proposed evaluation framework is the Level(s) tool by the European Commission. On the basis of critical considerations, this tool is integrated with criteria and indicators deduced from other previous studies and other official tools on this issue (Green Building Council and Heritage Impact Assessment tools). The evaluation framework is here tested to evaluate the renovation/reuse project of Villa Vannucchi, a historic building located in the city of San Giorgio a Cremano in the metropolitan city of Naples (Italy).

Keywords: circular economy; cultural heritage renovation/reuse projects; multidimensional evaluation; Level(s) tool

Citation: Nocca, F.; Angrisano, M. The Multidimensional Evaluation of Cultural Heritage Regeneration Projects: A Proposal for Integrating Level(s) Tool—The Case Study of Villa Vannucchi in San Giorgio a Cremano (Italy). *Land* **2022**, *11*, 1568. https://doi.org/10.3390/land11091568

Academic Editor: María Fe Schmitz

Received: 26 July 2022
Accepted: 6 September 2022
Published: 14 September 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

The world in which we are living today is being transformed in a way not previously seen in recent times, producing enormous negative environmental, social and economic impacts. The time to act is now. The time to change direction before it is too late and systems collapse is now; there is still time to react.

There are several areas in which actions can be taken to avoid reaching the breaking point. One of them is related to cities, and the way they are organizing, developing and transforming themselves.

In fact, cities are the location of half of the world's population (despite occupying only 3% of the world's land area), producing 50% of global waste, consuming 75% of natural

resources, and contributing 80% of greenhouse gas emissions [1]. As a result, it is clear that they play a critical role in achieving (or failing to achieve) sustainable development. It is an important location to carry out actions to accelerate the transition to sustainable development, to fix the (almost) broken relationship between man and nature, to achieve (or not achieve) sustainable development, and to address the challenges of our time.

Furthermore, 2020 was a significant year in the global challenge of sustainable development. The entire world faced (and is still facing) a pandemic, the worst health crisis of the century, which is causing a massive economic crisis. Cities were the epicenters of COVID-19's spread in this highly urbanized world. As a result, the criteria upon which urban development models are based are continually questioned. COVID-19 has prompted a radical change in the urban lifestyle, and for this reason it is necessary to rethink city organization and transformation models [2].

In response to our times' various challenges (climate change, environmental degradation and the socio-economic crisis), a number of documents have been approved to support and incentivize measures to make our country more sustainable. To that end, the United Nations (UN) approved the *2030 Agenda* in 2015, which is an action plan for people, the planet, and prosperity aimed at achieving 17 Sustainable Development Goals (SDGs).

The *New Urban Agenda*, which was introduced by the United Nations in 2016, is the "territorial translation" of the principles of the 2030 Agenda. This document, which was approved by the UN at the UN Conference on Human Settlements and Sustainable Urban Development (HABITAT III) in Quito, Ecuador, in October 2016, represents a shared vision of what the future of our cities should be. It promotes an urban development model, which is a set of actions to rethink the planning and management of cities capable of integrating and combining the three components of sustainable development (social, economic, and environmental). As the United Nations has also recognised, in fact, if the urban transformation projects are well planned and managed, cities are able to support sustainable development.

With the 2016 "Amsterdam Pact," the European Union (EU) put the UN Principles, Commitments, and Actions into practice [3]. Inclusion, air quality, urban poverty, housing, the circular economy, employment, adapting to climate change, energy transition, sustainable land use and nature-based solutions, urban mobility, digital transition, and innovative and responsible public procurement were all listed as 12 challenges that cities should face.

Furthermore, in 2019, the EU approved the "European Green Deal", a "new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. It also aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. At the same time, this transition must be just and inclusive. It must put people first and pay attention to the regions, industries and workers who will face the greatest challenges" [4]. The built heritage and the necessity for the so-called "wave of renovations" of public and private assets to address the dual problem of energy efficiency and affordability are specifically mentioned in this document (considering that buildings are responsible for 40% of the global energy consumption).

In March 2020, the European Commission approved the new "Circular Economy Action Plan" as an integral part of the European Green Deal. In collaboration with economic actors, consumers, citizens, and civil society organisations, it offers "a future-oriented agenda for attaining a cleaner and more competitive Europe". This communication recognizes the construction sector as one of the key sectors to promote the principles of the circular economy for the reduction of environmental effects through the building life cycle.

Furthermore, among the measures taken to respond to the consequences of the COVID-19 pandemic, the different European countries have adopted "National Resilience and Recovery Plans (NRRP)" which include, among others, a series of investments on the built heritage in general and on the cultural heritage (cultural buildings, villages, historic

gardens, etc.). The aim is to improve the efficiency of the built heritage, both public and private. In fact, much of the NRRP funding has been allocated for upgrading and improving the energy efficiency (in line with the European Green Deal indications) of buildings, which today are often old, energy-intensive and low-maintenance.

The built heritage also includes the cultural heritage, a heritage characterised by particular values and attributes, a unique building subset that is "an expression of the ways of life, developed by a community and handed down from generation to generation, including customs, practices, places, objects, artistic expressions and values" [5].

The UNESCO Recommendations on Historic Urban Landscape [6] also highlight the interconnection of the development/urbanization and cultural debates. Furthermore, the New Urban Agenda (NUA) recognizes cultural heritage as a significant aspect of urban sustainable development in many sections of the Agenda, in contrast to the 2030 Agenda, where it plays a minor role (i.e., points 10. 26, 38, 45, 60, 124). Culture is seen as "a priority component of urban plans and strategies in the adoption of planning instruments, including master plans, zoning guidelines, building codes, coastal management policies, and strategic development policies that safeguard a diverse range of tangible and intangible cultural heritage and landscapes" (point 124).

The "New European Bauhaus", launched by the European Commission in 2020, is a new design movement to make the "New Green Deal" operative in the field of the built environment. It is a "new sustainable and circular movement" that seeks to "green" the built environment. The use of renewable energy, bio-materials, the reuse of waste materials, and protection and conservation of biodiversity are the fundamental pillars of this movement. Also, this movement recognizes that cultural heritage and historical monuments can help achieve the goals of the new European Bauhaus's development by making historical buildings more energy efficient, which is part of the New Green Deal's "green transition" [7].

From the circular economy perspective, cultural heritage can play a significant role in the sustainable growth of the city, helping to achieve economic, environmental, and social goals at the same time.

This paper aims to propose an evaluation framework, called "Cultural Heritage Level(s)"-CHL(s)-by the authors, for evaluating cultural heritage reuse and renovation projects while taking into account the multidimensional impacts that they can produce (economic, social, and environmental impacts).

Here, the evaluation framework is tested to evaluate the renovation/reuse project of Villa Vannucchi, a historic building located in the city of San Giorgio a Cremano in the city of Naples.

The proposed evaluation framework takes into account and integrates different already existing and consolidated evaluation approaches (mostly sectoral), by critically integrating them (also with considerations deduced from case studies analyzed in previous studies), providing a comprehensive and simultaneous assessment of the impacts produced by reuse and renovation projects of cultural heritage. CHL(s) could be viewed as a sort of "technical sheet" that can also be used to compare various project scenarios.

Based on critical considerations, the proposed tool includes criteria and indicators that were taken from other previous studies and other official instruments about this issue.

The European Commission's Level(s) tool provides the starting point for developing the proposed evaluation framework. Specifically, the proposed evaluation tool integrates the Level(s) assessment method (proposed by the European Commission), the Heritage Impact Assessment (proposed by ICOMOS), the Green Building Council certifications and some already previous scientific research conducted on the basis of concrete case studies [8]. In addition, the proposed assessment framework gives particular attention to the evaluation of the environmental impacts (through the Life Cycle Assessment) generated by a heritage reuse/renovation project. Moreover, the social and cultural effects are also strongly taken into account, as emphasized in all UNESCO and ICOMOS recommendations.

The paper is structured as follows: after the introduction in Section 1, Section 2 deals with the state of the art of evaluation tools for cultural heritage renovation/reuse projects in the perspective of the circular economy. Section 3 shows the methodology adopted in this study for the development of the proposed integrated evaluation approach. Then, in Section 4, the proposed methodology is tested in the case study of the renovation/reuse of Villa Vannucchi in San Giorgio a Cremano (Naples, Italy). After the testing phase, discussions and conclusions about strengths, limitations, and future research perspectives are presented in Sections 5 and 6.

2. The Relation between Circular Economy and the Conservation of Cultural Heritage Values

The circular economy model is based on the principle that there is no waste in nature, but that everything can become a resource [9], and aims to operationalize the principles of sustainable development. Although there are more than 114 definitions of the circular economy in the literature, it can be generally defined as "the restructuring the industrial systems to support ecosystems through the adoption of methods to maximise the efficient use of resources by recycling and minimizing emissions and waste" [10]. Reference is made to how resource flows can be closed [11].

The United Nations also introduced, both in the *2030 Agenda* and the *New Urban Agenda*, the circular economy model as a general development model capable of minimising negative environmental and social impacts while producing economic growth at the same time.

Numerous cities are adopting the circular economy model as an urban development model, transforming their processes from linear to circular and organizing the urban system analogously to the nature systems. A number of these cities refer to themselves as "circular cities" [12]. The starting points of the circular processes in these cities are different and include different sectors: the textile sector, the construction sector, the agri-food sector, etc. However, the circular economy model should not only refer to technical aspects (e.g., waste management), but should be a broad concept that encompasses multiple aspects of the city, such as its organisation, economy, community, and governance [12].

Cultural heritage can play a key role in the implementation of the circular processes in the city. Some principles that define the circular economy model are also mentioned in the UNESCO Recommendations on Historic Urban Landscapes (HUL), even if not explicitly [12].

In many cities nowadays, there are a large number of abandoned historic buildings; and the reason for this is that there are scarce financial resources to invest in reuse or maintenance projects (in order to keep the heritage "alive"), although cultural heritage is recognised as a driver for sustainable development [8]. It is estimated that urban buildings can have a lifespan of up to hundreds of years. When a cultural building can no longer fulfill its original function, its use should be changed. It is necessary to preserve the "historical values" of buildings when their transformation is planned.

The functional reuse strategy is able to adapt the building to new functions in order to meet evolving community needs (in line with the circular economy principles) [13]. In accordance with the Leeuwarden Declaration, "new functions are thus brought together with heritage values in an active and meaningful dialogue" [14].

For future generations to continue to enjoy cultural heritage, its integrity and authenticity should be preserved. It can be achieved through functional reuse that also allows for the preservation of the use value of cultural heritage, giving it "a new life".

Functional reuse is an alternative to demolition and replacement or new construction, thus reducing energy consumption and waste production while also providing social benefits through the restoration and revitalization of historic landmarks [15–17].

According to the circular economy perspective, functional reuse provides multiple benefits, including the preservation of all cultural heritage values, including use values and

intrinsic values. Furthermore, the Leeuwarden Declaration [14] emphasizes the many advantages of reusing built heritage (economic, environmental, social, and cultural benefits).

When dealing with cultural heritage, it is necessary to consider all the values that characterize it. Cultural heritage of a community is an expression of its religion, culture, and other beliefs, constituting an important aspect of community life.

It is the element through which the community can recognize itself, making it essential for the transfer of cultural identity to future generations [16]. Conservation/reuse of cultural heritage is important for maintaining a community's identity, enhancing it, and allowing future generations to "learn" about their roots. It is important to preserve not only the tangible values, but also the intangible ones that cultural heritage has.

Since values can vary from person to person (and between different social groups), in order to identify the preferable design choices, it is necessary to have a value-based strategy that requires considerations and research into the values that are significant for a community, its transformations, and its quality of life. Therefore, in this perspective, experts (scientific knowledge) should conduct the decision-making processes with the community's cooperation (common knowledge) in a more inclusive way.

Community participation is crucial in the mid and long-term conservation/regeneration of cultural heritage, as the latter can only occur if it is shared and accepted by the community [18].

Cultural heritage is characterized by an intrinsic value [19,20]. The concept of intrinsic value is based on ecological economics and the understanding of the autopoietic capabilities of a system [21–24].

John Ruskin and Williams Morris had previously advanced this concept [25,26] that Riegel later adopted as a "value of memory" [27]. The Burra Charter [28] was effective in introducing the concept of the intrinsic value to the field of cultural heritage conservation.

The European Commission (2014) has lately taken up the concept of intrinsic value, recognising the dual dimension of culture referred to as both a value "in and of itself" and an instrumental value [29].

The intrinsic value expresses the individual character, significance, identity, and beauty of a place, fostering a sense of interconnectedness among its inhabitants and between the community and its cultural heritage. The intrinsic value shows how a community has lived, worked, and organized itself over time.

In contrast to natural ecosystems, cultural heritage's intrinsic value is subjective because it was created by people over time [30,31]. Therefore, it depends on the subjects who have acknowledged the value, uniqueness, beauty, and significance of that cultural heritage [8]. Not only is it personal, but it is also not static. It is mutable because the individual evaluator is mutable, due to their growing up, and also due to external influences, such as cultural and social ones [32]. The convergence of individual values produces the community values associated with a particular cultural heritage [32].

The aforementioned changeability of values associated with cultural heritage over time is related to the concept of the "shifting baseline syndrome" [33] that, "in heritage studies, not only manifests itself in change perceptions of the state of the natural and built environment, but also in change perceptions of attributed values" [34]. As people's perception about these values change over time (this is called "intergenerational change"), the value of cultural heritage is seen in different ways at different times.

Cultural heritage links the present to the past and the present to the future by expressing the values and customs of a community. However, it is possible that different societies and even different individuals within a single community can interpret it differently. In fact, many social groups can have different beliefs and points of view, attributing different values to heritage.

Conservation and functional reuse of cultural heritage prolong its intrinsic and usevalues, allowing it to "live" for both present and future generations. It preserves a symbol of the collective identity. Therefore, the value of cultural heritage cannot be ignored in a framework for evaluating conservation and regeneration projects.

Social value is another important value associated with cultural heritage. Since the 1970s, there has been a great deal of emphasis on the social values of cultural heritage.

Given that cultural heritage has positive effects on social capital, generating and regenerating synergies, ties, and collaborative partnerships (the "glue value" of cultural heritage), it is necessary to include the social dimension when discussing cultural heritage [35–38].

Cultural heritage has the potential to be a "connective infrastructure" [39,40], that is capable of maintaining social cohesion in today's highly fragmented society, especially in large urban agglomerations, by generating and regenerating bonds and relationships.

Cultural heritage is important for social cohesion because it organizes the community as a whole as well as its relationships (that can be generated and regenerated through conservation and functional reuse) through its symbolic power and aesthetic dimension.

Cultural heritage contributes to building social capital and social cohesion [35,38,41] by providing a context for involvement, engagement, and also fostering integration [35,42]. In addition, it encourages associations and new economic models (i.e., crowdfunding) that, in turn, contribute to the local economy.

Employment is a significant component of social capital. Given that it not only helps people "feel good", but also acts as a "bridge" between the individual and society, it is a very important indicator of social inclusion. Through the production of job opportunities, cultural heritage also contributes to the increase in wellbeing and quality of life [32]. This aspect becomes, from a circular perspective, an input for economic productivity given that people's wellbeing increases their productivity [43], as also recognized by several business leaders like Olivetti, Bata, and Ferrero.

Cultural heritage can enhance people's health and well-being (different but strictly interconnected concepts) [44]. For instance, the wise old features of historical structures can promote good health. Effective orientation and physical characteristics, such as the thickness of the walls, contribute to lower temperatures inside and outside the building, thereby improving the indoor microclimatic conditions. In addition, cultural heritage enhances the quality of life in a variety of ways, including the creation of new jobs, the expansion of living and working spaces through adaptive reuse, the improvement of public spaces, etc. [45].

As stated previously, there is a growing awareness of the significance of intangible values of cultural heritage and the need to take them into account alongside (with equal weight) tangible values in the decision-making processes of cultural heritage projects [2,45,46].

2.1. Implementation Tools for Cultural Heritage Renovation and Reuse Projects

Evaluation tools play a key role in assessing and monitoring the effectiveness and efficiency of cultural heritage projects from a circular perspective, that is, to assess the (positive and/or negative) effects of the circular agenda's strategies and projects.

Reviewing the relevant scientific literature, a number of authors note that the renovation or reuse of cultural heritage has a variety of positive effects, particularly on the environment. However, many researchers emphasise the environmental benefits (though they are not widespread) of embodied energy as energy-related advantages [17,47–52].

Several of these studies emphasize environmental benefits solely from a narrative standpoint; no indicators and quantitative data are identified to operationally quantify the environmental benefits of renovation/reuse of historic buildings.

Moreover, from an economic perspective, reusing heritage buildings is (often) cheaper and faster than demolishing and rebuilding them [53–55], with the exception of situations where the building needs to have its structural elements rebuilt [56].

Moreover, redeveloping a historic building is more cost-effective because it requires less time and costs less than building a new structure with the same characteristics [57]. Costs are also reduced because most of the structural components are already built and the raw materials for their possible reconstruction are already on site, reducing the duration of the work [56].

Studies have shown that preserving cultural heritage through renovation or reuse increases overall property values, which benefits both the asset being developed and the neighbouring buildings [45,58].

Functional reuse requires less materials than demolition and reconstruction, thereby decreasing embodied energy and carbon dioxide emissions. However, it should be emphasized that historic buildings have more difficulty in satisfying energy standards than new construction does [54,59,60].

However, some studies suggest that existing buildings could be upgraded to a (quite) similar energy level as new buildings, although this could significantly increase construction costs. However, this cost can be balanced if the social and cultural dimensions are considered in addition to the economic dimension. Indeed, despite the fact that reuse is sometimes more expensive than demolition and reconstruction, it is culturally [61] and environmentally [17] advantageous. For example, Baker et al. (2017) argue that renovation/reuse of cultural heritage has high significance for the local community because it "regenerates" a symbol of its identity [60].

To date, there is no officially-recognized multidimensional evaluation framework for the evaluation of cultural heritage renovation and reuse projects in a circular perspective. Sectoral approaches are the primary ones.

An officially recognized tool for the assessment of cultural heritage projects is the Heritage Impact Assessment (HIA) by ICOMOS (2011) [62]. Furthermore, in 2010, the Green Building Council (GBC) protocol was drawn up to assess and certify the sustainability of heritage renovation/reuse projects (see Section 2.1.3).

Moreover, in the past, cultural heritage assessment processes were mainly led by experts. Today, such evaluations tend to be more inclusive, recognizing the community as the most important stakeholder and increasingly involving it within decision-making processes [34]. However, the two aforementioned officially recognized evaluation tools (HIA and GBC) are based solely on expert knowledge.

The Level(s) tool is, however, the only officially recognized evaluation tool in the circular economy perspective. As explained in the following paragraphs, this tool only applies to new buildings and not to heritage renovation and reuse interventions. As previously stated, the purpose of this paper is to fill the gap left by these purely sectorial evaluation tools within this framework.

2.1.1. The Level(s) Tool by the European Commission

The Level(s) Tool [63] is the only official evaluation tool that the European Commission has adopted (in collaboration with various stakeholders, such as various producers, associations, and organizations) that is more detailed and focused on the evaluation of projects related to buildings from the perspective of the circular economy. It exclusively refers to the construction sector and provides a set of indicators for evaluating the environmental performance of commercial and residential buildings, while taking into account all aspects of their life cycles. It is not currently mandatory, but can be adopted voluntarily.

In 2017, the European Commission developed a first framework for evaluating the circular economy by grouping a number of indicators into five categories: production and consumption, waste management, secondary raw materials, competitiveness, and innovation [63]. These indicators are a good starting point, but they alone are insufficient to evaluate and monitor the complex framework of the circular economy, which consists of numerous sectors, actors, and "flows". One of the most resource-intensive sectors is the construction industry, which accounts for half of all resources consumed, half of all energy used, a third of all water used, and a third of all waste produced [63]. Therefore, it stands as a major goal for the circular economy and sustainability policies of the European Commission.

Since the testing phase began in 2018 [64], 136 construction projects (74 residential and 62 non-residential) have utilised the Level(s) tool. The Level(s) tool's goal is to standardize the framework for evaluating environmental sustainability in Europe using a set of indicators to assess the sustainability of various types of buildings throughout their life span, including

both new and renovated office and residential buildings. Each indicator was elaborated to establish a link between the impact of a building and European sustainability targets.

In sustainable buildings, less energy is used. Furthermore, they provide healthier and more comfortable living conditions. In addition to having fewer negative environmental effects, they also have lower management costs. Level(s) encourages operators to implement both the Life Cycle Assessment (LCA) and the Life Cycle Cost Assessment (LCCA), or the assessment of life cycle costs.

In contrast to a fragmented view of individual performances, the Level(s) tool, which is still undergoing testing, promotes a holistic perspective based on life cycle assessment. It allows for the evaluation of a variety of factors, such as environmental ones, performance-related health and welfare issues, life cycle costs, and the potential future dangers of performances.

The Level(s) framework is based on six macro-objectives that correspond to the three thematic areas, listed below:

- environmental performances of the life cycle;
- health and comfort;
- cost, value and risk.

Each of the aforementioned thematic areas contains some macro-objectives, for a total of six macro-objectives, as shown in Table 1.

Table 1. Thematic areas and macro-objectives of the Level(s) tool.

Thematic Areas	Macro-Objectives
Environmental performances of life cycle	Greenhouse gas emissions along a building life cycle Resource efficient and circular material life cycle Efficient use of water resources
Health and comfort	Health and comfort
Cost, value and risk	Adaptation and resilience to climate change Optimised life cycle cost

Source: [65].

The intended outcome is the achievement of these macro-objectives in order for buildings to contribute to the implementation of European environmental policies [65].

The different phases of Level(s) range from the gathering, assessing, and analyzing of data on a building's performance. Additionally, as implied by its name, this instrument consists of three progressive depth levels of performance evaluation [63,65]:

- common performance assessment; the simplest level, a common reference guide for building evaluation;
- comparative performance assessment; the level that allows for the comparison between two or more equivalent buildings from the functional point of view;
- optimized performance assessment; the more complex level, which allows for the performance of a more detailed analysis and calculation models aimed at optimizing performances.

The levels illustrate ways to reduce environmental effects and can assist operators in preparing for more complex performance evaluation tools and schemes.

Given that human health is significantly influenced by policies and actions taken in many other sectors that are beyond the healthcare field but affect health through various pathways, assessing the health effects of circular economy projects adds value to the decision-making process. Good health conditions are an essential component of the circular city because, from the perspective of human-centered development, they reduce costs associated with illness, malaise, etc.

Since the construction sector produces the greatest number of interdependencies overall, it is important to examine it from the perspective of the circular economy. Along with producing economic productivity and environmental sustainability, this also helps to promote "social" productivity, such as through creating jobs. Due to its ability to

simultaneously satisfy the needs of economic, environmental, and social sustainability, the construction industry is an ideal starting point for implementing the circular model, thereby minimising the conflict between the green economy and the social economy.

Although quite comprehensive, the Level(s) tool does not specifically mention cultural heritage. However, given that the European Union itself recognizes the significant role that cultural heritage plays as one of the drivers of sustainable development, it is essential that the EU specifically addresses the issue related to implementation tools for the functional reuse of cultural heritage by providing a comprehensive and adequate list of multidimensional indicators (economic, environmental, social, and cultural).

In a recent paper, Ferrari et al. (2022) assert that there are different evaluation methods for green building certification. Among them, the LEED (Leadership in Energy and Environmental Design) protocol is the most similar to Level(s) (81% affinity), while BREEAM (BRE environmental Assessment Method) and DGNB (German Sustainable Building Council) are more similar in terms of regulations and life cycle coverage. In contrast, WELL (Well building standards) and CASBEE (Comprehensive Assessment System for Building Environmental Efficiency) are objectively far from meeting Level(s) principles [66].

All of these certifications use Life Cycle Assessment (LCA) as an operational assessment tool to quantify the potential negative impacts related to a design project.

The Level(s) Framework also employs the Life Cycle Assessment (LCA). The entire life cycle of a building or product can be evaluated using Life Cycle Assessment. It is used to evaluate all environmental effects resulting from the extraction of raw materials to the demolition of a building. These effects include those associated with the supply of raw materials, their production, transportation, maintenance, repair, and disposal, as well as the greenhouse gas emissions produced by a building and the materials it contains [67].

Numerous studies acknowledge that using LCA alone to evaluate design alternatives for building renovating is insufficient. It is necessary, for example, to combine LCA with a participatory approach that involves residents/users in the project's definition phase in order to comprehend the actual needs of those who live in the building.

In this regard, a number of studies emphasise the importance of involving diverse stakeholders in the renovation and reuse project of historic buildings.

For example, Claude et al. (2017) argue that it is necessary to activate a "living lab methodology" among all the stakeholders involved in the building renovation/reuse projects. Claude et al. tested the "living lab methodology" (reaching positive results) for the thermal renovation of some historic buildings in the Cahors historic centre, France [68]. From the design phase to the implementation phase, numerous participants have been involved (i.e., craftsmen, students, end-users, local authorities, material producers). This allowed for an acceptable and efficient building renovation solution.

According to Wender et al. (2014), LCA undervalues the important role of stakeholder involvement in guiding the decision models, thereby reducing the social reliability and significance of results [69]. The realization of an "anticipatory" LCA can be used to investigate the potential future environmental costs associated with a developing technology. These anticipatory techniques can generate alternative research scenarios and provide an operational tool to support environmentally responsible projects by identifying the most pertinent uncertainty and involving research and development decision-makers [69].

To evaluate the public perception based on the livability, comfort, use, and esthetic of buildings, stakeholder engagement for defining the built environment is necessary [70].

In the research conducted by Göswein et al., it is recognized that the stakeholders involved in a regeneration project express different priorities that should be considered. Therefore, it is important to assess the potential behavior of users [71].

Additionally, they argue that the literature review on the topic shows that "involvement" emerges at multiple phases, particularly during project specification, concept development, and prototyping.

According to a study by Kaulio et al. (2016), there is the necessity to involve users in the design process in order to better meet their needs [72]. However, this is uncommon in

practice. Kaulio et al. (2016) investigate the role of users in the design process and propose the use of virtual design and construction to permit the analysis of virtual users and to encourage the direct participation of real users [73].

In this light, Göswein et al. (2020) assert that it could be interesting to determinate decision criteria and relative weights in a Multi-Criteria Decision Analysis starting from user requests (MCDA) [71]. Göswein et al. (2020) conducted an extensive research on the integration of Life Cycle Assessment (LCA) with multi-criteria evaluation methods by performing a thorough literature review [71]. In this study, it is highlighted that Seager and Linkov (2008) emphasised the value of coupling LCA with MCDA in order to better understand trade-offs and future multiple perspectives to build redevelopment interventions [74].

Furthermore, other factors, such as the cost of interventions, the achievable thermal comfort, and the level of structural performance [74] can be considered in an MCDA. It is important to note that different stakeholders involved in these processes will attribute different importance to the indicators identified to carry out the MCDA [72]. In this regard, there is the possibility of using specific weight sets or value functions for each stakeholder group [75].

2.1.2. Testing Projects of the Level(s) Tool

The implementation of the Level(s) tool is still in its early stages. In fact, to date, there are few documents about case studies in which it has been used. These are mainly reports from countries that have collaborated with the European Commission to test the evaluation method and determine its strengths and weaknesses.

The Level(s) tool was launched in 2017 by the European Commission, which in 2018 invited member states to participate in the test phase to suggest integration to improve the assessment tool. The two years of testing and public consultation ended in 2020.

More than twenty nations, including Luxembourg, Denmark, the Netherlands, Belgium, the United Kingdom, France, Spain, Portugal, Germany, Italy, Austria, Malta, Slovenia, Croatia, Greece, Romania, Poland, Lithuania, Sweden, Finland, the Czech Republic, etc., participated in the test phase. This method was utilized by experts from each country to certify the sustainable design of approximately 130 buildings.

In Finland and Slovenia, the Ministry of the Environment and the Green Building Council invited planners to evaluate the sustainability of eighteen building projects using the Level(s) assessment method. Participants included public sector representatives, construction companies, builders, consultants, and manufacturers of building materials. The majority of the projects involved new residential buildings, schools, offices, sanitary facilities, and dormitories. Each project was completed using innovative materials and technologies for illumination, energy efficiency, drainage in health systems, etc. The carbon footprint calculation supported the designers in deciding, in the ex-ante evaluation phase, among alternative project scenarios. Furthermore, the "Building Information Model" (BIM) models have facilitated the study through an almost immediate data collection project.

For each case study, an analysis of the impacts for a 60-year forecast period was conducted, resulting in a Life Cycle Assessment. The LCA (elaborated using One Click LCA software) was used as the assessment tool to collect the data necessary to meet the Level(s)' proposed indicators. Only two of these projects involved "building refurbishment".

Erlandsson et al. (2019) conducted the Level(s) test on the Skanska Backkra residential building in Sweden (Sweden). At the conclusion of the analysis, they proposed a number of methodological integrations to the Level(s) method, such as:

- to define common regulations regarding the scenario setting for design;
- to define common standards for data collection;
- to define a common digital report for sharing results;
- to improve the use of "Building Information Modelling" (BIM) in the redaction of the project. Integration of BIM and Level(s) can be useful for defining a better design process [76].

In Spain, the Level(s) test was used to evaluate the sustainability of residential and commercial construction projects. A BIM model of each building was created. At the end of the project definition, the Level(s) evaluation method was applied to evaluate the project's environmental impacts. According to the results, additional actions are required to improve the sustainability of the buildings. Furthermore, the integration of BIM and LCA software was highly effective.

In France, the Alliance HQE-GBC coordinated the testing of the Level(s) methodology in nine projects of renovation/reuse and new construction of offices and residences. Also in this instance, the BIM methodology was used to support the Level(s) tool, thereby enhancing the efficiency of the evaluation process.

In Italy, the "Green Building Council" is implementing a number of initiatives (seminars, meetings, workshops, etc.) to inform the professionals on the use of Level(s) tool, with the goal of integrating its indicators into the existing certification systems in order to collect a comparable set of data among projects across Europe.

When the testing process concluded in 2020, the European Member States convened in separate meetings to determine the tool's strengths and weaknesses based on the analysis of case studies, and they then released an updated version of the tool.

The main consideration from the "test phase" concerns the revision of the content of the different "levels" referred to in the project and building life cycle.

In particular, the first three levels were revised and modified as follows:

- Level 1 applies to the preliminary design and evaluates it qualitatively;
- Level 2 applies to the executive design and construction phases for quantitative performance evaluation;
- Level 3 applies to the completion of construction and during the building's use phase to measure and monitor performance [77].

The new Level(s) edition expands on the concept of the circular approach to building design throughout its life cycle by focusing on how to close the performance gap between design and actual performance in use.

The need to strengthen the relationship between BIM, LCA, and Level(s), which is becoming increasingly consolidated in the design and planning process, is an additional important consideration that emerged during the workshops.

Some European nations emphasised the need to provide a Level(s)'guide translated into each language in order to simplify and clarify environmental assessment operations. In addition, the need to develop a European Common platform for sharing Level(s) application results has emerged.

Only Denmark has emphasised the need to combine environmental and social indicators within the Level(s) framework.

2.1.3. Green Building Council and Heritage Impact Assessment tools

Heritage Impact Assessment (HIA) and Green Building Certification (GBC) are two further important evaluation tools that can contribute to the assessment of renovation/reuse projects of historic buildings.

The Heritage Impact Assessment (HIA) is an evaluation framework proposed by ICOMOS in order to operationalize the Historic Urban Landscape Recommendations by UNESCO in 2011 [78]. This is the only official methodological guideline for assessing the effects of cultural heritage and landscape valorization and regeneration projects [78].

Specifically, the "Guide to Cultural Impact Assessment" (HIA) refers to sites on the World Heritage List (ICOMOS, 2011) that are recognized as having "Outstanding Universal Value" (OUV) [62].

This method is considered as a tool to go beyond the limits of the Environmental Impacts Assessment (EIA). In fact, when EIA is applied to cultural heritage, it disaggregates all its possible attributes and assesses the impacts separately, adopting specific perspectives [79]. In this view, the HIA is able to assess the impacts of a large urban development project and the potential vulnerability of an asset/site undergoing a change in urban poli-

cies (e.g., changes in land use and urban planning policies, management of infrastructure and tourism flows, etc.) [79].

However, it is evident that the ICOMOS recommendations place a greater emphasis on the procedure's effectiveness than on the expected outcomes from the standpoint of protecting heritage attributes [56]. Consequently, a more global and objective approach to the Historic Urban Landscape is still required for taking into account the relationship between attributes and values in the context of development.

Furthermore, since 2011, the ICOMOS guide has been applied to different operational case studies for assessing the impact of urban regeneration projects and projects for the reuse of historic buildings. Best practices include the regeneration of the Liverpool waterfront, the realization of Stockholm Bypass Road, the Wald-schlösschen Bridge project in Germany, the Cologne Cathedral in Germany, the New Railway Tunnels in Germany, the project of Gallery Lower Austria, and many others [80].

Also on the SoPHIA platform, there are several case studies that show how HIA was used. This platform was developed as part of the SoPHIA Horizon project (Social Platform for Holistic Impact Heritage Assessment). The goals of the project are to encourage group reflection on the impact evaluation and effectiveness of interventions in the European historical environment and cultural heritage at the urban level [81].

The research work of SoPHIA is structured around four key analytic impact dimensions: social, cultural, economic, and environmental impacts. These dimensions provide a framework for identifying the most significant obstacles and opportunities associated with interventions in cultural assets in Europe [82]. As part of the SoPHIA study, twelve case studies have been presented, including a landscape site, two museums, three cultural districts, a place of memory, an island, a historic city centre, and a monastery [81].

Rogers's [82] study demonstrates that HIA should become a mandatory methodology when defining redevelopment projects for cultural buildings or entire neighbourhoods in order to make decision-makers aware of the potential effects of human actions on cultural heritage.

According to some researchers, conducting a comprehensive HIA requires a multidisciplinary professional team to provide comprehensive information and an in-depth assessment using a variety of approaches and methods across multiple dimensions. Such a comprehensive and interdisciplinary approach can enhance decision-making and, consequently, the preservation of cultural resources in policies for sustainable development [83]. Again, a study by Ashrafi et al. [83], in collaboration with WHITRAP and ICCROM [84], analysed additional case studies in which HIA was applied. They argued that multisectoral collaboration is necessary to improve urban development strategies based on their analysis of these case studies. In addition, the dialogue among experts in different disciplines is essential because it would increase the effectiveness of HIA by enhancing the perception, knowledge, and skills of stakeholders, with the aim of preserving world heritage properties exposed to the threats of future development.

ICCROM, IUCN, ICOMOS, and the World Heritage Centre of UNESCO are collaborating to develop and disseminate the new version of Heritage Impact Assessment. This new document aims to address the current gaps and challenges that World Heritage sites face with regard to impact assessment processes [84].

This document will result in the development of an impact assessment toolkit for World Heritage properties, based on a framework applicable to both natural and cultural environments [84].

Green Building Council (GBC) Italia launched a protocol to certify the sustainability of renovation/reuse projects for cultural heritage after analysing the scientific literature on evaluation methods for testing the sustainability of such projects. GBC is a non-profit organization whose members include the most competitive companies, associations, and professional communities operating in the sustainable building sector. GBC Italia is a member of the World GBC, a network of national GBCs present in more than 70 countries and the world's largest sustainable construction market-focused international organization [85].

The Green Building Council (GBC) is very active in the green certification of historic building reuse projects, developing a manual to guide the designers to obtain the certification. "GBC Historic building" is a voluntary certification protocol that assesses the level of sustainability of conservation, rehabilitation, restoration and integration of historic buildings with different uses [85].

Moreover, this certification is applied to historic buildings that constitute "material evidence with a value of civilization" that were built before 1945 [85].

The GBC Historic Building assesses the performance of buildings from an overall perspective throughout their entire life cycle, both during the design phase of interventions and their subsequent operation. The sustainability of a building is assessed using a variety of indicators clustered by thematic areas (environmental categories) that define GBC rating systems, as shown in Table 2. To each thematic area corresponds a set of sub-criteria, and each is assigned a numerical value as a score. According to the guide, the distribution of credits among the different thematic areas is determined in relation to their effects on environmental and human health [85].

Table 2. Thematic areas (environmental categories) of GBC.

Thematic Area	Assignable Points
Historical value (VS)	20
Site Sustainability (SS);	13
Water Management (GA);	8
Energy and Atmosphere (EA);	29
Materials and Resources (MR);	14
Indoor Environmental Quality (IQ);	16
Innovation in Design (IP);	6
Regional priority (RP)	4

Source: [86].

GBC Italy has already issued a number of certifications that can be considered as best practices for future certifications of historic buildings, such as the Meis in Ferrara, the Guinelli building in Ferrara, the Santander building in Turin, and the Scuderie of Sant'Apollinare in Perugia [85].

3. Methodology

As stated previously, the aim of this research work is to propose an evaluation framework for assessing cultural heritage renovation and reuse projects from the perspective of the circular economy (Figure 1). The starting point for the development of the proposed evaluation framework is, as mentioned before, the Level(s) tool as used by the European Commission. This tool can also be used, with appropriate integrations, for evaluating the renovation/reuse projects of cultural heritage, which represents a particular type of built heritage, characterized by different values.

According to a previous study by Nocca et al. [8], the Level(s) tool has been integrated with other thematic areas and indicators in order to include in the framework the various aspects and values associated with cultural heritage projects.

In particular, Nocca et al. [8] identified three new thematic areas to be added to those identified by the European Commission (environmental performances of life cycle; health and comfort; cost, value and risk):

- social value;
- intrinsic value;
- state of conservation (and related use value).

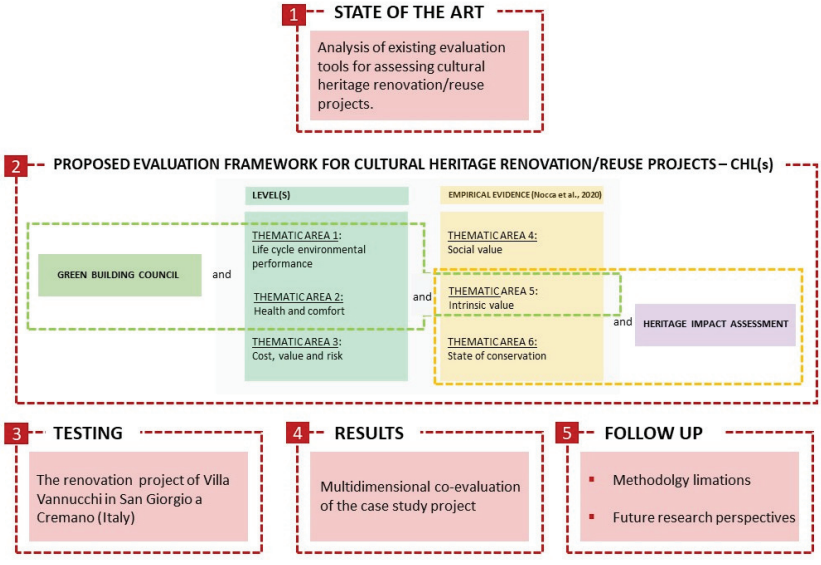


Figure 1. The methodological workflow.

The above three thematic areas are essential to have (together with the other three thematic areas identified by European Commission) a complete and omni-comprehensive evaluation framework of cultural heritage projects, with the awareness that cultural heritage is characterized by both tangible and intangible values (as highlighted in the previous sections). Therefore, indicators related to intrinsic value (expressed for example in terms of attachment to place) and social value (expressed for example in terms of generated social relationships) have been considered in the proposed evaluation framework. This represents one of the aspects that differentiates the proposed evaluation framework from the Level(s) tool, which, being related to new construction buildings, neglects these kinds of values. As was previously mentioned, the incorporation of such values into the evaluation process requires the integration of expert and common knowledge.

Therefore, the six thematic areas are able to cover all dimensions: the environmental, social, cultural and economic. The environmental and the economic ones were already included in the European Commission's Level(s) tool, and the others were identified by Nocca et al. [8].

The CHL(s) proposed in this paper identifies additional indicators to further integrate those proposed by Nocca et al. [8]:

- Indicators deduced from the Green Building Council (GBC) manual;
- Indicators deduced from the Heritage Impact Assessment.

Some GBC indicators were not included in the proposed framework only because their corresponding measures were already included in the indicators identified by Nocca et al. [8]. Therefore, they would constitute a duplication. Regarding the indicators deduced by the GBC, the proposed evaluation framework also incorporated the scores assigned by the guide. The HIA indicators selected for this study are capable of evaluating the various impacts of a renovation/reuse project, in reference, for example, to impact magnitude, scale and severity of change/impact, value of the heritage asset and the significance of impact. The indicators deduced from HIA are mainly included in the cultural thematic area.

Additionally, the indicators of the proposed evaluation framework (CHL(s)) refer to three different levels of territorial scale: the macro scale (Ma), meso scale (Me), and micro scale (Mi). The first one refers to regional, national and international levels. The meso scale

is related to neighbourhood level and city level. The micro scale refers to building level and citizens' level.

In conclusion, the set of thematic areas and indicators, deduced from the Level(s) tool, the study by Nocca et al., the GBC, and HIA, is shown in Table 3. The unite of measures, both quantitative and qualitative, are those indicated by the tools taken as reference (Level(s), GBC, HIA and Nocca et al.)

Table 3. Indicators of the proposed evaluation framework CHL(S).

THEMATIC AREA 1–Life Cycle Environmental Assessment			
Macro-objective 1: Greenhouse gas emissions along a Buildings Life Cycle			
Indicator	**Unit of measure**	**Territorial scale**	**Source**
Use stage energy performance	kWh/m^2/yr	Micro	[63]
Life cycle Global Warming Potential	Kg CO_2e/m^2/yr	Micro	[63]
Macro-objective 2: Resource efficient and Circular Material Life Cycles			
Construction and demolition waste and materials	kg waste and materials per m^2 of total useful floor area	Micro	[63]
Reuse of materials in projects related to cultural heritage	%	Micro	[87]
Re-use of buildings: retaining existing technical elements and finishes	Qualitative (scale 1–3)	Micro	[86]
Macro-objective 3: Efficient use of water resources			
Use stage water consumption	m^3/occupant/yr	Micro	[63]
Reducing external water use	Qualitative (scale 1–3)	Micro	[86]
Water consumption metering	Qualitative (scale 1–2)	Micro	[86]
THEMATIC AREA 2–Health and comfort and wellbeing			
Macro-objective 1: Healthy and comfortable spaces			
Indoor air quality a. Ventilation rate (air flow) b. CO_2 c. Particulates d. Relative humidity	a. Liters per second per square meter (l/s per m^2) b. Parts per million (ppm) c. µg/m^3 d. % ratio of partial to equilibrium vapour pressure	Micro	[63]
Time out of thermal comfort range	% of the time out of range of defined maximum and minimum temperatures during the heating and cooling seasons	Micro	[63]
Lighting and visual comfort	Useful Daylight Illuminance (UDI)	Micro	[63]
Acoustics and protection against noise	Yes or not	Micro	[63]
Perception of wellbeing	% Percentage of people feeling in a wellbeing condition inside the building	Micro	[45]
Ambient air monitoring	Qualitative (scale 1–2)	Micro	[86]
Control and management of installations: thermal comfort	Qualitative (0–1)	Micro	[86]
Thermal comfort: design	Qualitative (0–1)	Micro	[86]

Table 3. *Cont.*

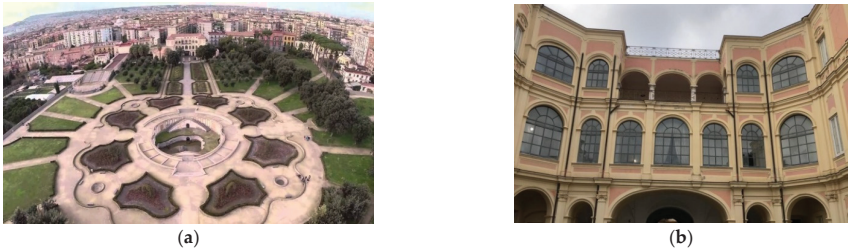
THEMATIC AREA 1–Life Cycle Environmental Assessment			
Macro-objective 1: Greenhouse gas emissions along a Buildings Life Cycle			
Indicator	**Unit of measure**	**Territorial scale**	**Source**
Renewable energy	Qualitative (scale 1–6)	Micro	[86]
THEMATIC AREA 3–Cost, value and risk			
Macro-objective 1: Adaptation and resilience to climate change			
Life cycle tools: Scenarios for projected future climatic conditions	Protection of occupier health and thermal comfort. Simulation of the building's projected time out of thermal comfort range for the years 2030 and 2050.	Micro	[63]
Macro-objective 2: Optimised life cycle cost and value			
Life cycle costs	€/m^2/yr	Micro	[63]
Real estate value of surrounding buildings	€/sqm	Meso	[45,87]
THEMATIC AREA 4–Social Value			
Macro-objective 1: Generation and regeneration of the social capital			
Number of new jobs related to functional reuse projects (employment sub-category)	N./project	Micro	[45,87]
Number of associations, number of volunteers, number of cooperative enterprises related to functional reuse projects (social cohesion sub-category)	N./project	Micro	[45,87]
THEMATIC AREA 5–Intrinsic Value			
Macro-objective 1: Generation and regeneration of the intrinsic value			
Place attachment and local identity (following the implementation of projects related to cultural heritage)	Qualitative (scale 1–5)	Meso	[45,87]
Sense of place in sites	Qualitative (scale 1–5)	Meso	[45,87]
Value of heritage asset (built heritage or Historic Urban Landscape)	Very High, High, Medium, Low, Negligible, Unknown potential	Micro	[62]
THEMATIC AREA 6–State of conservation			
Macro-objective 1: Enhancing the state of conservation and prolonging use value of the building			
Overall state of preservation of the building	Qualitative (very low, low, moderate, high, very high)	Micro	[62]
Scale & severity of change/impact	No Change, Negligible change, Minor change, Moderate change, Major change	Micro	[62]
Significance of effect or overall impact (either adverse or beneficial)	Neutral; Slight; Moderate/ Large; Large/very Large; Very Large/ Slight	Micro	[62]
Conservation of the geometric features	Qualitative (Yes or Not)	Micro	[88,89]
Recognizability and acceptability of the transformations	Qualitative (high-medium-low)	Micro	[88,89]
Diagnostic investigations of materials and forms of degradation	Qualitative (scale 1–2)	Micro	[86]
Advanced investigations: diagnostic investigations of structures and structural monitoring	Qualitative (scale 1–2)	Micro	[86]

Table 3. *Cont.*

THEMATIC AREA 6–State of conservation			
Macro-objective 1: Enhancing the state of conservation and prolonging use value of the building			
Indicator	**Unit of measure**	**Territorial scale**	**Source**
Reversibility of conservation action	Qualitative (scale 1–2)	Micro	[86]
Compatibility of destination use and settlement benefits	Qualitative (scale 1–2)	Micro	[86]
Programmed Maintenance Plan	Qualitative (scale 1–2)	Macro	[86]
Recovery and rehabilitation of degraded sites	Qualitative (scale 1–2)	Macro	[86]
Site development: rehabilitation of open spaces	Qualitative (scale 1–2)	Macro	[86]

4. Case Study: Villa Vannucchi in San Giorgio a Cremano (Italy)

The CHL(s) proposed tool has been tested in the renovation/reuse project of Villa Vannucchi, one of the many villas of the "Golden Mile", in San Giorgio a Cremano (Naples, Italy) (Figure 2). The building is approximately 1200 square metres in size and is surrounded by a very large green park. The garden is a typical "Italian garden" with long avenues leading to a monumental fountain in the centre.



(**a**) (**b**)

Figure 2. (**a**,**b**)–Villa Vannucchi, San Giorgio a Cremano. (**a**) The park of Villa Vannucchi, www.wikipedia.org (accessed on 5 May 2022); (**b**) The internal façade of Villa Vannucchi. Source: Photo by the authors.

The 1980 earthquake caused severe damage to the property. Subsequently, in 2006, it was transferred from private ownership to the municipal property of San Giorgio a Cremano and subjected to an extensive refurbishment project. Three years later, the reorganization of the park was completed.

Villa Vannucchi is located in the "UNESCO buffer zone" and is part of the "Somma, Vesuvius, and the Golden Mile" UNESCO Man and the Biosphere (MAB) Reserve in the Gulf of Naples. The above mentioned buffer zone encompasses the territory included in the Vesuvius National Park as well as the surrounding coastal strip, comprising the city of Pompeii and the 16th- and 17th-century Vesuvian villas located along the so-called "Golden Mile," which represents an architectural heritage of exceptional value.

Today, the Villa Vannucchi serves as the headquarters for Pegaso Telematic University, while the park serves as an urban park. Additionally, the villa's rooms from the 17th century are used for periodic events organised by the municipality and various organizations.

4.1. Renovation Project of Villa Vannucchi

Two researchers (Dr. M. Angrisano and Dr. P. Iodice), under the direction of Professors Francesco Fabbrocino and Luigi Fusco Girard (Pegaso University), elaborated a plan for the energy renovation/reuse of Villa Vannucchi in 2021. This project's objective was to reduce

the negative effects of heating and cooling interior spaces, which are responsible for a high energy consumption. Through specific project actions, the building's energy operation was optimized.

Similar to all historical buildings, the livability of the villa's interior spaces is compromised by space heating and cooling problems, which require a substantial amount of electricity consumption [89].

For this reason, the energy project for the renovation/reuse of the villa began with some technical inspections of the external and internal walls. During these investigations, it was determined that the southeast wall of the building is the one most susceptible to moisture and infiltration issues due to its completely exposed facade. Over time, infiltration has caused problems with mould, plaster swelling, and wooden frame damage.

For this reason, a thermoscanner was utilised to conduct a more thorough investigation of these walls. The objective was to establish the degree of thermal insulation of the walls, identify thermal bridges, analyse the plaster in the process of detachment, and examine the receptivity of the materials.

During measurements, the following emissivity coefficients were utilised: wood only (0.85), window (1.00), and wall (0.95) [90]. The investigation revealed that the majority of thermal bridges are between windows and their adjacent walls. The presence of windows and doors with a single pane of glass has a significant impact on the thermal insulation of the rooms.

The investigation and knowledge of the existing building are especially important in the case of historic buildings, as it enables the project to be oriented towards design choices that guarantee the protection of the intrinsic value of the building elements, avoiding unnecessary oversizing of systems or overlap of any insulating layers [88].

After the investigation phase, three different design alternatives were developed. First, a BIM model of the villa was elaborated. This model allows for the assessment of the environmental impact more quickly. Therefore, using One Click LCA software (by Bionova), a Life Cycle Assessment was conducted on the above three design alternatives. This software is the same used for the testing of the case studies by the member countries of the European Commission.

The three project scenarios are as follows:

- Scenario A includes the replacement of the roof membranes with FPO/PVC-P waterproofing reinforced with polyester, the installation of a second window frame for all of the interior windows, and the use of breathable exterior plastering on the building's facades;
- Scenario B adds to scenario A photovoltaic panels and a thermal coat on the internal facade of the building with expanded polystyrene insulation panels.
- Scenario C is a combination of Scenarios A and B, with the exception that the thermal coat in Scenario C is made of hemp panels [89].

As mentioned previously, for the aforementioned design scenarios, a life cycle assessment was processed by One Click LCA software to identify, among the three scenarios, the one that most minimizes environmental impacts in terms of CO_2 emissions.

The results of LCA demonstrated that conventional energy interventions for historic buildings (using polyurethane panels for wall insulation, as in the scenarios A and B) have significant negative environmental effects in terms of CO_2 emissions [90]. This does not happen when they are employed because hemp-based insulation panels include a significant amount of "biogenic carbon" (common in bio-based materials), which has the ability to lower atmospheric carbon dioxide levels [89]. This indicates that carbon is incorporated into bio-based products even during development [91].

Consequently, Scenario C emerges as the preferable one. It consumes less operational energy compared to options A and B. By utilising hemp-based products, the materials extraction indicator was significantly reduced.

This application demonstrates that, compared to conventional materials, the use of hemp material for thermal insulation of walls significantly reduces the percentage of

environmental impact over the entire material life cycle [89]. This was attributed to the fact that, as a plant grows, it removes a considerable amount of CO_2 from the environment.

Therefore, in this paper, the result of the LCA identifying the preferable design alternative for the energy renovation/reuse of the villa (the project utilising hemp insulation panels) was incorporated into the proposed CHL(s) tool. Where data could not be determined, "n.d." (not defined) was indicated in Table 4.

Table 4. CHL(s) applied to Villa Vannucchi renovation/reuse project.

THEMATIC AREA 1–Life Cycle Environmental Assessment		
Macro-objective 1: Greenhouse gas emissions along a Buildings Life Cycle		
Indicator	**Unit of measure**	**Territorial scale**
Use stage energy performance	260.000 KWh/a 216.66 KWh/ m^2/yr	Micro
Life cycle Global Warming Potential	87.52 CO_2e/m^2/yr	Micro
Macro-objective 2: Resource efficient and Circular Material Life Cycles		
Construction and demolition waste and materials	2536 kg/m^2	Micro
Reuse of materials in projects related to cultural heritage	80 % (materials reused for park intervention)	Micro
Re-use of buildings: retaining existing technical elements and finishes	3	Micro
Macro-objective 3: Efficient use of water resources		
Use stage water consumption	200.000 m^3/occupant/yr	Micro
Reducing external water use	2	Micro
Water consumption metering	1	Micro
THEMATIC AREA 2–Health and comfort and wellbeing		
Macro-objective 1: Healthy and comfortable spaces		
Indoor air quality-Ventilation rate (air flow)	5200 l/s (four air changes)	Micro
Time out of thermal comfort range	30 %	Micro
Lighting and visual comfort	480.000 lumens	Micro
Acoustics and protection against noise	Yes	Micro
Perception of wellbeing (prevision)	80%	Micro
Ambient air monitoring	2	Micro
Control and management of installations: thermal comfort	1	Micro
Thermal comfort: design	1	Micro
Renewable energy	4	Micro
THEMATIC AREA 3–Cost, value and risk		
Macro-objective 1: Adaptation and resilience to climate change		
Life cycle tools: Scenarios for projected future climatic conditions	n.d.	Micro
Macro-objective 2: Optimised life cycle cost and value		
Life cycle costs	80,000 €/yr	Micro
Real estate value of surrounding buildings (prevision after intervention)	2500 €/sqm	Meso
THEMATIC AREA 4–Social Value		
Macro-objective 1: Generation and regeneration of the social capital		
Number of new jobs related to functional reuse projects. Employment sub-category. (Prevision)	20	Micro

Table 4. *Cont.*

THEMATIC AREA 4–Social Value		
Macro-objective 1: Generation and regeneration of the social capital		
Indicator	**Unit of measure**	**Territorial scale**
Number of associations, number of volunteers, number of cooperative enterprises related to functional reuse projects. Social cohesion sub-category. (Prevision)	3	Micro
THEMATIC AREA 5–Intrinsic Value		
Macro-objective 1: Generation and regeneration of the intrinsic value		
Place attachment and local identity (following the implementation of projects related to cultural heritage). (Prevision)	5	Meso
Sense of place in sites (prevision)	5	Meso
Value of heritage asset (built heritage or Historic Urban Landscape)	High	Micro
THEMATIC AREA 6–State of conservation		
Macro-objective 1: Enhancing the state of conservation and prolonging use value of the building		
Overall state of preservation of the building	Moderate	Micro
Scale and severity of change/impact	Negligible change	Micro
Significance of effect or overall impact (either adverse or beneficial)	Slight	Micro
Conservation of the geometric features	Yes	Micro
Recognizability and acceptability of the transformations	High	Micro
Diagnostic investigations of materials and forms of degradation	2	Micro
Advanced investigations: diagnostic investigations of structures and structural monitoring	2	Micro
Reversibility of conservation action	2	Micro
Compatibility of (current) destination use and settlement benefits	2	Micro
Programmed Maintenance Plan	1	Macro
Recovery and rehabilitation of degraded sites	2	Macro
Site development: rehabilitation of open spaces	2	Macro

Specifically, the indicators used for the CHL(s) evaluation framework are:

- Use stage energy performance: 216,66 kWh/m2/yr;
- Life cycle global warming potential: 87.52 Kg CO2e/m2/yr
- Use stage water consumption: m3/occupant/yr 200.000 [91].

Furthermore, a "participatory process" involving different stakeholders was also activated to define the three design solutions in order to collect the different needs and perceptions of those who use (enjoys and benefits from) the villa. The support of common knowledge is important for both the defining of design choices (that so they are most shared by the community that experiences the project sites) and the assessment of the subjective-perceptual indicators that characterise the evaluative framework of cultural

heritage, which is characterised by both tangible and intangible values. Thus by both quantitative and qualitative subjective indicators.

Therefore, a questionnaire was created and sent (by e-mail via the "Google form platform") to professors, students, office workers, and associations. In three months, roughly 150 individuals responded to the survey. The questionnaire's purpose was to determine the perceptions and perspectives of the building's occupants (both of the state of the art and of the project). In order to understand the perception indicators, various images (renders) and videos relating to the state of the art and the scenarios were shown to the interviewees, who were asked to rate them on a scale from 1 to 5.

After analyzing the survey results, it was determined that humidity is a major issue in almost all of the rooms. This unfavourable microclimate causes rooms to feel colder, particularly during winter. As a result of the inefficiency of the single-glazed wooden window frames, there are instances of flooding in certain rooms (those facing east) during rainy weather. The continuous use of air conditioners to heat the villa was deemed unsustainable. This method is comparable to the "anticipatory LCA" outlined in Section 2.1.2.

4.2. The Evaluation of the Villa Vannucchi Project through CHL(s)

The CHL(S) proposed evaluation framework was applied to Villa Vannucchi, including the data and information highlighted in the previous paragraph. The indicators sheet (Table 4) has been filled. The indicators include both quantitative and qualitative data.

Data were derived from various sources, including the LCA application results, the energy project, and the submitted questionnaire.

As stated previously, the units of measure used to populate the indicators (both quantitative and qualitative) are those of the studies used as a basis for the proposed evaluation framework's development.

In order to evaluate the impact of cultural heritage functional renovation/reuse, data resulting from Life Cycle Assessment (LCA) were used to compile the specific indicators listed in Table 4. This is an ex-ante evaluation of the Villa Vannucchi retrofit project, specifically of Scenario C, that is the preferable alternative deduced from the previous evaluation (through LCA).

5. Discussion

This study aims to contribute to the scientific landscape by providing a comprehensive evaluation framework capable of assessing the impact of reuse/renovation projects of cultural heritage, integrating specific consolidated evaluation tools examined in the literature review of this paper (see Section 2).

The results derived from the application of CHL(s) to the Villa Vannucchi case study provide a comprehensive understanding of the environmental, economic, and social-cultural impacts produced by the renovation project. It is a useful evaluation tool capable of supporting planners in decision-making processes by analysing the multidimensional effects produced, i.e., "measuring" its "sustainability performance".

The Villa Vannucchi renovation project was evaluated using specific indicators, which were then incorporated into the CHL(s) evaluation framework (see Table 4). These indicators are derived from LCA conducted on Villa Vannucchi and from the questionnaire (see Section 4.1).

LCA was used to evaluate three project scenarios for renovation/reuse of the villa in order to determine the "project with the lowest environmental impact".

LCA measured carbon emissions, impacts related to material use, water consumption, indoor air quality, use stage performance, and global warming potential over the product's life cycle.

LCA have revealed good results in terms of CO_2 emissions released in the atmosphere by the planned project activities. This is because in the "satisfying project" [92] uses hemp-materials for the wall insulation. Biogenic CO_2 is prevalent in hemp materials and

more generally in biomaterials. These are substances that have produced or grown while removing carbon dioxide from the atmosphere [89].

In this framework, the life cycle approach can significantly support designers and decision-makers in considering various environmental effects (as GHG emissions) based not only on the operational energy performance of the building after construction, also known as the energy performance level of the building, but also on the emissions produced over the entire life cycle of the construction work and building (re)use.

The CHL(s) were used to evaluate the impacts of scenario C (satisfying project). Nonetheless, it might be worthwhile to reassess it after the interventions have been implemented to determine whether the predictions were accurate.

All the LCA results were used to populate the indicators related to thematic areas 1 (Life Cycle Environmental Assessment) and 2 (health and comfort and wellbeing) of the CHL(s) evaluation framework.

Indicators related to the reuse of waste materials (thematic area 1, macro-objective 2) from construction operations will be used for some planned park interventions in the context of the circular economy (thematic area 1, macro-objective 2).

The indicators of macro-objective 3 (the efficient use of water resources) of thematic area 1 can be considered satisfactory in terms of results, thanks to the introduction in the project of a rainwater recovery system planned for the irrigation of the park.

Analyzing the results of the indicators related to thematic area 2 (health, comfort and wellbeing), it can be observed that they are very encouraging, particularly due to the renovation/reuse project's maintenance programme for the villa. In this project scenario, sensors will be installed in the future to monitor air quality and determine future humidity levels.

In the third thematic area (cost, value and risk), management costs were also estimated in order to have a forecast of the expenditures to be incurred for the realization of the project.

Moreover, an important indicator of this third thematic area refers to the increase in the real estate value of surrounding buildings. In fact, a forecast of the increase in real estate values of the asset near the villa has been identified.

The energy retrofit projects of the historic buildings should combine the need to adapt the building to the changing needs of the community with the need to preserve the cultural heritage's intrinsic value [19]. For this reason, the CHL(s) evaluation framework also considers the effects related to the social and cultural dimensions in thematic area 4 (social value) and thematic area 5 (intrinsic value).

Indicators related to "sense of place" and "place attachment and local identity" that were assessed via questionnaires revealed a high level of performance from this perspective. The villa has always been a symbol of the city's history, as significant and nationally recognised events have constantly been held in the park.

Important support was provided by the indicators derived from the HIA because they allow for the evaluation of the "value of heritage asset" (considered "high"), the "overall state of preservation of the building" (considered "moderate"), the "severity of change" (considered "negligible"), and the "significance of effect or overall impact" (considered "minor"). In the sixth thematic area (state of conservation), the preservation status of the villa was evaluated.

Through this study conducted for Villa Vannucchi, a comprehensive data sheet containing indicators pertaining to all the multidimensional effects produced by the reuse/renovation interventions was developed, effectively testing the proposed evaluation framework.

The analysis of the indicators demonstrates that the Villa Vannucchi project has positive environmental, economic, and social impacts.

In environmental terms, satisfactory results were achieved. In fact, three project alternatives were evaluated and compared using the LCA to determine the one with the smallest environmental impact in terms of carbon emissions, the use of biomaterials, and alternative energy solutions, etc.

Regarding the social and cultural effects, it emerges that the local community positively receive and share the project, as demonstrated from the satisfactory score achieved by the indicators related to "social value thematic area", including the perception of wellbeing, number of associations, volunteer cooperatives related to the functional reuse, place attachment and local identity, sense of place, and to the identification of the heritage value.

Regarding the economic aspect, the most positive impact produced is related to the costs incurred for the realization of the project, which will be amortised by future electricity savings incurred previously for heating/cooling the facility. The creation of new jobs can also be considered a substantial economic effect.

Furthermore, another significant piece of information deduced from the application of the CHL(s) evaluation framework refers to the state of conservation of the villa. The results shows that the actions identified in the Scenario C are "respectful" of building values, showing high performance in terms of recognizability and reversibility.

The achieved results show an integrated approach that distinguishes this case study from others in which Level(s), HIA, and GBC tools were utilised.

In fact, the case studies that referred to HIA (Liverpool, Stockholm bypass road, Cologne Cathedral in Germany, Gallery Lower in Australia, etc.) are based solely on the collection of data analyzed by expert knowledge. The good practices in which Level(s) has been applied (Finland, Spain, Slovenia, Croazia, Poland case studies and so on) do not take into account the social and cultural dimensions. Furthermore, GBC certifications focus exclusively on the measurement of environmental impacts (the Guinelli building in Ferrara, Meis in Ferrara, scuderie of S. Apollinare in Perugia, etc).

This study represents a contribution to research in this field because the proposed evaluation tool was developed with the intention of providing decision-makers with a tool to simultaneously assess economic, environmental, and socio-cultural impacts.

Concerning the limitations of the proposed evaluation framework, the required data referred to economic and environmental are often not easy to gather. Another limitation pertains to the data collected during the participation phase (the survey through the questionnaire): the number of respondents is limited and they do not always make an informed judgment at the time of survey submission (but can be influenced by external factors).

The difficulty related to economic and environmental data collection can be overcome by enhancing and implementing the BIM methodology, in particular through the potential offered by the Heritage BIM (HBIM). The application of BIM to existing heritage provides numerous opportunities to optimize the management, maintenance and preservation of built heritage [89].

In addition, by combining BIM with assessment tools, such as CHL(s), it allows for dynamic monitoring of the impacts of different design alternatives.

It is important to note that urban transformation involved not only the heritage registered to the world heritage lists, but also historical buildings and landscapes of state and regional significance, which are regulated and protected by local cultural heritage superintendencies (the Italian Ministry of Culture).

In this view, in the evaluation process of heritage projects included in the world lists, the interviewed sample have to be expanded and go beyond the local community. Thus, the evaluation should be carried out first at the local level, "creating a patchwork quilt of values and attitudes" [18] and then to the wider levels (such as the world one). Commonalities can be extracted to the state and ultimately to the national level.

6. Conclusions

A crucial step in the decision-making process is gaining an in-depth understanding of the building to be renovated in order to identify those design options that complement the building's particular characteristics. This knowledge enables the identification of the building's strengths and weaknesses so that design decisions can be oriented to maximize the former and minimize the latter.

In addition, an in-depth understanding of the building's behaviour enables the identification of actions that improve its performance, thereby reducing negative environmental impacts over the building's entire life cycle.

The proposed tool can be used to evaluate different project alternatives referring to the same building, taking into account multidimensional impacts that can be produced.

Incorporating the various dimensions, values, and attributes that characterise cultural heritage, this tool aims to overcome the sectorial limitations of officially recognised evaluation tools currently in use (Section 2).

Furthermore, the suggested integrated evaluation framework can be utilized at various stages of the decision-making process: ex ante, ongoing, and ex post.

Ex-ante evaluation provides early-stage strategic information about the main choices at an early stage of a project process [66]. LCA can be used as ex-ante evaluation tool for testing alternative interventions, putting claims of environmental sustainability to the test, and supporting early design improvements and sound investments [67]. However, this tool alone is insufficient on its own; it needs to be integrated with other evaluation tools that can capture the multidimensional impacts of projects (such as CHL(s)).

In contrast to the Level(s) tool, based only on expert knowledge, a strength of the proposed approach is the integration between the expert and common knowledge.

In fact, the data in the evaluation sheet refer both to technical data and data deduced from the community's involvement (through the survey), which represents one of the project's primary users/beneficiaries. The survey allows for the co-evaluating of the project's impacts.

The evaluation framework has multiple receivers: the researchers and professionals responsible for developing such an analysis; the building's users; the managers who finance the reuse project; the material suppliers; and the community who "live and transform" the building. Given the number of potential recipients and the specificity of the required data, it may be useful to invest in training courses to help users become more confident and aware when using this tool.

In addition, the drafting of guidelines to improve the clarity and accessibility of such a tool would be a significant step forward in the current research. The development of the aforementioned guidelines (as was done for the Level(s) tool) can support the management of the complexity and specificity of some of the data required by the evaluation framework, as well as their integration with other tools such as BIM. Integration with modelling tools that dynamically show, in real time, the variation of potential effects in response to varying design choices is a fruitful research area.

In conclusion, the future step of this research is to stress and implement the proposed evaluation framework in order to strengthen the relation between CHL(s) and HBIM design. Changes made on the BIM model can result, in real time, in the change of effects assessed in the CHL(s). The CHL(s) can "communicate" and interact with the HBIM, providing indicators referring to the fifth dimension of BIM (the economic dimension) and the sixth dimension (environmental dimension), that is, integrating the indicators currently existing in the HBIM. Furthermore, a new dimension could be included in reference to socio-cultural indicators.

Since the BIM methodology does not allow for the measuring of social and cultural effects, a future goal of related research would be to include the data that refers to the stakeholders' perception in the BIM model.

Author Contributions: Conceptualization, F.N. and M.A.; methodology, F.N.; in-depth study of evaluation methods F.N. and M.A.; data curation in the case study, M.A.; discussions of the results, F.N. and M.A.; writing—draft, F.N. and M.A..; writing—review and editing, F.N. and M.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by PON Ricerca e Innovazione, DD n. 407 del 27/02/2018-AIM-ATTRACTION AND INTERNATIONAL MOBILITY". Miur Italia.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare that they have no conflicts of interest.

References

1. Available online: Https://Www.Un.Org/Sustainabledevelopment/Cities/ (accessed on 15 July 2022).
2. Fusco Girard, L.; Nocca, F. Climate Change and Health Impacts in Urban Areas: Towards Hybrid Evaluation Tools for New Governance. *Atmosphere* **2020**, *11*, 1344. [CrossRef]
3. European Commission. Urban Agenda for the EU Pact of Amsterdam. Available online: http://urbanagendaforthe.eu/pactofamsterdam/ (accessed on 8 May 2022).
4. European Commission. *The European Green Deal*; European Commission: Bruxelles, Belgium, 2019.
5. International Council of momunents and sites (ICOMOS), International Cultural Tourism Charter. Principles and Guidelines for Managing Tourism at Places of Cultural and Heritage Significance 2002. Available online: https://www.icomos.org/charters/tourism_e.pdf (accessed on 7 June 2022).
6. UNESCO. Recommendation on Historic Urban Landscape; UNESCO, Paris, France 2011. Available online: file:///C:/Users/fabio/Downloads/activity-638-98-1.pdf (accessed on 5 May 2012).
7. European Commission (EU). *New European Bauhaus*; European Commission (EU): Bruxelles, Belgium, 2020.
8. Nocca, F.; De Toro, P.; Voysekhovska, V. Circular Economy and Cultural Heritage Conservation: A Proposal for Integrating Level(s) Evaluation Tool | Aestimum. Available online: https://oaj.fupress.net/index.php/ceset/article/view/10119/10253 (accessed on 19 July 2022).
9. Ellen MacArthur Foundation. *Towards a Circular Economy: Business Rationale for an Accelerated Transition*; Ellen MacArthur Foundation: London, UK, 2015.
10. Preston, F.A. Global Redesign? Shaping the Circular Economy. *Energy Environ. Resour. Gov.* **2012**, *2*. Available online: https://www.chathamhouse.org/2012/03/global-redesign-shaping-circular-economyt (accessed on 16 July 2022).
11. Chertow, M.R. Industrial Symbiosis: Literature and Taxonomy. *Annu. Rev. Energy Environ.* **2000**, *25*, 313–337. [CrossRef]
12. Girard, L.F.; Nocca, F. Circular City Model and Its Implementation: Towards an Integrated Evaluation Tool. *BDC Boll. Del Cent. Calza Bini* **2018**, *18*, 11–32.
13. De Toro, P.; Nocca, F.; Buglione, F. Real Estate Market Responses to the COVID-19 Crisis: Which Prospects for the Metropolitan Area of Naples (Italy)? *Urban Sci.* **2021**, *5*, 23. [CrossRef]
14. Architect's Council of Europe (ACE). Leeuwarden Declaration Preserving and Enhancing the Values of Our Built Heritage for Future Generations. Available online: https://www.ace-cae.eu/uploads/tx_jidocumentsview/LEEUWARDEN_STATEMENT_FINAL_EN-NEW.pdf (accessed on 4 May 2022).
15. Conejos, S.; Langston, C.; Smith, J. Improving the Implementation of Adaptive Reuse Strategies for Historic Buildings. In Proceedings of the Le Vie dei Mercanti SAVE HERITAGE: Safeguard of Architectural, Visual, Environmental Heritage, Naples, Italy, 9–11 June 2011.
16. Mısırlısoy, D.; Gunce, K. Adaptive Reuse Strategies for Heritage Buildings: A Holistic Approach. *Sustain. Cities Soc.* **2016**, *26*, 91–98. [CrossRef]
17. Foster, G.; Kreinin, H. A Review of Environmental Impact Indicators of Cultural Heritage Buildings: A Circular Economy Perspective. *Environ. Res. Lett.* **2020**, *15*, 043003. [CrossRef]
18. Spennemann, D.H.R. Gauging Community Values in Historic Preservation. *CRM J. Summer* **2016**, *3*, 6.
19. Girard, L.F. *Risorse Architettoniche e Culturali: Valutazioni e Strategie Di Conservazione*; Franco Angeli: Milan, Italy, 1987.
20. Girard, L.F.; Nijkamp, P. *Le Valutazioni per lo Sviluppo Sostenibile della Città e del Territorio*; Franco Angeli: Milan, Italy, 1997; ISBN 978-88-464-0182-3.
21. Zeleny, M.; Hufford, K.D. The Application of Autopoiesis in Systems Analysis: Are Autopoietic Systems Also Social Systems? *Int. J. Gen. Syst.* **1992**, *21*, 145–160. [CrossRef]
22. Turner, R.K. *Sustainable Environmental Economics and Management*; Belhaven Press: Belhaven, UK, 1993.
23. Costanza, R.; Cumberland, J.H.; Daly, H.; Goodland, R.; Norgaard, R.B.; Kubiszewski, I.; Franco, C. *An Introduction to Ecological Economics*; CRC Press: New York, NY, USA, 2014.
24. Maturana, H.R.; Varela, F.J. *Autopoiesi e Cognizione. La Realizzazione Del Vivente*; Marsilio Editori: Venice, Italy, 2001.
25. Morris, W. Address to the Annual General Meeting of SPAB. 1889. Available online: https://www.marxists.org/archive/morris/works/1889/spab16.htm (accessed on 8 June 2022).
26. Ruskin, J. *The Seven Lamps of Architecture*; Dover Publications: New York, NY, USA, 1989.
27. Riegl, A. The Modern Cult of Monuments: Its Character and Its Origin. *Oppositions* **1903**, *25*, 21–51.
28. ICOMOS. The Burra Charter, The Australia ICOMOS Charter for Places of Cultural Significance. 1979. Available online: http://openarchive.icomos.org/id/eprint/2145/ (accessed on 20 June 2022).
29. European Commission. The Circular Economy: Connecting, Creating and Conserving Value. 2014, pp. 1–4. Available online: https://doi.org/10.2779/80121 (accessed on 10 June 2022).
30. Callicott, J.B. In Defense of the Land Ethic: Essays in Environmental Philosophy. 1989. Available online: https://philpapers.org/rec/CALIDO-4 (accessed on 10 June 2022).
31. Elliot, R. Intrinsic Value, Environmental Obligation, and Naturalness. *Monist* **1992**, *75*, 138–160. [CrossRef]
32. Spennemann, D.H.R. The Nexus between Cultural Heritage Management and the Mental Health of Urban Communities. *Land* **2022**, *11*, 304. [CrossRef]
33. Pauly, D. Anecdotes and the Shifting Baseline Syndrome of Fisheries. *Trends Ecol. Evol.* **1995**, *10*, 430. [CrossRef]

34. Spennemann, D.H.R. The Shifting Baseline Syndrome and Generational Amnesia in Heritage Studies. *Heritage* **2022**, *5*, 2007–2027. [CrossRef]
35. Consortium Cultural (CHCfE), Heritage Counts for Europe. Available online: www.encatc.org/culturalheritagecountsforeuro (accessed on 18 May 2022).
36. Department for Culture, Media & Sport (DCMS). *The Culture White Paper*; Department for Culture, Media & Sport (DCMS): London, UK, 2016; ISSN 0262160935.
37. Girard, L.F.; Vecco, M. Genius Loci: The Evaluation of Places between Instrumental and Intrinsic Values. *BDC Boll. Del Cent. Calza Bini* **2019**, *19*, 473–495.
38. Throsby, D. *The Economics of Cultural Policy*; Cambridge University Press: Cambridge, UK, 2010; ISBN 9780511845253.
39. Girard, L.F. Capitale Culturale Intangibile e Sviluppo Locale "Circolare". In *Festività Carnevalizie, Valori Culturali Immateriali e Città Storiche. Una Risorsa per lo Sviluppo Turistico di Qualità del Mezzogiorno*; Franco Angeli: Milan, Italia, 2018.
40. Girard, L.F.; Nocca, F. La Rigenerazione Del "Sistema Matera" Nella Prospettiva Dell'economia Circolare. In *Matera, Città del Sistema Ecologico Uomo/Società/Natura il Ruolo Della Cultura per la Rigenerazione del Sistema Urbano/Territoriale*; Giannini Editore: Napoli, Italia, 2019; pp. 69–100.
41. Hosagrahar, J.; Soule, J.; Girard, L.F.; Potts, A. Cultural Heritage, the UN Sustainable Development Goals, and the New Urban Agenda. *BDC Bollettino del Centro Calza Bini* **2016**, *16*, 37–54.
42. European Association of Historic Towns and Region (EAHTR), Investing in Heritage. A Guide to Successful Urban Regeneration. 2007. Available online: https://www.paperzz.com/doc/7831751/a-guide-to-successful-urban-regeneration (accessed on 5 May 2022).
43. Zamagni, S.; Venturi, P.; Rago, S. Valutare l'impatto Sociale. La Questione Della Misurazione Nelle Imprese Sociali. *Doss. Indice* **2015**, *6*, 25.
44. Nocca, F.; Girard, L.F. Towards an Integrated Evaluation Approach for Cultural Urban Landscape Conservation/Regeneration. *Region* **2017**, *5*, 33–51. [CrossRef]
45. Nocca, F. The Role of Cultural Heritage in Sustainable Development: Multidimensional Indicators as Decision-Making Tool. *Sustainability* **2017**, *9*, 1882. [CrossRef]
46. Sowińska-Heim, J. Adaptive Reuse of Architectural Heritage and Its Role in the Post-Disaster Reconstruction of Urban Identity: Post-Communist Łódź. *Sustainability* **2020**, *12*, 8054. [CrossRef]
47. Bullen, P.A.; Love, P.E.D. The Rhetoric of Adaptive Reuse or Reality of Demolition: Views from the Field. *Cities* **2010**, *27*, 215–224. [CrossRef]
48. Roders, A.P.; Oers, R. Van Editorial: Bridging Cultural Heritage and Sustainable Development. *J. Cult. Herit. Manag. Sustain. Dev.* **2011**, *1*, 5–14. [CrossRef]
49. Munarim, U.; Ghisi, E. Environmental Feasibility of Heritage Buildings Rehabilitation. *Renew. Sustain. Energy Rev.* **2016**, *58*, 235–249. [CrossRef]
50. Assefa, G.; Ambler, C. To Demolish or Not to Demolish: Life Cycle Consideration of Repurposing Buildings. *Sustain. Cities Soc.* **2017**, *28*, 146–153. [CrossRef]
51. Mahpour, A. Prioritizing Barriers to Adopt Circular Economy in Construction and Demolition Waste Management. *Resour. Conserv. Recycl.* **2018**, *134*, 216–227. [CrossRef]
52. Foster, G. Circular Economy Strategies for Adaptive Reuse of Cultural Heritage Buildings to Reduce Environmental Impacts. *Resour. Conserv. Recycl.* **2020**, *152*, 104507. [CrossRef]
53. Douglas, J. *Building Adaptation*; Routledge: London, UK, 2006; ISBN 9780750666671.
54. Bullen, P.A.; Love, P.E.D. Adaptive Reuse of Heritage Buildings. *Struct. Surv.* **2011**, *29*, 411–421. [CrossRef]
55. Aigwi, I.E.; Egbelakin, T.; Ingham, J. Efficacy of Adaptive Reuse for the Redevelopment of Underutilised Historical Buildings: Towards the Regeneration of New Zealand's Provincial Town Centres. *Int. J. Build. Pathol. Adapt.* **2018**, 36. [CrossRef]
56. Shipley, R.; Utz, S.; Parsons, M. Does Adaptive Reuse Pay? A Study of the Business of Building Renovation in Ontario, Canada. *Int. J. Herit. Stud.* **2006**, *12*, 505–520. [CrossRef]
57. Highfield, D.; Gorse, C. *Refurbishment and Upgrading of Buildings*; Routledge: London, UK, 2009; ISBN 9780415441247.
58. Aigwi, I.E.; Ingham, J.; Phipps, R.; Filippova, O. Identifying Parameters for a Performance-Based Framework: Towards Prioritising Underutilised Historical Buildings for Adaptive Reuse in New Zealand. *Cities* **2020**, *102*, 102756. [CrossRef]
59. Ball, R.M. Re-Use Potential and Vacant Industrial Premises: Revisiting the Regeneration Issue in Stoke-on-Trent. *J. Prop. Res.* **2002**, *19*, 93–110. [CrossRef]
60. Baker, H.; Moncaster, A.; Al-Tabbaa, A. Decision-Making for the Demolition or Adaptation of Buildings. *Forensic Eng.* **2017**, *170*, 144–156. [CrossRef]
61. Girard, L.F. The Circular Economy in Transforming a Died Heritage Site into a Living Ecosystem, to Be Managed as a Complex Adaptive Organism. *Aestimum* **2020**, *77*, 145–180.
62. ICOMOS. *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties*; International Council of Monuments and Sites: Paris, France, 2011.
63. European Commission. *Level(s)—A Common EU Framework of Core Sustainability Indicators for Office and Residential Buildings Part 3: How to Make Performance Assessments Using Level(s) (Draft Beta v1.0)*; European Commission: Seville, Spain, 2017.
64. European Commission (EC), Level(s) Taking Action on the total Impact of the Construction Sector. 2019. Available online: https://ec.europa.eu/environment/eussd/pdf/LEVEL(S)%20CONFERENCE%20REPORT.pdf (accessed on 18 June 2022).

65. European Commission (EC). *Level(s): A Guide to Europe's New Reporting Framework*; European Commission: Seville, Spain, 2017.
66. Ferrari, S.; Zoghi, M.; Blázquez, T.; Dall'O, G. New Level(s) Framework: Assessing the Affinity between the Main International Green Building Rating Systems and Euroean Scheme. *Renew. Sustain. Energy Rev.* **2021**, *155*, 111924. [CrossRef]
67. Bionova Ltd. *Embidied Carbon Review*; Bionova Ltd.: Helsinki, Finland, 2018; Available online: www.embodiedcarbonreview.com (accessed on 5 June 2021).
68. Claude, S.; Ginestet, S.; Bonhomme, M.; Moulène, N.; Escadeillas, G. The Living Lab Methodology for Complex Environments: Insights from the Thermal Refurbishment of a Historical District in the City of Cahors, France. *Energy Res. Soc. Sci.* **2017**, *32*, 121–130. [CrossRef]
69. Wender, B.A.; Foley, R.W.; Hottle, T.A.; Sadowski, J.; Prado-Lopez, V.; Eisenberg, D.A.; Laurin, L.; Seager, T.P. Anticipatory Life-Cycle Assessment for Responsible Research and Innovation. *J. Responsible Innov.* **2014**, *1*, 200–207. [CrossRef]
70. Peter, H.; Scott, M.; Declan, R. Sustainability versus Liveability: An Investigation of Neighbourhood Satisfaction. *J. Environ. Plan. Manag.* **2008**, *52*, 847–864.
71. Göswein, V.; Rodrigues, C.; Silvestre, J.D.; Freire, F.; Habert, G.; König, J. Using Anticipatory Life Cycle Assessment to Enable Future Sustainable Construction. *J. Ind. Ecol.* **2020**, *24*, 178–192. [CrossRef]
72. Kaulio, M.A. Customer, Consumer and User Involvement in Product Development: A Framework and a Review of Selected Methods. *Total Qual. Manag.* **1998**, *9*, 141–149. [CrossRef]
73. Linkov, I.; Seager, T.P. Coupling Multi-Criteria Decision Analysis, Life-Cycle Assessment, and Risk Assessment for Emerging Threats. *Environ. Sci. Technol.* **2011**, *45*, 5068–5074. [CrossRef] [PubMed]
74. Chantrelle, F.P.; Lahmidi, H.; Keilholz, W.; Mankibi, M.E.; Michel, P. Development of a Multicriteria Tool for Optimizing the Renovation of Buildings. *Appl. Energy* **2011**, *88*, 1386–1394. [CrossRef]
75. Parnell, G.S. *Trade-Off Analytics: Creating and Exploring the System Tradespace*; John Wiley & Sons: Hoboken, NJ, USA, 2016.
76. Erlandsson, M.; Lundin, J.S.; Leveau, N. Evaluation of the European Assessment Method Levels (s) for Buildings. A Swedish Level(s) Pilot Project Including a Skanska Building. 2019, pp. 1–28. Available online: https://www.diva-portal.org/smash/get/diva2:1549544/FULLTEXT01.pdf. (accessed on 19 April 2022).
77. Level(s). Available online: https://environment.ec.europa.eu/topics/circular-economy/levels_en (accessed on 19 July 2022).
78. Angrisano, M.; Biancamano, P.F.; Bosone, M.; Carone, P.; Daldanise, G.; De Rosa, F.; Franciosa, A.; Gravagnuolo, A.; Iodice, S.; Nocca, F.; et al. Towards Operationalizing UNESCO Recommendations on "Historic Urban Landscape": A Position Paper. *Aestimum* **2016**, 165–210. [CrossRef]
79. Gravagnuolo, A.; Bosone, M.; Fusco Girard, L.; De Toro, P.; Iodice, S.; Micheletti, S.; Buglione, F.; Aliona, L. Methodologies for Impact Assessment of Cultural Heritage Adaptive Reuse; Deliverable D2.5; 2021. Available online: https://www.clicproject.eu/wp-content/uploads/2022/01/D2.5-Methodologies-for-impact-assessment-of-cultural-heritage-adaptive-reuse.pdf. (accessed on 19 March 2022).
80. Kloos, M. Heritage Impact Assessment Some Cases and Examples Meeting on Heritage and Environmental Impact Assessments (HIA) (EIA). In *A State of the Art HIA and EIA Practices*; Taylor & Francis: Oxfordshire, UK, 2017.
81. Available online: Www.Sophiaplatform.Eu/En (accessed on 16 April 2022).
82. Rogers, A.P. Built Heritage and Development: Heritage Impact Assessment of Change in Asia. *Built Herit.* **2017**, *1*, 16–28. [CrossRef]
83. Ashrafi, B.; Neugebauer, C.; Kloos, M. A Conceptual Framework for Heritage Impact Assessment: A Review and Perspective. *Sustain. J.* **2021**, *14*, 1–27. [CrossRef]
84. Impact Assessment | ICCROM. Available online: https://www.iccrom.org/projects/impact-assessment (accessed on 19 July 2022).
85. Green Building Council Italia. GBC Historic Building Manual for Sustainable Restoration and Rehabilitation of Historic Buildings. Available online: https://gbcitalia.org/web/guest/gbc-historic-building-documenti (accessed on 19 July 2021).
86. Girard, L.F.; Nocca, F. Moving towards the Circular Economy/City Model: Which Tools for Operationalizing This Model? *Sustainability* **2019**, *11*, 6253. [CrossRef]
87. De Medici, S.; Pinto, M.R.; Senia, C.; Fabbricatti, K.; De Toro, P. Building Reuse: Multi-Criteria Assessment for Compatible Design. *Int. J. Des. Sci. Technol.* **2017**, *22*, 165–193.
88. De Medici, S.; De Toro, P.; Nocca, F. Cultural Heritage and Sustainable Development: Impact Assessment of Two Adaptive Reuse Projects in Siracusa, Sicily. *Sustainability* **2020**, *12*, 311. [CrossRef]
89. Angrisano, M.; Fabbrocino, F.; Iodice, P.; Fusco Girard, L. The Evaluation of Historic Building Energy Retrofit Projects through the Life Cycle Assessment. *Appl. Sci.* **2021**, *11*, 7145. [CrossRef]
90. Angrisano, M.; Fabbrocino, F. The Relation between Life Cycle Assessment and the Historic Buildings Energy Retrofit Projects. In In Proceedings of the World Heritage and Design for Health International Conference: Le vie dei Mercanti—IXI International Forum 2021, Naples, Italy, 15–17 July 2021.
91. Hyrkas, B. *White Paper. Seven Steps Guide to Building Life Cycle Assessment: Why You Need LCA to Build Sustainability*; One Click LCA Bionova: Helsinki, FI, USA, 2018; Available online: https://www.oneclicklca.com (accessed on 19 March 2022).
92. Simon, H.A. From Substantive to Procedural Rationality. In *25 Years of Economic Theory*; Springer: Boston, MA, USA, 1976; pp. 129–148.

land

MDPI

Article

Typology, Preservation, and Regeneration of the Post-1949 Industrial Heritage in China: A Case Study of Shanghai

Chaoyu Mo, Lin Wang * and Fujie Rao *

Department of Architecture, School of Design, Shanghai Jiao Tong University, Shanghai 200240, China
* Correspondence: wanglinalice@sjtu.edu.cn (L.W.); raofujie@gmail.com (F.R.)

Abstract: Industrial heritage is one of the most neglected types of cultural heritage and urban landscape, often being vulnerable to rather than blessed by urban (re)development. China is confronting an unprecedentedly intensive challenge of preserving industrial heritage, as the country has rapidly shifted towards post-industrialization only several years after being recognized as the "world's factory" in the 21st century. However, none of the existing literature has systematically investigated the typology and preservation of China's post-1949 industrial heritage. This research selects Shanghai—the largest metropolis and a prime industrial hub in China— for the case study, and examines 83 accredited modern industrial heritage sites in the city through typological analysis, descriptive statistical analysis, and GIS spatial analysis. Two principal findings are identified. First, there is a diverse range of the post-1949 industrial heritage in China, by industries, time, and spatial forms. Particularly the industrial block—where industrial development is intermingled with the surrounding urban fabric—is the dominant spatial type. Second, the preservation and regeneration of China's post-1949 industrial heritage in the suburbs are substantially more complex and more threatened than those in the inner city. This study concludes by providing implications for enhanced management and investigation of China's post-1949 industrial heritage preservation and regeneration.

Keywords: China's post-1949 industrial heritage; typology; preservation; regeneration; Shanghai

Citation: Mo, C.; Wang, L.; Rao, F. Typology, Preservation, and Regeneration of the Post-1949 Industrial Heritage in China: A Case Study of Shanghai. *Land* **2022**, *11*, 1527. https://doi.org/10.3390/land11091527

Academic Editors: Pasquale de Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 10 August 2022
Accepted: 6 September 2022
Published: 9 September 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

Industrial heritage is a key component of cultural heritage, with significant historical, social, cultural, technological, economic, and aesthetic value [1–3]. Promoting the preservation and regeneration of industrial heritage has become an international consensus, supported by the United Nations Educational, Scientific and Cultural Organization [4] and the International Council on Monuments and Sites [5]. In China, the preservation of industrial heritage confronts pressing challenges. China is experiencing a rapid transition from what some called the "world's factory" [6] to the era of post-industrialization—the gross domestic product (GDP) of manufacturing (43.9%) was beaten by that of services (46.1%) in 2013 and the former decreased to 69% of the latter in 2020 [7]. Meanwhile, the mode of urban growth mode in China has shifted from extensive greenfield development to intensive urban regeneration, creating more demands for brownfield redevelopment. In Shanghai, according to the latest master plan 2017–2035, the area of industrial land to be transformed ranges from 359 to 519 km^2, or from 43% to 62% of the total industrial land (see Figure 1). As a result, a large number of industrial facilities are about to be reconfigured, posing a threat to the preservation of industrial heritage, and highlighting the urgency of preserving China's post-1949 industrial heritage.

The existing literature of industrial heritage focuses on three key aspects. First is the typology of industrial heritage by industries, time, spatial forms, and so forth. Second is the mode of industrial heritage regeneration, embodying a range of ways, such as turning industrial heritage into museums, tourism sites, parks, cultural and creative industrial enclaves, apartments, and more. The third research focus is on the management of industrial heritage preservation, covering rules (e.g., laws, codes, and regulations), supporting

technologies, finance, and more. With respect to the research of China's industrial heritage, much attention has been paid to the preservation of industrial heritage that emerged in the colonial era before the establishment of the People's Republic of China in 1949 [8–10], in particular, 1840–1949 Shanghai [11–13]. However, China's post-1949 industrial heritage, with unique socialist and modernist styles, has not been well investigated.

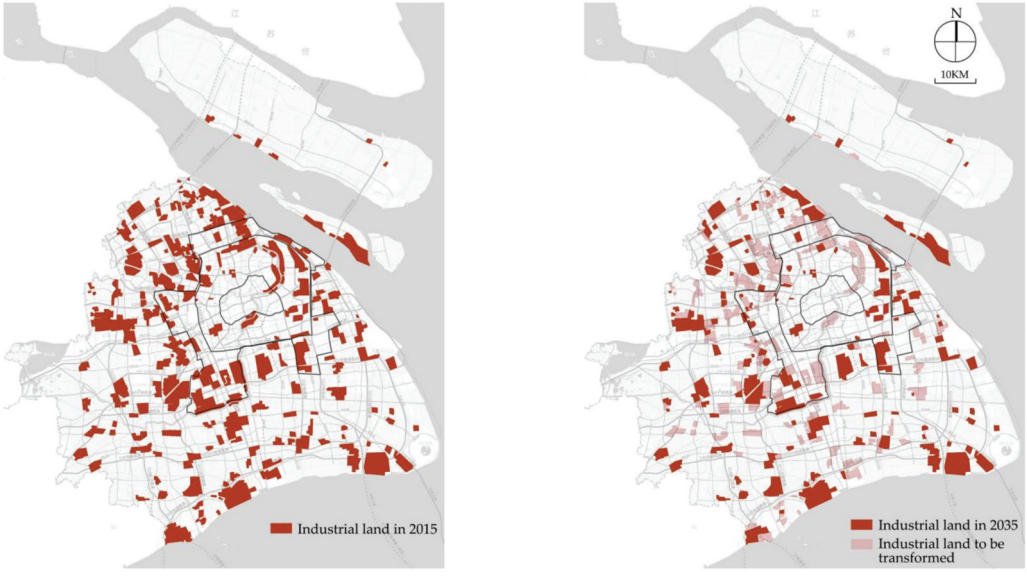


Figure 1. Distribution of industrial land: (**a**) 2015; (**b**) 2035.

In an attempt to tackle the research gap, this study revolves around two key topics. First is to systematically investigate the types of industrial heritage by industries, time, and morphology. Second is to interrogate how well the current industrial heritage preservation has been made and to assess the scale and trend of future industrial heritage preservation and regeneration. This research selected Shanghai for the case study, with a focus on 83 accredited post-1949 industrial heritage sites in the city. Key research methods incorporate typological analysis, descriptive statistical analysis, and spatial analysis using ArcGIS 10.2. Principal findings unveil a diverse range of the post-1949 industrial heritage in China—particularly the industrial block acts as the dominant spatial type—and highlight the complexity and significance of preserving and regenerating such industrial heritage in the suburban area.

In what follows, this paper first reviews the industrial heritage research geared to the international and Chinese contexts, respectively. Next is the section of research methods, describing the case selection, data collection, and data analysis. Then, the analytical section presents the results of typological and temporal-spatial research. Lastly, the paper reflects upon the key findings, provides policy implications for industrial heritage preservation management, and points out future research opportunities.

2. Literature Review

The literature review contains two subsections based on the international and Chinese contexts. Each is organized by two strands of themes: one is centered on history and definition; the other focuses on spatial types, modes of regeneration, and preservation management.

2.1. International Industrial Heritage

In the mid-twentieth century, major western countries led the socio-spatial transition to the post-industrial world, with more workers employed in the service industry than manufacturing. The term 'industrial heritage' was first used by the American bridge engineer Steinman in 1952, and industrial heritage preservation practices took place in a range of countries [14–16]. A proliferation of industrial heritage preservation research and practices emerged, after *Ironbridge Gorge* was recognized as a world heritage site in 1986—this is the first industrial heritage ever to be included under the list of world heritage. By the early twenty-first century, international organizations reached a consensus on promoting industrial heritage preservation [4,5].

One of the most important and authoritative international documents on industrial heritage is the *Nizhny Tagil Charter*, adopted in 2003. The *Nizhny Tagil Charter* defines industrial heritage as the tangible or intangible remains of industrial culture, with significant historical, technological, social, architectural, or scientific value. The tangible heritage mainly refers to material remains including buildings, machines, workshops, mills, mines, factories, warehouses, transport, places used for social activities related to industry, and more. The intangible heritage is mostly geared towards socio-economic processes and forces shaping industrial development, incorporating industrial processes, traditional crafts, data recording, enterprise archives, and more [17]. The physical industrial remains at various scales—e.g., the building, site, and zone—have been prioritized by existing studies, such as factories (e.g., *London Bankside Power Station* [18] and iron and steel plants in Slovakia [19]), mining sites (*Belgium's Limburg Region Mining Sites* [20], *Spanish Rio Tinto Mining Area* [21]), and more [22–24]), railways (e.g., *High Line Park* in *New York City* [25]), and large industrial zones (e.g., *Ruhr Industrial Base* [26,27]).

When it comes to the modes of regeneration, the existing literature focused on the functions to which industrial heritage has been transformed. While art museums (e.g., *London Tate Modern* [18] and *Germany Gasometer Oberhausen Gas Tank Exhibition Hall* [28]) and industrial tourism (*Ruhr Industrial Culture Tourism Route* [26], *Poland Industrial Monuments Route* [29], and more [30]) were most frequently investigated, a diverse range of industrial heritage reuse has received increasing attention in recent years, such as urban open space (e.g., *New York High Line Park* [25]), cultural and creative industrial enclaves (e.g., *SoHo* [31]), and apartments (e.g., *Manchester Royal Cotton Mill* [32]).

In terms of preservation management, current studies mainly cover rules, technologies, and finance. Researchers analyzed industrial heritage preservation rules at various governance levels ranging from the city to region, state, and the globe [33–35]. Some researchers have recently applied two-dimensional geographic information system (GIS) and three-dimensional building information modeling (BIM) to establishing, analyzing, and managing industrial heritage databases, leading to heritage building information modeling (HBIM) technologies [36–38]. Several researchers also emphasized the importance of establishing accountable and sustainable financial systems for fostering successful industrial heritage preservation and regeneration projects [39].

2.2. China's Industrial Heritage

In China, industrial heritage preservation started to catch research attention around the 1990s [40–42]. The preservation of industrial heritage in China was boosted in 2006 when the first Industrial Heritage Preservation Forum was held that led to the "*Wuxi Proposal*". The definition of industrial heritage by the *Wuxi Proposal* is in line with that by the *Nizhny Tagil Charter*. In addition to conceptualizing a variety of tangible and intangible industrial heritage, the *Wuxi Proposal* highlighted the importance of differentiating the industrial heritage of two eras—the early-industrialization and colonial era of 1840–1949 and the post-1949—according to the Chinese context [43]. One year after the *Wuxi Proposal*, the State Council of China published The Third National Cultural Relics Survey, in which industrial heritage was included for the first time, stimulating the rise of industrial heritage preservation practice and research in China.

A diverse range of physical industrial remains have been investigated by existing studies, such as industrial buildings [2,44–46], waterfront industrial heritage (e.g., *Shanghai Huangpu River Industrial Heritage* [47]), railways and related facilities (e.g., *China Eastern Railway Industrial Heritage* [48]), and large industrial zones (e.g., *Beijing Shougang Industrial Zone* [49] and *Jingdezhen Ceramic Industrial Heritage* [50]). China's 1840–1949 industrial heritage has received frequent attention, with a focus on Shanghai, Beijing, and Tianjin [11,51,52]. In particular, Xu and Aoki [8] established a systematic typology of China's 1840–1949 industrial heritage and comprehensively reviewed the preservation system of such industrial heritage. However, less attention has been paid to China's post-1949 industrial heritage, and the relevant literature has been largely limited to case studies: such as *Beijing Second Cotton Factory* [51] and *Shanghai Baosteel Stainless Steel Zone* [52]. There is a lack of systematic typology of China's post-1949 industrial heritage.

With respect to the modes of regeneration, the existing literature covered three typical types: turning industrial heritage into museums, cultural/creative industrial compounds, or public parks. Museums (e.g., *Shenyang Industrial Museum* [53,54]) and cultural and creative industrial parks (e.g., *Beijing 798 Art District* [55] and *Shanghai M50 Art Creative Park* [56]) were frequently investigated, yet a few researchers examined cases where the industrial heritage is reused as a heritage park [57,58]. Furthermore, current studies have focused on the policies, planning, and technologies for managing industrial heritage preservation. Researchers analyzed policies of industrial heritage preservation at the city, provincial, and national levels [59,60]. Researchers also argued that cities should prepare special plans for industrial heritage preservation and integrate such special plans into master plans [61,62]. More recently, researchers have applied GIS and BIM technology to analyzing the temporal-spatial evolution and genealogy of China's 1840–1949 industrial heritage [63,64].

3. Research Methods

This research selected Shanghai for the case study and examined 83 accredited industrial heritage sites in the city through typological analysis, descriptive statistical analysis, and GIS spatial analysis.

3.1. Case Selection

Shanghai was chosen for the study for four key reasons. First, Shanghai has a rich industrial development history with a diverse range of industrial facilities [11,65–67]. From 1840 to 1949, the industrial development of Shanghai mainly revolved around light industries—e.g., *Ewo Cotton Spinning & Weaving Co., Ltd.*, *Fou Foong Flour Mill Co., Ltd.*, and *Union Brewery*, operated by foreign companies and domestic entrepreneurs. From the establishment of the People's Republic of China in 1949 to the 1980s, the focus of Shanghai's industrial development shifted to large state-owned factories or enclaves for heavy industries, marked by the rise of *Si Fang Boilers Works*, *Shanghai Baosteel Stainless Steel Zone*, and more. From the 1990s to the present, Shanghai's industrial development has been reoriented towards high-tech and creative industries and the use of foreign direct investment, leading to new forms of industrial development that are better integrated with other urban functions such as living, shopping, and working.

Second, there has been an urgent need for the preservation and regeneration of industrial heritage in Shanghai, as the city is leading the post-industrial and urban transitions of Chinese cities [68–70]. With the rapid development of global urbanization, Shanghai, as a super metropolis, is facing a new round of urban regeneration. Large-scale post-1949 industries are also decaying and disappearing periodically, or upgrading and transforming. Therefore, it is necessary to study the preservation of post-1949 industrial heritage in Shanghai.

Third, Shanghai has one of the most advanced industrial heritage preservation management systems and practices among Chinese cities. In 1989, the city of Shanghai published the first accredited list of historic buildings (1840–1949) for preservation, which officially

included examples of industrial heritage—*Yangshupu Water Plant*—for the first time in mainland China. The city of Shanghai then added industrial building preservation in municipal regulations in 1991 [71], and introduced industrial heritage preservation under municipal bylaws in 2002 [72].

Fourth, the industrial heritage database in Shanghai tops other cities in mainland China. The city of Shanghai carried out a survey of 1840–1949 architectural heritage in 1986, and conducted a comprehensive survey of industrial heritage in 2007. Furthermore, the literature regarding industrial heritage in Shanghai accounts for around 18% of the total studies related to industrial heritage in Chinese journals, according to the China Knowledge Network database (2022). There have been a range of discrete data sources of Shanghai's industrial heritage from recent publications [73–77].

3.2. Data Collection

The data of 83 accredited industrial heritage sites are obtained from all four of the latest authoritative official lists of cultural relics and heritage buildings and blocks in Shanghai, as shown in Table 1, consisting of 53 sites from the list of *Shanghai's Immovable Cultural Relics*, 6 sites from the list of *Shanghai Heritage Architecture*, 5 sites from the list of *Shanghai Heritage Blocks*, and 26 sites from the list of *Shanghai Industrial Heritage Survey*.

Table 1. Data sources of 83 accredited industrial heritage sites in Shanghai.

Number	List	Source	The Number of Industrial Heritage Sites
1	*Shanghai Immovable Cultural Relics*	Shanghai Municipal People's Government	53 [1,2]
2	*Shanghai Heritage Architecture*	Shanghai Municipal People's Government	6 [1]
3	*Shanghai Heritage Blocks*	Shanghai Urban Planning Bureau	5 [2]
4	*Shanghai Industrial Heritage Survey*	Shanghai Cultural Relics Bureau	26

Notes: [1] There are two overlaps of industrial heritage sites between the lists of Shanghai Immovable Cultural Relics and Shanghai Heritage Architecture. [2] There are five overlaps of industrial heritage sites between the lists of Shanghai Immovable Cultural Relics and Shanghai heritage blocks.

Through field investigations and virtual observation in Baidu Map and Streetview, this study collected the geographical coordinates, construction year, building age, industrial type, morphological type, status of preservation, and modes of regeneration of the selected industrial heritage sites.

3.3. Data Analysis

This study adopted three research methods: typology, descriptive statistical analysis, and GIS spatial analysis. First, to systematically scan and analyze the selected post-1949 industrial heritage sites in Shanghai and also according to the existing literature, the typology of this study considered the following four key criteria: geographical distribution, industrial type, spatial form, and preservation and regeneration, as shown in Table 2. Second, this study applied descriptive statistical analysis to analyzing the numeric distribution of industrial heritage sites by different typologies. Third, this study employed GIS spatial analysis using ArcGIS 10.2, consisting of the "simple analysis" of the geographical distribution of industrial heritage sites of various types and the "overlay analysis" through which different layers of thematic analysis were combined to explore their interrelationships.

Table 2. The industrial heritage typological criteria of this study.

Number	Criteria	Types
1	Geographical distribution	The inner city (within the inner ring road; mostly the previous concessions and the core of *Pudong New District*) Mature neighborhoods (in-between the inner and outer ring roads; mostly 1949–1990s urban expansion) Suburbs (outside the outer ring road)
2	Industrial type (according to *Shanghai Local Chronicles* and *National Industrial Classifications GB/T4754-2011*)	Heavy industry Light industry Non-industrial infrastructure and functions
3	Spatial form	Industrial building Industrial block Industrial zone
4	Preservation and regeneration	Functional continuation (maintaining the original industrial production) Functional regeneration (adapted to other functions) Not in use Demolished

4. Results

4.1. Geographical Distribution

The geographical distribution of the 83 accredited modern industrial heritage sites is analyzed by ring roads, major rivers, and the planned main city boundary, as shown by Figure 2. The majority of the selected modern industrial heritage sites—21 out of 83—are located within the inner ring road, with 36 located in-between the inner-outer ring roads and 26 located outside the outer ring road. In addition, 28 industrial heritage sites are distributed along the river, with 14 near the *Huangpu River*, such as *Shanghai Wusong Shipyard* and *Maritime Watchtower*, and 4 near the *Suzhou Creek*, such as *Shanghai Fine Arts Film Studio* and *Daming Rubber Factory*. Further, more than 80% of the selected industrial heritage sites are located within the main urban area (yellow) of Shanghai envisioned by the latest master plan Shanghai 2017–2035.

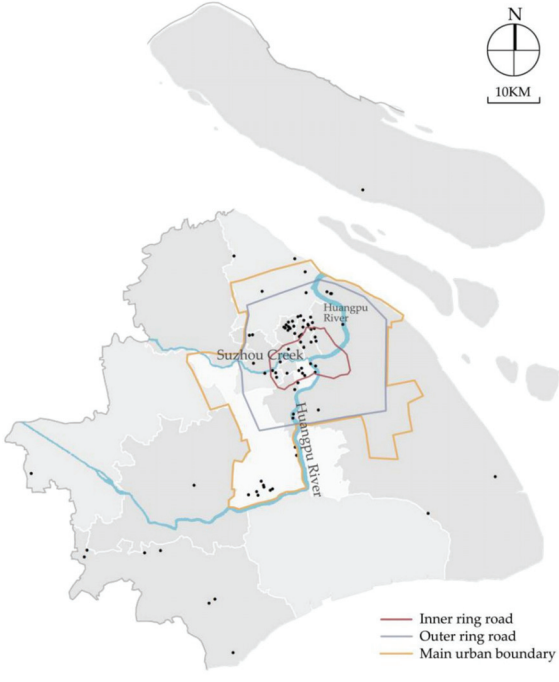


Figure 2. Distribution of the 83 accredited industrial heritage sites in Shanghai.

4.2. Industrial Type

The 83 accredited industrial heritage sites in Shanghai cover a wide range of industries as shown in Table 3, incorporating all three major categories of heavy industry, light industry, and non-industrial infrastructure and functions, and 26 subcategories such as shipbuilding industry, textile industry, and warehousing—covering 72% of the total industrial classifications in China.

Table 3. Industrial types of the 83 accredited industrial heritage sites in Shanghai.

Major Categories (I)	Number	Subcategories (II)	Quantity	Proportion
I Heavy industry (65%)	1	Shipbuilding industry	4	5%
	2	Electric power industry	4	5%
	3	Electronic instrumentation industry	2	2%
	4	Iron and steel industry	4	5%
	5	Aviation industry	2	2%
	6	Chemical industry	7	8%
	7	Electromechanical industry	22	27%
	8	Building materials industry	3	4%
	9	Coal industry	1	1%
	10	Automobile industry	2	2%
	11	General equipment manufacturing industry	1	1%
	12	Rubber industry	2	2%
II Light industry (28%)	13	Film machinery Industry	3	4%
	14	Textile industry	5	6%
	15	Household electrical appliance industry	1	1%
	16	Metal products industry	1	1%
	17	Food industry	7	8%
	18	Toy industry	1	1%
	19	Culture, education, sports industry	1	1%
	20	Camera manufacturing industry	1	1%
	21	Pen making industry	2	2%
	22	Lock making industry	1	1%
III Non-industrial infrastructure and functions (7%)	23	Transportation	1	1%
	24	Warehousing	1	1%
	25	Maritime	1	1%
	26	Educational R & D	3	4%

Among the major categories, the number of sites is dominated by heavy industry (65%), followed by light industry (28%) and non-industrial infrastructure and functions (7%). The heavy industry is dominated by electromechanical industry (27%), followed by chemical industry (8%), shipbuilding industry (5%), electric power industry (5%), and iron and steel industry (5%). With respect to the light industry, there are two primary subcategories, food industry (8%) and textile industry (6%).

The numeric distributions of the selected industrial heritage sites by industrial types vary in three focused areas, as presented in Figure 3. Within the inner ring road, the proportion of heavy industry and light industry is 48% and 43%, with balanced distribution. In-between the inner-outer ring roads and outside the outer ring road, the industrial sites are dominated by heavy industry, while the light industry only accounts for 22% and 23%.

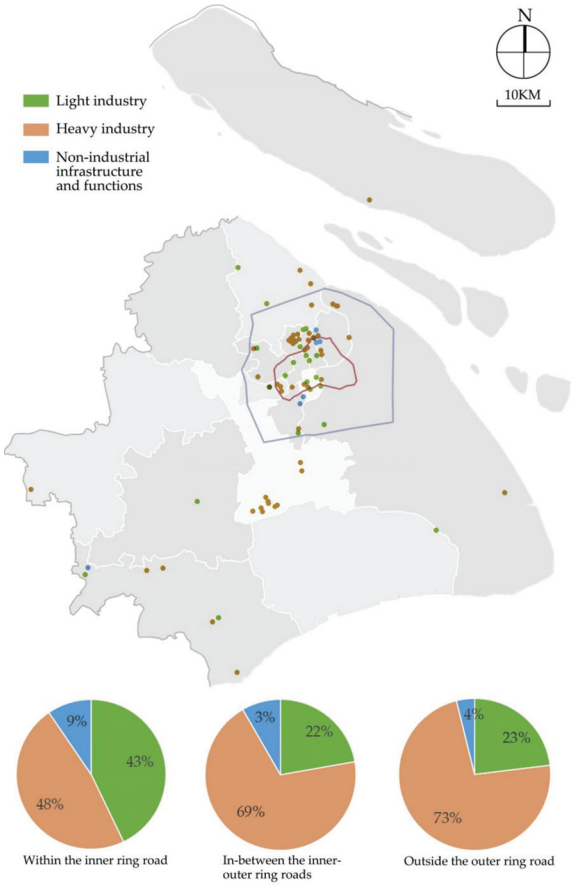


Figure 3. Distribution of the 83 accredited industrial heritage sites by industries in Shanghai.

4.3. Spatial Form

The 83 accredited industrial heritage sites in Shanghai embody three primary spatial forms: the building, block, and zone. Industrial building is mostly a standalone factory, warehouse, or structure, such as *Maritime Watchtower* (Figure 4a) and *Fengjing Railway Station*.

(**a**) (**b**) (**c**)

Figure 4. Photographs of industrial heritage sites by spatial forms: (**a**) *Maritime Watchtower* (building); (**b**) *Shanghai Hero Golden Pen Factory* (block); and (**c**) *Shanghai Baosteel Stainless Steel Zone* (zone).

Industrial block refers to a cluster of industrial buildings intermingled with the urban neighborhood at the walkable scale. For example, as shown in Figure 4b, the *Shanghai Hero Golden Pen Factory* is surrounded by several residential neighborhoods, with a site area of about 26,500 m^2 and 20 buildings for a variety of functions such as production, storage, working, catering, and childcare.

Industrial zone refers to a large independent industrial compound, often attached with a workers' neighborhood. For example, as shown in Figure 4c, *Shanghai Baosteel Stainless Steel Zone* covers an area of 3,370,000 m^2, with 447 buildings and structures. Furthermore, in addition to a set of full-process stainless steel production lines for iron making, steel making, hot rolling, and cold rolling, *Baosteel Stainless Steel Zone* incorporates a series of buildings supporting neighborhood functions (e.g., office, residential, commercial, and more).

These 83 industrial heritage sites are dominated by industrial blocks (71%), followed by industrial buildings (20%) and industrial zones (9%).

The numeric distributions of the selected industrial heritage sites by spatial forms vary in three focused areas, as presented by Figure 5. Within the inner ring road and in-between the inner-outer ring roads, only two spatial types of industrial heritage are identified: the industrial building and block. Within the inner ring road, the distributions of the selected industrial heritage sites in the building and block are largely balanced, with 47% and 53% in the total, respectively. In-between the inner-outer ring roads, the number of industrial blocks dominates, with 81% in the total. Outside the outer ring road, all three spatial types are covered, with 68% industrial block, 24% industrial zone, and 8% industrial building.

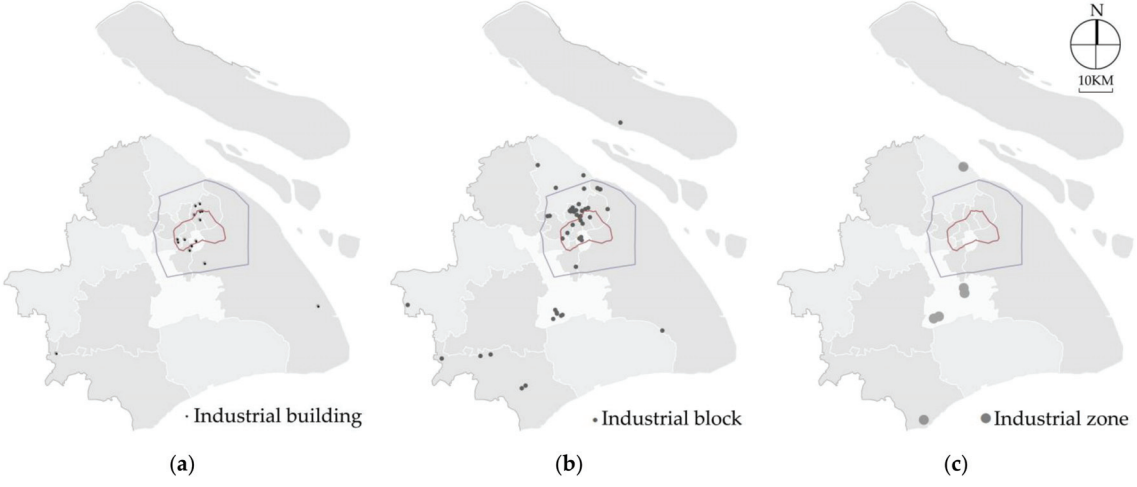
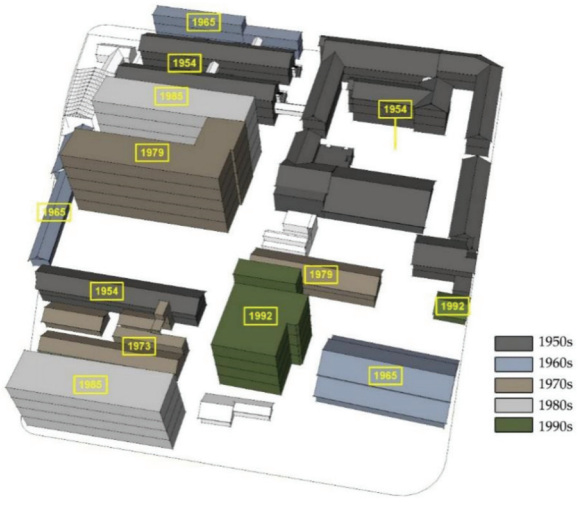


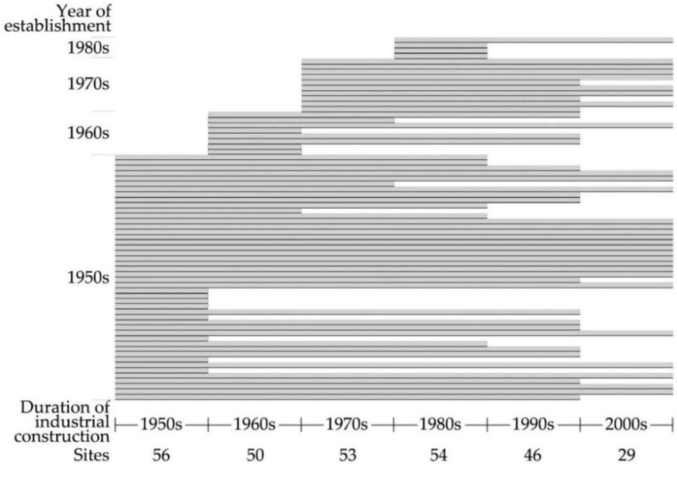
Figure 5. Distribution of the spatial form of all existing industrial heritage sites: (**a**) Building; (**b**) Block; and (**c**) Zone.

4.4. Temporal Evolution

In the second half of the 20th century, industrial development often required several decades of construction to become mature. For example, as shown in Figure 6a, the industrial construction of *Shanghai Hero Golden Pen Factory* lasted for five decades from the 1950s to 1990s.



(**a**)



(**b**)

Figure 6. Duration of industrial construction in industrial heritage sites: (**a**) A typical example—*Shanghai Hero Golden Pen Factory*; (**b**) All existing sites.

The construction of industrial buildings in all the 83 selected industrial heritage sites covers the six decades between the 1950s and 2000s well. Figure 6b depicts how many decades the construction of industrial buildings covers in each of the selected industrial heritage sites between the 1950s and 2000s. The intensity of industrial building construction—measured by the number of heritage sites constructing new industrial buildings—was largely stable from the 1950s to the 1990s, ranging from 46 to 56, yet it significantly diminished from 46 in the 1990s to 29 in the 2000s. In addition, most selected industrial heritage sites—56 out of 83—started the construction of industrial buildings as early as the 1950s. In 20 out of the 83 selected industrial heritage sites, the construction of industrial buildings spans across the six decades between the 1950s and 2000s.

According to Figure 7, from the 1950s to 2000s, within the inner ring road, the number of the selected industrial heritage sites with industrial construction plummeted from 16 to

2; in-between the inner-outer ring roads, the number was halved, from 22 to 9; outside the outer ring road, the number remained the same: 18 (Figure 7a,b). Particularly, 14 out of the 20 industrial heritage sites with continuous industrial construction from the 1950s to 2000s are located beyond the outer ring road, with 5 in-between the inner and outer ring roads and only 1 inside the inner ring road (Figure 7c).

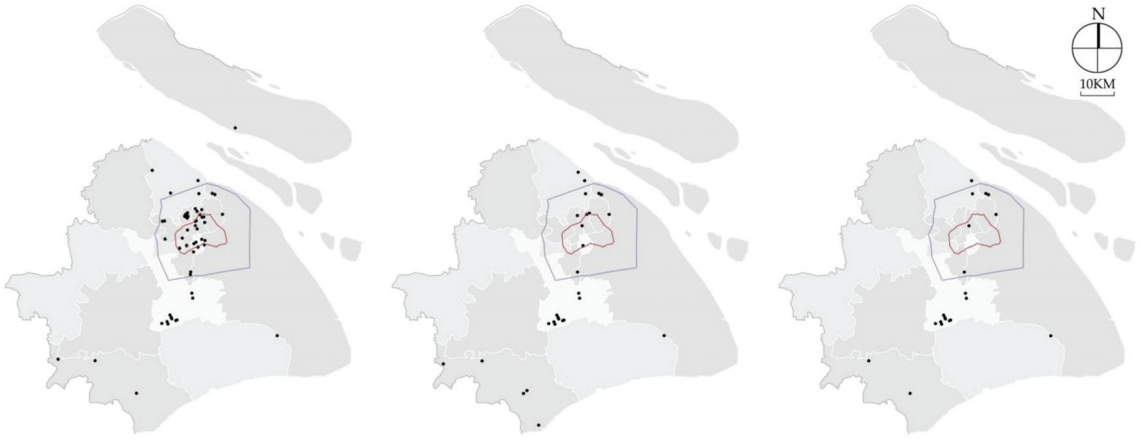


Figure 7. Distribution of the industrial construction in industrial heritage sites: (**a**) 1950s; (**b**) 2000s; and (**c**) 1950s to 2000s.

4.5. Preservation and Regeneration

Among the 83 accredited industrial heritage sites in Shanghai, 37% of the total keep industrial functions, 30% have been regenerated, 15% are not in use, and 18% have been demolished.

One typical example of the preserved industrial heritage is *Shanghai Baosteel Stainless Steel Zone*. It ceased industrial production in May 2018. The blast furnace plant—43 m tall—has been transformed into a steel museum and the section steel plant—856 m long, 120 m wide, 20 m high—has been proposed to be transformed into the new campus of the *Shanghai Academy of Fine Arts*.

One typical example of the demolished industrial heritage is the *Bayi Film Machinery Factory*, known as the cradle of China's film machinery industry. It was once a state-owned industrial compound with a range of functions (e.g., production, education, and public activity facilities) surrounded by farmland and villages, and it has been demolished and redeveloped into a mixed-use area and is now part of the established city.

According to Figure 8, among the 83 accredited industrial heritage sites in Shanghai, the sites with continued functions are mainly—20 out of 31—located outside the outer ring road, with merely 3 sites within the inner ring road (Figure 8a). The sites of regenerated functions are mostly located within the outer ring road, with only one outside the outer ring road (Figure 8b). Half of the not-in-use sites are located in-between the inner and outer ring roads, with four beyond the outer ring road and only two within the inner ring road (Figure 8c). The sites of the demolished are mainly—9 out of 15—located in-between the inner–outer ring roads, with 5 sites located within the inner ring road and only 1 outside the outer ring road (Figure 8d).

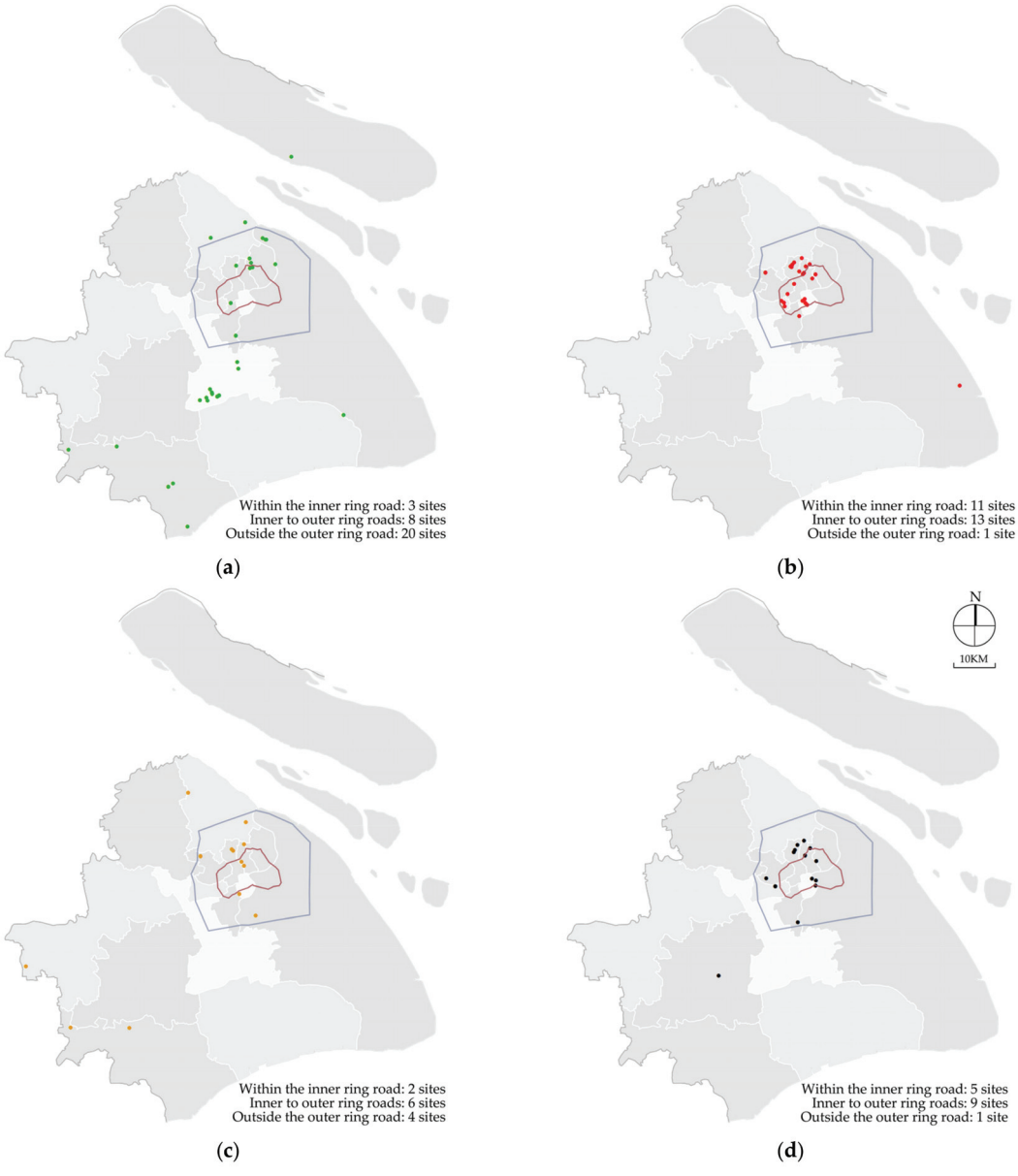


Figure 8. Distribution of industrial heritage sites in preservation and regeneration: (**a**) Functional continuation; (**b**) Functional regeneration; (**c**) Not in use; and (**d**) Demolition.

The 25 industrial heritage sites of functional regeneration cover six models of regeneration according to the new function, including 18 cultural and creative industrial parks—72% of the total; the dominant function for regeneration, 2 museums, 2 shopping centers, 1 heritage park, 1 hotel, and 1 large-scale urban regeneration project.

5. Conclusions

This research sought to examine the post-1949 industrial heritage in China, focusing on the geographical distribution, industrial type, spatial form, and the status of preservation and regeneration. A rare database of 83 accredited industrial heritage sites in Shanghai was constructed and used for the typological investigation, descriptive statistical analysis, and GIS spatial analysis. The analytical results led to four key findings as follows.

First, Shanghai's post-1949 industrial heritage embodies a diverse range of types by *industries*—consisting of heavy industries, light industries, and related infrastructure in as many as 26 subtypes—covering 72% of the total industrial classifications in China, *morphologies*—covering three types of building, block, and zone, and *time*—from the 1950s to 2000s. These typologies of the post-1949 industrial heritage by this study enriched the previous research of industrial heritage in China which revolved on the years between 1840 and 1949 [8,10,11].

Second, among the three key spatial types of Shanghai's post-1949 industrial heritage: the building, block, and zone, the block acts as the dominant type in terms of number—48 sites; more than half of the total, and of geographical distribution—industrial blocks are widely distributed across the city, reinforcing the recent argument that the focus of industrial heritage preservation is increasingly evolving from standalone buildings to industrial blocks and zones [26,65].

Third, the temporal-spatial analysis highlighted the pressing need to preserve and regenerate post-1949 industrial heritage in the suburban area of Shanghai, contrary to many existing studies of industrial heritage that focused on the central city such as in Shanghai, Tianjin, and London [18,52,62]. The significance of the suburban industrial heritage preservation and regeneration in Shanghai is evidenced as follows. Most of the post-1949 industrial heritage sites—62 out of 83—are located beyond the inner city. The heritage sites in the form of the industrial zone only exist outside the outer ring road, and those with persistent industrial construction from the 1950s to 2000s are mainly located outside the outer ring.

Fourth, the preservation and regeneration of Shanghai's post-1949 industrial heritage confront two key challenges. There is a pressing need for preserving such industrial heritage. Among the 83 accredited post-1949 industrial heritage sites, 15 have been unfortunately demolished and 12 are not in use—in danger of potential destruction. Meanwhile, modes of regeneration need to be diversified, as 72% of the regenerated post-1949 industrial heritage sites in Shanghai are reused for cultural and creative industrial parks. The dominance of cultural and creative industrial parks in industrial heritage regeneration has also been identified by previous studies in other cities such as New York City [31] and Manchester [32]. The lack of diversity in the land use of regeneration projects may hinder the sustainability of industrial heritage preservation.

The findings of this study afford four implications for practice. First, the planning authority should promote the survey and assessment of the post-1949 industrial heritage in Shanghai, particularly in the suburban area, in collaboration with related municipal bureaus such as cultural heritage administration and economic development. Second, more attention should be paid to the industrial heritage sites in the form of block and zone. The preservation and regeneration of such industrial heritage need to focus on the spatial fabric, streetscape, landscape, and sense of community in addition to buildings and industrial processes and crafts. Third, for industrial heritage regeneration projects, local municipalities could encourage the industrial site to be transformed into a more diverse range of urban spaces besides cultural and creative parks (e.g., higher-education campuses, sports venues, shopping centers, and apartments), and provide incentives for a wider range of stakeholders to join regeneration initiatives and projects—particularly, it is crucial to attract more market talents and investments. Fourth, the intensity of industrial heritage preservation should be enhanced by establishing special laws or codes, introducing more financial resources from the government and industry, encouraging public participation, and promoting the public education of industrial heritage.

Lastly, future studies could consider the following directions. Researchers could continue to build and analyze the database of the post-1949 industrial heritage sites in Shanghai as the current rapid transition towards post-industrialization would likely lead to more industrial sites to be added to the heritage list. In addition, researchers could apply quantitative modeling to examine the interrelationship between the degree of preservation and a range of socio-spatial attributes besides the four criteria considered in this paper, such as the land and floor area, geographical location, spatial type, year of establishment, degree of damage/regeneration, and modes of regeneration. Next, researchers could conduct qualitative interviews and observations in typical industrial heritage sites to record collective memories and interrogate the related place attachment.

Author Contributions: Conceptualization, C.M., L.W. and F.R.; methodology, L.W. and F.R.; formal analysis, C.M.; investigation, C.M. and L.W.; data curation, C.M.; writing—original draft preparation, C.M.; writing—review and editing, L.W. and F.R.; visualization, C.M.; supervision, L.W.; project administration, L.W. and F.R.; funding acquisition, L.W. All authors have read and agreed to the published version of the manuscript.

Funding: The research project and publication of this paper are supported by the National Social Science Fund of China [Key Project]: *The study on the theory and methods of preservation and utilization of industrial cultural heritage in the new era* [Grant No. 18AGL025] and by the 2022 Project of Shanghai Municipal Housing and Urban-Rural Development Management Committee: *Study on the connotation and strategy of urban regeneration in the new development era*.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

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

References

1. Harris, F. From the industrial revolution to the heritage industry. *Geogr. Mag.* **1989**, *61*, 38–42.
2. Jixiang, S. Focus on New Cultural Heritage: Protection of Industrial Heritage. *Beijing Plan. Rev.* **2007**, *2*, 11–17.
3. de Haan, D. Industrial Heritage Re-Tooled: The TICCIH Guide to Industrial Heritage Conservation. *Ind. Archaeol. Rev.* **2013**, *35*, 82–83. [CrossRef]
4. United Nations Educational, Scientific and Cultural Organization—UNESCO. Convention Concerning the Preservation of the World Cultural and Natural Heritage. 1972. Available online: https://whc.unesco.org/en/conventiontext/ (accessed on 20 June 2022).
5. ICOMOS. The Dublin Principles. 17th ICOMOS General Assembly. 2011. Available online: https://www.icomos.org/Paris2011/GA2011_ICOMOS_TICCIH_joint_principles_EN_FR_final_20120110.pdf (accessed on 20 June 2022).
6. Mullen, A. China Manufacturing: Everything You Need to Know. *South China Morning Post*, 16 December 2020. Available online: https://www.scmp.com/economy/china-economy/article/3114176/china-manufacturing-everything-you-need-know(accessed on 15 July 2022).
7. National Bureau of Statistics of China. China Statistical Yearbook. 2021. Available online: http://www.stats.gov.cn/tjsj/ndsj/2021/indexch.htm (accessed on 1 January 2022).
8. Subin, X.; Nobuo, A. *Comprehensive Research on the Preservation System of Modern Industrial Heritage Sites in China*; China City Press: Beijing, China, 2021.
9. Jie, C.; Judd, B.; Hawken, S. Adaptive Reuse of Industrial Heritage for Cultural Purposes in Three Chinese Megacities. In Proceedings of the COBRA AUBEA 2015, Sydney, Australia, 8 July 2015.
10. O'Connor, J.; Gu, X. Creative industry clusters in Shanghai: A success story? *Int. J. Cult. Policy* **2014**, *20*, 1–20. [CrossRef]
11. Song, Z. Conservation and Adaptive Reuse of Shanghai lndustrial Heritage. *Archit. J.* **2006**, *5*, 16–20. [CrossRef]
12. Pendlebury, J.; Wang, Y.W.; Law, A. Re-using 'uncomfortable heritage': The case of the 1933 building, Shanghai. *Int. J. Herit. Stud.* **2018**, *24*, 211–229. [CrossRef]
13. Sun, M.; Chen, C. Renovation of industrial heritage sites and sustainable urban regeneration in post-industrial Shanghai. *J. Urban Aff.* **2021**. [CrossRef]
14. Rix, M. *Industrial Archaeology*; Historical Association: London, UK, 1967.
15. Hudson, K. *World Industrial Archaeology*; CUP Archive: London, UK, 1979.
16. Krige, S. 'The power of power': Power stations as industrial heritage and their place in history and heritage education. *Yesterday Today* **2010**, *5*, 107–126.

17. The International Committee for the Conservation of Industrial Heritage—TICCIH. The Nizhny Tagil Charter for the Industrial Heritage. 2003. Available online: https://www.icomos.org/18thapril/2006/nizhny-tagil-charter-e.pdf (accessed on 20 June 2022).
18. Dean, C.; Donnellan, C.; Pratt, A.C. Tate Modern: Pushing the limits of regeneration. *City Cult. Soc.* **2010**, *1*, 79–87. [CrossRef]
19. Bellakova, E. Analysis of Industrial Architectural Heritage-Iron and Steel Plants as a Development Potential. *Procedia Eng.* **2016**, *161*, 1926–1931. [CrossRef]
20. Jonsen-Verbeke, M. Industrial heritage: A nexus for sustainable tourism development. *Tour. Geogr.* **1999**, *1*, 70–85. [CrossRef]
21. Abad, C. Valuation of Industrial Heritage in Terms of Sustainability: Some Cases of Tourist Reference in Spain. *Sustainability* **2020**, *12*, 9216. [CrossRef]
22. Edwards, J.A.; Llurdés, I. Mines and quarries. *Ann. Tour. Res.* **1996**, *23*, 341–363. [CrossRef]
23. Merwe, C.; Rogerson, C.M. Industrial heritage tourism at the 'Big Hole', Kimberley, South Africa. *Afr. J. Phys. Health Educ. Recreat. Dance* **2013**, *19*, 155–171.
24. Perfetto, M.C.; Vargas-Sanchez, A. Towards a Smart Tourism Business Ecosystem based on Industrial Heritage: Research perspectives from the mining region of Rio Tinto, Spain. *J. Herit. Tour.* **2018**, *13*, 528–549. [CrossRef]
25. Filler, M. Designing the High Line: Gansevoort Street to 30th Street. *N. Y. Rev. Books* **2009**, *56*, 12.
26. Copic, S.; Dordević, J.; Lukic, T.; Stojanovic, V.; Tumaric, A. Transformation of industrial heritage: An example of tourism industry development in the Ruhr area (Germany). *Geogr. Pannonica* **2014**, *18*, 43–50. [CrossRef]
27. Berger, S.; Wicke, C.; Berger, S.; Wicke, C. A post-industrial mindscape? The popularization of industrial heritage in the Ruhr and the representation of its regional identity. *ABA J.* **1995**, *81*, 30–31. [CrossRef]
28. Siebel, W. *Industrial Past and Urban Future in the Ruhr*; Anglo-German Foundation for The Study of Industrial Society Book Series; Palgrave Macmillan: London, UK, 1999; pp. 123–134. [CrossRef]
29. Szromek, A.R.; Herman, K.; Naramski, M. Sustainable development of industrial heritage tourism—A case study of the Industrial Monuments Route in Poland. *Tour. Manag.* **2021**, *83*, 104252. [CrossRef]
30. Hidalgo-Giralt, C.; Palacios-García, A.; Barrado-Timón, D.; Rodríguez-Esteban, J. Urban Industrial Tourism: Cultural Sustainability as a Tool for Confronting Overtourism—Cases of Madrid, Brussels, and Copenhagen. *Sustainability* **2021**, *13*, 4694. [CrossRef]
31. Simpson, C.R. *Soho, The Artist in the City*; University of Chicago Press: Chicago, IL, USA, 1981. [CrossRef]
32. Mengusoglu, N.; Boyacioglu, E. Reuse of Industrial Built Heritage for Residential Purposes in Manchester. *Metu J. Fac. Archit.* **2013**, *30*, 117–138. [CrossRef]
33. Ifko, S. Comprehensive Management of Industrial Heritage Sites as A Basis for Sustainable Regeneration. *Procedia Eng.* **2016**, *161*, 2040–2045. [CrossRef]
34. Landorf, C. A Framework for Sustainable Heritage Management: A Study of UK Industrial Heritage Sites. *Int. J. Herit. Stud.* **2009**, *15*, 494–510. [CrossRef]
35. Virginija, J.; Martynas, R. Models of cultural heritage management. *Transform. Bus. Econ.* **2014**, *13*, 236–256.
36. Murphy, M.; Mcgovern, E.; Pavia, S. Historic building information modelling (HBIM). *Struct. Surv.* **2015**, *27*, 311–327. [CrossRef]
37. Oreni, D. From 3D Content Models to HBIM for Conservation and Management of Built Heritage. *Comput. Soc.* **2013**, *7974*, 344–357. [CrossRef]
38. Agapiou, A.; Lysandrou, V.; Themistocleous, K.; Hadjimitsis, D.G. Risk assessment of cultural heritage sites clusters using satellite imagery and GIS: The case study of Paphos District, Cyprus. *Nat. Hazards* **2016**, *83*, S5–S20. [CrossRef]
39. Taksa, L. Machines and Ghosts: Politics, Industrial Heritage and the History of Working Life at the Eveleigh Workshops. *Labour Hist.* **2003**, *85*, 65–88. [CrossRef]
40. Shaoming, L. Ruins, or Landscape? A study on the development and design of the urban port industrial district. *Huazhong Archit.* **1999**, *2*, 102–105.
41. Hong, Y. A Thinking on the Development of Industry Tourism in China. *Resour. Dev. Mark.* **1999**, *15*, 2. [CrossRef]
42. Hui, Z.; Feng, Q. Analysis of the preservation value of Shanghai's 1840–1949 industrial heritage architecture. *Archit. J.* **2000**, *11*, 43–47. [CrossRef]
43. *Wuxi Proposal–Focusing on Industrial Heritage Conservation in a Period of High Economic Development*; Archicreation: Wuxi, China, 2006; pp. 199–200.
44. Jianguo, W.; Nan, J. Protective Reuse of Chinese lndustrial Historic Building Heritage in the Post-industrial Age. *Archit. J.* **2006**, *X3*, 8–11. [CrossRef]
45. Boying, L. A Review of Research on China's Industrial Architectural Heritage. *New Archit.* **2012**, *TU27*, 6. [CrossRef]
46. Fuying, L.; Yang, X.; Shunjiang, H. A Study on the Modern Textile Industry Building Heritages in Shanghai. *World Archit.* **2020**, *6*, 4–9.
47. Song, Z. Industrial Heritage Conservation and Regeneration in Redevelopment Areas on Both Sides of the Huangpu River in Shanghai. *Urban Plan. Forum* **2015**, *2*, 102–109. [CrossRef]
48. Yuquan, T. Distribution and Integrity Protection of the Chinese Eastern Railroad Heritage. *Urban Dev. Stud.* **2013**, *6*, 41–46. [CrossRef]
49. Boying, L.; Kuang, L. Conservation Planning and Remodeling Design for ClSW Industrial Heritage. *Archit. J.* **2012**, *6*, 30–35. [CrossRef]

50. Jie, Z.; Jianxin, H.; Yan, L.; Bingbing, Z. Regeneration of Jingdezhen ceramic cultural heritage based on overall planning. *Archit. Pract.* **2021**, *6*, 70–73.
51. Boying, L.; Kuang, L. Study on the System of Beijing Industrial Heritage Conservation and Reuse. *Archit. J.* **2010**, *6*, 1–6. [CrossRef]
52. Hong, J.; Subin, X.; Nobuo, A. Overview of Modern Industrial Development in Tianjin and Classification of Industrial Remains. *Beijing Plan. Rev.* **2011**, *1*, 26–31.
53. Yan, Z.; Yanwei, C. Interpreting the Cultural Connotation of Beijing's Modern lndustrial Heritages: From the Perspectives of Danwei in Urban China. *Urban Dev. Stud.* **2013**, *20*, 23–28. [CrossRef]
54. Chaoyu, M.; Lin, W.; Minghua, X. Preservation-regeneration and Urban Design Practice of the Shanghai Baosteel Stainless Steel Zone. *Time Archit.* **2018**, *6*, 162–167.
55. Lei, W.; Shaojun, Z. An Introduction to the Conservation and Reuse of Industrial Heritage: The Case of China Industrial Museum. *Chin. Mus.* **2013**, *3*, 89–93.
56. Jiancang, L. A Study of Conservation Models for Industrial Heritage of Modern Times. *Southeast Cult.* **2011**, *4*, 14–19.
57. Kai, W.; Chengcai, T.; Jiaming, L. A Measuring Model on Tourist Satisfaction Index in Cultural Creative-type Tourism Destination—A Case of 798 Art Zone in Beijing. *Tour. Trib.* **2011**, *26*, 36–44. [CrossRef]
58. Minghua, X.; Lin, W. Preservation and Regeneration of the Industrial Landscape of the City Centre in Shanghai: A Case Study of the M50 Industrial Transformation and Artistic, Creative Development. *Time Archit.* **2019**, *3*, 163–169.
59. Kongjian, Y.; Wei, P. Understanding design: Reuse of old industrial sites in Zhongshan Qijiang Park. *Archit. J.* **2002**, *8*, 47–52. [CrossRef]
60. Min, Y.; Xu, X.; Yiming, Z.; Yu, L.; Shengyu, Z. Design Strategy of Old Industrial Bases Follow City Transition. *Planners* **2015**, *31*, 130–135.
61. Xin, Q. New Standards for National Industrial Heritage. *People's Daily*, 11 July 2022.
62. Song, Z.; Peng, C. Conservation of Shanghai Industrial Building Heritage and Development of Creative Industry—Park: Based on Investigation, Analysis and Consideration on Hongkou District. *Archit. J.* **2010**, *12*, 12–16. [CrossRef]
63. Bo, W.; Wenlong, R. Research on the preservation and regeneration of industrial heritage in Jiangsu Province. *Jiangsu Soc. Sci.* **2021**, *9*, 232–240.
64. Jixiang, S. New Developments in China's Cultural Heritage Conservation in a Global Perspective. *Contemprary China World* **2022**, *1*, 53–68.
65. He, J.; Liu, J.; Xu, S. Spatial-temporal evolution of modern urban industry in China from 1840 to 1949. *City Plan. Rev.* **2021**, *9*, 79–88.
66. Zheng, J.; Wei, M. Study on the application of BIM+ technology in the preservation of industrial heritage of Middle East Railway—Jilin Province Gongzhuling City as an example. *Sichuan Build. Mater.* **2022**, *48*, 3.
67. Lin, W.; Minghua, X.; Chaoyu, M. Development Trend and System Construction of lndustrial Heritage Preservation. *Shanghai Urban Plan. Rev.* **2017**, *6*, 15–22.
68. Chang, C.; Hong, C.; Sidong, L. Research on the Difficulties and Countermeasures of Shanghai lndustrial Heritage Protection. *Sci. Dev.* **2018**, *4*, 97–107. [CrossRef]
69. Martínez, P. Urban authenticity at stake: A new framework for its definition from the perspective of heritage at the Shanghai Music Valley. *Cities* **2017**, *70*, 55–64. [CrossRef]
70. Yazar, M.; Hestad, D.; Mangalagiu, D.; Ma, Y.; Thornton, T.F.; Saysel, A.K.; Zhu, D. Enabling environments for regime destabilization towards sustainable urban transitions in megacities: Comparing Shanghai and Istanbul. *Clim. Change* **2020**, *160*, 727–752. [CrossRef]
71. Wang, J. 'Art in capital': Shaping distinctiveness in a culture-led urban regeneration project in Red Town, Shanghai. *Cities* **2009**, *26*, 318–330. [CrossRef]
72. Peng, Z.; Xiaojing, W. Evolution of Transformation Policy and Conservation & Regeneration of Industrial Architectural Heritages: A Case Study on Shanghai. *City Plan. Rev.* **2016**, *9*, 75–83. [CrossRef]
73. Shanghai. Measures of Shanghai Municipality for the Preservation and Management of China's 1840–1949 Heritage Architecture. 5 December 1991.
74. Shanghai. Regulations of Shanghai Municipality on the Preservation of Historical and Cultural Zones and Heritage Architecture. 25 July 2002.
75. Ying, S. *Study on the Conservation and Reuse of Industrial Heritage in Shanghai*; Fudan University Press: Shanghai, China, 2014.
76. Chenghao, L.; Yijun, T. *Tracing the Century-Old Industrial Buildings in Shanghai*; Tongji University Press: Shanghai, China, 2017.
77. Shanghai Federation of Economic Organizations; Shanghai Federation of Industrial Economics. *Shanghai Industrial Story from 1921–2021*; Xuelin Press: Shanghai, China, 2021.

land

MDPI

Article

Comparative Residents' Satisfaction Evaluation for Socially Sustainable Regeneration—The Case of Two High-Density Communities in Suzhou

Jinliu Chen [1,2], Paola Pellegrini [2,*] and Haoqi Wang [3]

[1] School of Science & Engineering, University of Liverpool, Liverpool L69 3BX, UK
[2] School of Design, Xi'an Jiaotong-Liverpool University, Suzhou 215123, China
[3] Department of Architecture and Urban planning, Suzhou University of Science and Technology, Suzhou 215123, China
* Correspondence: paola.pellegrini@xjtlu.edu.cn

Abstract: With the 14th Five-Year Plan for Development, China is promoting people-oriented urban regeneration for residential communities built before 2000. Evaluations of quality of life (QoL) and considerations of social sustainability must play an important role in defining people-oriented regeneration projects. Residents' satisfaction is an important indicator of QoL and is essential for achieving socially sustainable development. To contribute to the ongoing discussion about people-oriented urban regeneration, this paper studies the correlation between QoL and social sustainability, investigating residents' perception in high-density communities through a satisfaction evaluation approach based on the QoL index. Two high-density communities in Suzhou were analyzed: Nanhuan, a high-rise, gated community in one of the first expansions of the city in the 80s; and Daoqian, a multi-story, non-gated community in the old town. Both communities have a typical urban morphology and were selected for their exemplary characteristics. The study used a mixed research method: field investigation, on-site interviews, and a survey with over 670 questionnaires conducted and analyzed. It also applied the Structural Equation Model (SEM) to explore and define the satisfaction evaluation factors. The two communities expressed concerns about different factors: in the case of the Nanhuan community, property management and spatial scenario creation were emphasized, whereas in the case of the Daoqian community, unrestricted space mobility, poor existing conditions, and the demand for various facilities and recreation spaces were most prominent. The research found that improving community environmental quality and facilities would, as one would expect, improve residents' satisfaction in both communities. Still, our research also clearly indicated that diversified spatial activities, currently missing in both cases, and more opportunities for social interaction would enhance residents' satisfaction. The findings of this study offer some insights regarding socially sustainable community regeneration, as well as decision-making processes and design strategies.

Keywords: social sustainability; quality of life; residents' satisfaction; old community regeneration; structural equation model

Citation: Chen, J.; Pellegrini, P.; Wang, H. Comparative Residents' Satisfaction Evaluation for Socially Sustainable Regeneration—The Case of Two High-Density Communities in Suzhou. *Land* **2022**, *11*, 1483. https://doi.org/10.3390/land11091483

Academic Editors: Pasquale de Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 21 July 2022
Accepted: 31 August 2022
Published: 4 September 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

Since China's 13th national Five-Year Plan, social sustainability has been highlighted as an essential component for the realization of high-quality urbanization [1,2]. With the urbanization rate in 2021 reaching 64.7%, an urban regeneration approach to development was first mentioned in the Chinese 14th five-year plan (2021–2026). Combined with the idea of people-oriented development, regeneration aims to optimize urban spatial structures and improve urban quality [3,4]. The regeneration of old and obsolete residential communities, as the basic units of social space, is a critical step to achieving high-quality urbanization.

The regeneration movement pays attention to residents' sense of happiness, improves residents' satisfaction, and finally, creates socially sustainable communities [5–7].

The regeneration of old communities is a controversial process. In fact, the community regeneration process can easily cause social problems such as segregation, gentrification and inequality [8–10]. Therefore, social sustainability is particularly important when evaluating the effectiveness of old community regeneration projects. A socially sustainable community can be defined as a place where people want to live and work in the long term [11] and where the enhanced living environment meets residents' needs and ensures social justice [12–14].

Improving quality of life (QoL) is vital for enhancing social sustainability [14,15]. On one hand, the living environment can significantly affect the QoL. The measurement of QoL includes objective indicators of the built environment, which can assist in fulfilling living requirements. On the other hand, under the guidance of the current policy, the transformation process needs to focus more on residents' satisfaction [16,17]. Measurements of QoL include comprehensive consideration of subjective feelings, personal well-being, social balance and social justice [18].

Therefore, measuring resident satisfaction is a very effective way to achieve improved QoL, to evaluate the sustainable development of old communities, to measure infrastructure status and to achieve social sustainability [19].

China's ongoing urban regeneration initiative aims to improve the QoL by improving the living environment. Nevertheless, although QoL was recently highlighted as a national goal, there is still very limited research on how to regenerate old communities. Therefore, it is necessary to study how to combine resident satisfaction with QoL and socially sustainable regeneration. In the framework of the Chinese urban regeneration movement, this study focuses on two main research questions:

(1) How to build a residents' satisfaction evaluation system based on the QoL index?
(2) What factors significantly affect residents' satisfaction in two typical but radically different residential communities?

The structure of this paper is as follows. First, based on a literature review and using satisfaction measurement methods and indicators of social sustainability, a theoretical analysis of the correlation between social sustainability, quality of life, and old community regeneration is presented. Then, the analysis framework and index system of residents' satisfaction evaluation in old communities is explained. Third, the research method is explained, i.e., details are provided about the research sites, the applied questionnaire, and the data collection methods. Fourth, according to the conceptual framework and the main evaluation, the structural equation model (SEM) method is used to evaluate residents' satisfaction and comparatively analyze the significant influencing factors. Finally, the findings are presented along with some suggestions on regeneration interventions and decision-making policies.

2. Conceptual Framework

2.1. Social Sustainability and QoL

As social sustainability is a broad concept, the term has a range of meanings. In this paper, it describes the social goals of sustainable development [20,21]. In many explanations, social sustainability includes social capital, social equity, and public participation. At the community level, social sustainability implies a sustainable and positive QoL based on an understanding people's needs and sense of belonging [12,22,23].

QoL is a comprehensive synthesis of individual well-being and social balance, objective indicators and subjective feelings [24,25]. In the narrow sense, QoL quantifies psychological acceptance, individual characteristics, cognition, etc. on the part of the individual. In the broad sense, it encompasses social equity, including degrees of life satisfaction of different people and future generations (i.e., according to the objective material environment). The relationship between QoL and social sustainability at the community level is predicated

upon three dimensions: housing indicators, neighborhood index, and socioeconomic indicators (Table 1):

(1) Housing indicators: housing area, building quality, house type structure, ventilation, and lighting [26].
(2) Neighborhood indicators: facilities in the community, such as shops, educational facilities, and public transport [27]. Elderly care service measurements evaluate the level of elderly care and medical and health care [28], as well as public spaces [29,30].
(3) Socioeconomic indicators: individual characteristics and perception of QoL, such as gender, income level, home ownership [31,32].

Table 1. Quality of life evaluation index for social sustainability in community regeneration.

Housing Indicators	Housing Ownership, Housing Area, Per Capita Housing Area
Neighborhood Index	Educational Facilities, Business Services, Entertainment Services, Transportation Services, Open Space, Safety, Landscape, Social Environment (Community), Visual Perception
Socioeconomic	Age, Gender, Income, Education Level,

2.2. People-Oriented Old Community Regeneration and Social Sustainability

Current approaches to the regeneration of old communities have the following characteristics:

(1) Government-oriented development in response to the renovation of old communities, with major implementation strategies focusing on "wearing clothes and hats", that is, beautifying buildings and upgrading infrastructure.
(2) For different types of old communities, the applied approaches are the same.
(3) There are many contradictions in the regeneration process. Community planners focus on collecting and coordinating the willingness of residents to accept regeneration initiatives.

The people-oriented regeneration mentioned in the 14th national Five-Year Plan is intended to promote a sense of happiness and well-being for residents, from physical space, standardization, and implementation to social, incentive, and comprehensive regeneration [33]. The interest among old communities in a high-quality living environment and resident satisfaction were informed by assessments of QoL [20,21,34,35]. In this way, through the prism of QoL, social sustainability and community regeneration could be synchronized (Figure 1).

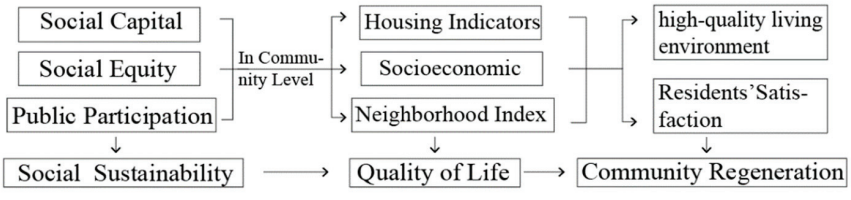


Figure 1. QoL as the mediating link for social sustainability and old community regeneration.

2.3. QoL and Residents' Satisfaction Evaluation

Residents' satisfaction usually refers to the satisfaction of residents living in a specific place [36]. It is a tool that reflects opinions about the housing status quo, planning proposals, and policy making [37,38]. Satisfaction-influenced factors are widely distributed and determined by the gap between actual and expected living environments [39]. Measurements of satisfaction can reflect residents' QoL. Such assessments must take into account the contradiction between the growing needs of people for a better life and unbalanced and insufficient development [40–43].

Based on a QoL evaluation index (Table 1) of urban regeneration, data regarding residents' life satisfaction levels can be divided into the objective environmental characteristics of residential areas [44] and the subjective feelings of residents [45–48]. Subjective feelings including individual characteristics, influenced by gender, age, and education level, are also called "internal causes". Objective environmental characteristics ("external factors") are measured at two levels:

(1) Built Environment, the impact of which on satisfaction is obvious [49], e.g., an overcrowded, polluted living environment has a negative effect on life satisfaction [50]. Individuals living in poor environments may offset the benefits of life satisfaction to community residents [51].
(2) Social Connection, i.e., social ties among community members. For example, greeting and chatting may significantly improve residents' satisfaction [51]. The shopping process accompanied by more or less communication will also affect satisfaction level [52].

Taking into account individual, environment, and social connections when assessing residents' satisfaction is essential for the development of renovation approaches which improve QoL, as well as guiding community regeneration toward social sustainability (Figure 2).

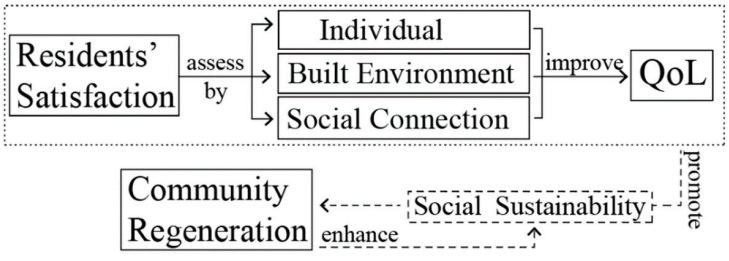


Figure 2. Resident satisfaction evaluation for social sustainability and community regeneration.

3. Data Collection and Methodology

3.1. Case Selection

Suzhou was selected as the case study for several reasons:

(1) It is one of the main historical and cultural cities in China and is comparatively affluent (its GDP in 2021 was USD $352.22 billion);
(2) It ranks 75th in the world and 1st in China in terms of "livability" (Global livable index report). It ranks 58th in the world and 6th in China on the sustainable city index [53];
(3) It was chosen by the national government as one of the first pilot cities for urban regeneration, and so is particularly relevant for an examination of sustainable urban regeneration.

Within Suzhou, two residential communities, with different urban morphology and building typology conditions, were selected to compare resident satisfaction; these communities are representative of typical neighborhoods which are replicated throughout the city. They have different spatial features: Daoqian is in the old town and comprises high-density, low-rise and compact small blocks covering an area of about 18.12 ha, whereas Nanhuan is a resettlement community, made of high-rises with public green areas covering an area of 21.54 ha (Figures 3–5). The Floor–Area Ratio (FAR) of Nanhuan is 2.58, while that of Daoqian FAR is 1.4. The greening rate of Nanhuan is 25.6% and that of Daoqian is 1.51%.

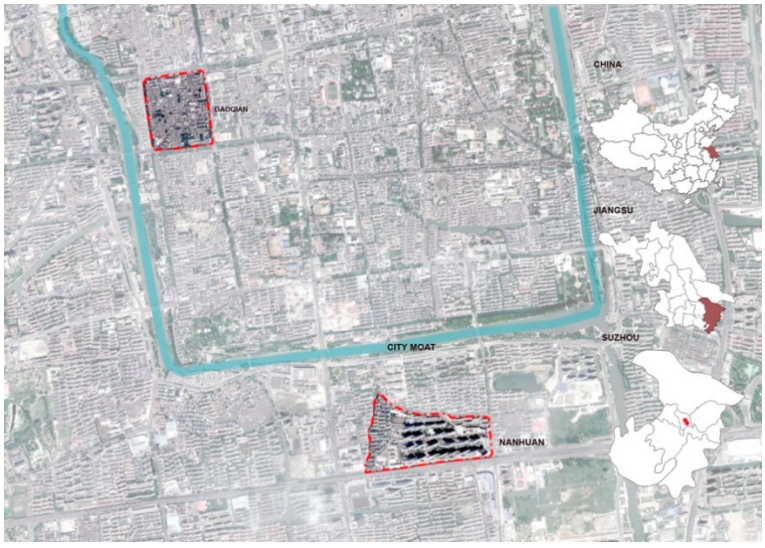


Figure 3. Locations of Nanhuan and Daoqian.

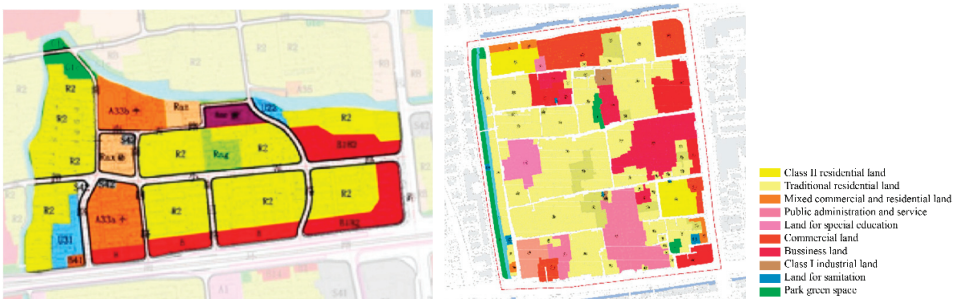


Figure 4. Land use in Nanhuan (**left**) and Daoqian (**right**).

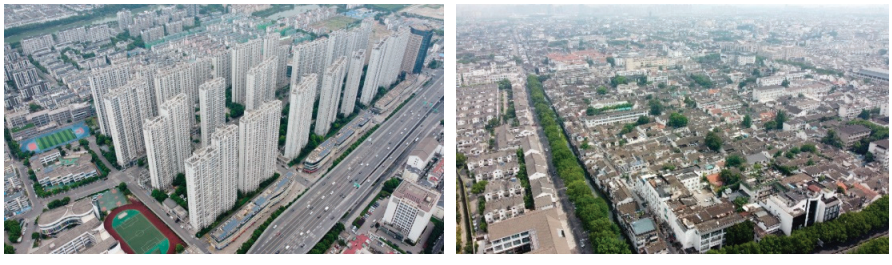


Figure 5. Aerial view of Nanhuan (**left**) and Daoqian (**right**).

Nanhuan is located south of Suzhou's ancient city (Figure 3). It comprises a sequence of multi-story buildings constructed for the resettled farmers between the end of the 1970s and the beginning of the 1980s. Due to poor building quality, part of it was demolished and rebuilt into high-rise residential buildings starting in 2010 (Table 2). Nanhuan new village was promoted and realized 10 years earlier than the current national regeneration guidelines and attracted attention due to its radical transformation and the densification of the preexisting community:

(1) It is the first regeneration of a resettlement area to have been planned, funded, and realized by the Suzhou local government. The project was included in the government's annual list of important tasks in order to set an example for communities experiencing similar conditions;
(2) The initiative resulted in the densification and relocation of local residents;
(3) It combines high-rise buildings with small compact blocks and mixed-use buildings, which is an unusual solution when single function super blocks are most common (Figure 4).

Table 2. Community construction index.

	Nanhuan	**Daoqian**
Total land area	21.54 ha	18.12 ha
Gross Floor Area (GFA)	555,375.76 m^2	252,450 m^2
Residential area and Percentage	391,425 m^2 (70%)	164,092 m^2 (65%)
Floor Area Ratio (FAR)	2.58	1.4
Building Density	26.80%	48.84%
Greenery Rate	25.60%	1.51%
Units	4852	-
Parking lots	2526	-

Daoqian is located in the ancient city (Figure 3). It is a low-rise, high-density residential area with an overall historical style (Table 2) and is a good example of the traditional urban morphology in the ancient city of Suzhou:

(1) The community is crisscrossed with alleys and has numerous original buildings which are protected for their historic, cultural, and architectural value;
(2) The current land ownership situation is complex, with a mix of individual properties and socially owned ones (Figure 4);
(3) The population density in the old town is several times that of other new districts in Suzhou. The green space rate is only 1.5% and the population is aging. Finally, the buildings are old and provide a low-quality living environment.

An analysis of the main spatial characteristics of the two communities showed how variables such as FAR, plot ratio, and green space ratio differed in quantity and quality (Table 2).

3.2. Questionnaire Design and Data Collection

In China, initial studies to measure residents' satisfaction were undertaken relatively late, and various approaches coexisted: some used quantitative and statistical analysis methods to define the influencing factors, while others used qualitative comparisons and descriptive analyses [54,55].

According to the literature, a comprehensive multi-level index system can be used to analyze residents' satisfaction with their communities. The index system considers objective and subjective factors. Objective factors include the characteristics of the residential unit, the surrounding environment, and infrastructure [56–64], while subjective factors include personal and family characteristics, income level, house ownership, and compensation for relocation [64–69].

These factors can be grouped into three main categories:

(1) Individual attributes, such as age, education, family structure, economic level, and house ownership [66,70,71];
(2) Housing conditions, such as building quality, building area, building age, building orientation, lighting, and ventilation [72–76];
(3) Community Context, such as community management, supporting infrastructure, transportation convenience, surrounding environmental conditions, relationships with fellow residents [61,70,77–80].

In addition, as interactions within a community significantly impact its residents' perception thereof, we introduced the category of "intercommunication" [81].

The questionnaire summarized in Table 3 comprises five groups of variables to represent a range of the factors and the related degree of satisfaction. The data were recorded using a scale from 1 to 5.

Table 3. Questionnaire structure and content.

Satisfaction Index	Observational Variable
Personal characteristics	Gender Age Income Marital status Educational background
Inhabited environment	Area Number of members Building quality
Community environment	Air quality Estate management Pedestrian safety Green landscape People and cars Cultural symbols
Community convenience	Public space Leisure space Parking convenience Facility convenience Facility diversity Ageing services Traffic convenience
Intercommunication	Neighborhood interaction Shopping tendency
	Overall satisfaction

A preliminary field survey was conducted to test the questions and the structure of the questionnaire. In addition, people with different professional knowledge and involvement in the community were interviewed to gain an in-depth understanding of the current situation and to improve the accuracy of data.

From August to October 2021, the questionnaire was distributed in both communities by convenience sampling, which is a non-probabilistic sampling method whereby respondents are selected randomly at a specific time and in a specific community area. To this end, 680 questionnaires were distributed, i.e., 330 in Nanhuan new village and 350 in Daoqian community. The samples are representative because the statistics show how the residents are homogenous in terms of their demographic and socio-economic characteristics.

3.3. Data and Model Analysis

The first conclusions to be drawn from the results of the questionnaire (Table 4) were as follows:

(1) Income: 36.4% of residents in Daoqian community have an income below 5000, while 25.2% of residents in Nanhuan new village had an income of 10,000–15,000.

(2) Living area: 64% of residents live in apartments of 50–80 m^2 in size in Nanhuan; the living areas of residents in Daoqian were generally smaller, as would be expected for the houses in the old town (no accurate official data are available).

(3) Overall satisfaction: In Nanhuan new village, scores of 3 and 4 out of 5 were reported by 45.2% and 45.5% of respondents, respectively. The satisfaction scores of Daoqian community were mainly 2, 3, and 4, accounting for 14.2%, 47.3%, and 30.9%, respectively.

Table 4. Questionnaire analysis.

	Mean Value		Standard Deviation	
	Nanhuan	**Daoqian**	**Nanhuan**	**Daoqian**
Gender	1.51	1.45	0.501	0.498
Age	1.77	1.02	0.823	0.926
Income	2.42	3.26	1.109	1.473
Area	3.11	2.40	1.233	0.991
Number of members	2.76	2.62	1.213	1.037
Building quality	3.14	3.27	0.788	0.794
Air quality	3.49	3.18	0.841	1.132
Estate management	2.96	3.09	0.982	0.838
Pedestrian safety	3.44	2.99	1.071	0.961
Green landscape	3.02	3.36	1.068	0.814
Public space	2.98	3.63	0.983	0.946
Leisure space	2.87	2.69	0.875	0.723
Parking convenience	2.75	2.35	0.981	1.226
Facility convenience	3.34	3.42	1.037	1.055
Ageing services	3.25	1.63	1.106	0.954
Traffic convenience	3.73	3.63	1.007	0.950
Neighborhood interaction	3.18	1.68	1.232	1.185
Shopping tendency	1.49	1.62	0.553	0.510
Overall satisfaction	3.26	3.40	0.831	0.692

In a general overview of the average level of overall satisfaction of the residents, Daoqian, where traditional structures and urban open spaces are conserved, offers worse living conditions, e.g., smaller living areas, to an aging population with a low income than the newer Nanhuan. On account of this, the overall satisfaction was low and the distribution was concentrated (Figure 6). A further detailed analysis showed how the two communities have different expectations.

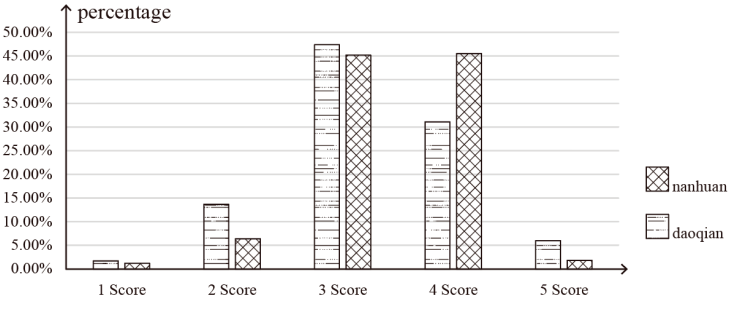


Figure 6. Frequency distribution of satisfaction.

3.4. Method Selection

The structural equation model (SEM) is a research method based on statistical analysis technology. It can deal with complex multivariable research data analyses. Joreskog proposed a multivariate statistical analysis method to analyze the complex relationship structure between multiple index variables by using a SEM; this was one of the three significant advances in statistics in recent years [82]. The SEM overcomes the limitations of traditional statistical methods, making it an important tool for multivariate data analyses. It is suitable for three-dimensional and multi-level analyses and can exist in human thinking

forms. It can analyze variables (i.e., latent variables) that cannot be directly measured, quantify the causal relationships among various factors, and carry out various subdivisions and comparisons. As shown in Figure 7, a and B are observation variables used to characterize latent variable C, and C influences H. Therefore, this paper used SEM to analyze the results from our resident satisfaction questionnaire.

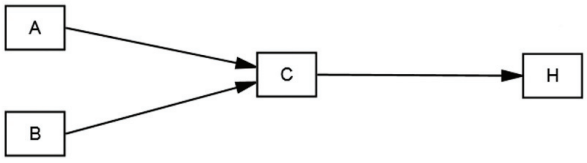


Figure 7. SEM analysis method.

4. Results and Discussions

4.1. Identification of Factors and Modelling

In SPSS, we applied the Kaiser Meyer Olkin and Bartlett tests to ensure that the results were in the normal range and, therefore, valid. Then, exploratory factor analysis (EFA) was applied. Using the maximum variance method, EFA summarized the original data into several groups of explanatory elements by orthogonal rotation. These elements were called "shallow variables" in the structural program model, and the SEM was constructed on this basis (Tables 5 and 6).

Table 5. Exploratory factor analysis of Nanhuan.

Factor Name	Included Variables (Factor Loading)
Surrounding	Facility convenience (0.533), Estate management (0.784), Building quality (0.693), Air quality (0.566),
Socialize	Shopping tendency (0.841), Age (0.852), Neighborhood interaction (0.476),
Community	Traffic convenience (0.818), Public space (0.730), Leisure space (0.690),
Character	Pedestrian safety (0.688), Income (−0.775), Gender (0.578),

Table 6. Exploratory factor analysis of Daoqian.

Factor Name	Included Variables (Factor Loading)
Individual	Marital status (0.643), Age (0.802), Educational background (−0.809),
Recreation	Green landscape (0.685), Public space (0.744), Leisure space (0.739),
Management	Air quality (0.560), Estate management (0.638), Pedestrian safety (0.822),
Vitality	Facility diversity (0.628), People and cars (0.784), Cultural symbols (0.723),

Using the maximum variance orthogonal rotation statistical method, the influencing factors in Nanhuan were found to be: "surroundings", "socializing", "community", and "character". Table 5 shows the significant factors and the corresponding variables. The influencing factors obtained from Daoqian were: "individual", "recreation", "management", and "vitality". Table 6 shows these significant factors and the corresponding variables.

Starting from the influencing factors condensed by the exploratory factor analysis and the hypothesized relationships among the variables, IBM® SPSS® Amos 26, a structural equation modeling program, was used to construct the SEM. The statistical method of maximum likelihood estimation was applied to calculate the value of the variables in the model (see Figure 8).

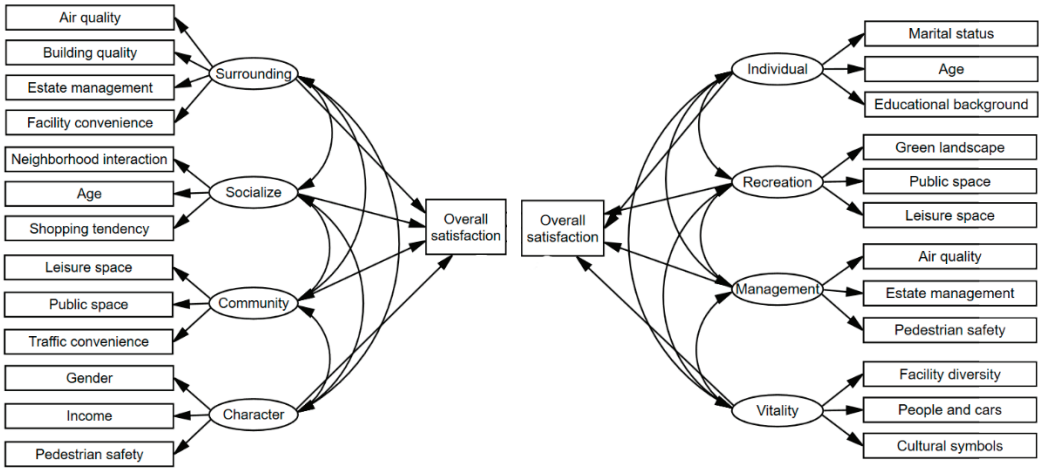


Figure 8. Model structure (**left**: Nanhuan; **right**: Daoqian).

4.2. SEM Analysis Results

On the basis of the test results of the structural equation model, and using the correction index provided by AMOS to correct the model, we observed that the "model fit" was within a reasonable range (Table 7). We then applied the coefficient results, selected the variables of C.R. > 2, $p < 0.01$, and finally, determined that the degree of life satisfaction of the residents of Nanhuan new village was determined by the parameters "surrounding", "socialize", "community" and "character" (Table 8), of which "surrounding" had the most significant impact, followed by "character". Meanwhile, the degree of life satisfaction experienced by the Daoqian community was determined by "recreation", and "management" (Table 9).

Table 7. Test results for Nanhuan and Daoqian.

Match Index	Reference Value	Model Result (Nanhuan)	Model Result (Daoqian)	Whether It Met
CMIN/DF (relative chi square)	<3.00	1.239	1.291	Yes
RMSEA	<0.05	0.026	0.03	Yes
RMR	<0.08	0.045	0.038	Yes
NFI	>0.9	0.920	0.906	Yes
TLI	>0.9	0.976	0.965	Yes
CFI	>0.9	0.983	0.976	Yes
GFI	>0.8	0.972	0.968	Yes

Table 8. Modified SEM coefficient results for Nanhuan.

			Estimate	S.E.	C.R.	*p*	Estimate (S)
Facility convenience	<–	Surrounding	1.000				0.324
Estate management	<–	Surrounding	2.023	0.377	5.369	***	0.825
Building quality	<–	Surrounding	1.355	0.268	5.050	***	0.583
Air quality	<–	Surrounding	1.129	0.275	4.113	***	0.340
Shopping tendency	<–	Socialize	1.000				0.604
Age	<–	Socialize	2.549	0.374	6.826	***	0.846
Neighborhood interaction	<–	Socialize	1.883	0.257	7.315	***	0.486
Pedestrian safety	<–	Character	1.000				0.494
Income	<–	Character	−2.034	0.459	−4.433	***	−0.658
Gender	<–	Character	0.363	0.074	4.881	***	0.348
Traffic convenience	<–	Community	1.000				0.846
Public space	<–	Community	0.619	0.120	5.166	***	0.527
Leisure space	<–	Community	0.399	0.081	4.934	***	0.445
Overall satisfaction	<–	Surrounding	1.836	0.361	5.093	***	0.904
Overall satisfaction	<–	Socialize	0.627	0.210	2.980	0.003	0.278
Overall satisfaction	<–	Community	−0.112	0.070	−1.611	0.107	−0.131
Overall satisfaction	<–	Character	0.842	0.245	3.437	***	0.576

*** Indicates significance at the $p < 0.001$.

Table 9. Modified SEM coefficient results for Daoqian.

			Estimate	S.E.	C.R.	*p*	Estimate (S)
Marital status	<–	Individual	1.000				0.504
Age	<–	Individual	1.498	0.204	7.333	***	0.737
Educational background	<–	Individual	−2.755	0.377	−7.299	***	−0.747
Green landscape	<–	Recreation	1.000				0.557
Public space	<–	Recreation	1.230	0.152	8.078	***	0.742
Leisure space	<–	Recreation	0.952	0.122	7.814	***	0.640
Facility diversity	<–	Vitality	1.000				0.729
People and cars	<–	Vitality	0.735	0.122	6.030	***	0.518
Cultural symbols	<–	Vitality	0.745	0.126	5.930	***	0.496
Air quality	<–	Management	1.000				0.616
Estate management	<–	Management	1.221	0.167	7.322	***	0.646
Pedestrian safety	<–	Management	1.143	0.164	6.953	***	0.554
Overall satisfaction	<–	Individual	0.087	0.131	0.662	0.508	0.043
Overall satisfaction	<–	Recreation	0.494	0.128	3.858	***	0.351
Overall satisfaction	<–	Management	0.391	0.144	2.711	0.007	0.242
Overall satisfaction	<–	Vitality	−0.117	0.084	−1.398	0.162	−0.110

*** Indicates significance at the $p < 0.001$.

For the observation variables, the significant factors were “property management”, “age”, “shopping tendency”, and “construction quality”.

In the Nanhuan community, “age” and “property management” had a strong correlation with resident satisfaction (Table 8), while “facility convenience”, “air quality”, and “gender” had low correlations. Residents also focused on some factors which are not related to space, such as “community management” and “shopping”. Still, the results showed that “property management” was the main influencing factor, based on the absolute values. This finding may be surprising, but it shows the importance of factors that directly affect daily life, such as the efficiency and function of buildings and complexes. For the renewal part of the community, it could be concluded that resettlement is interpreted as an opportunity [83].

In Nanhuan, “Supporting facilities”, “air quality”, and “pedestrian safety” had little impact on overall satisfaction (Figure 9). It is worth mentioning that although facilities and green spaces play an important role in people’s lives, their impact on satisfaction was not significant due to the high level of renovation and reconstruction that took place in 2014.

Public facilities were created between the two parts of the Nanhuan community, and are equally available for both territories. The green space along the canal and the small park in the center of the new part easily accessible to residents of both territories.

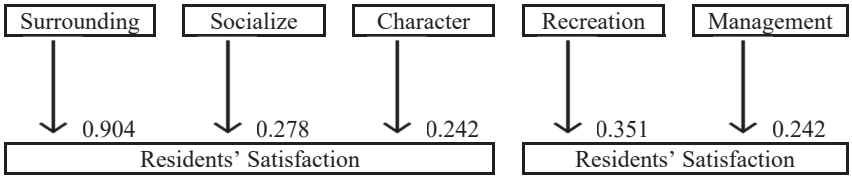


Figure 9. Final influencing factors of Nanhuan (**left**) and Daoqian (**right**).

In the Daoqian community, potential variables were only "recreation" and "management" (Figure 9). The corresponding observation variables, such as "green landscapes", "public spaces", "recreational spaces", "air quality", "property management", and "pedestrian safety", were shown to have a great impact on satisfaction.

After examining the results of the analysis, we sought to engage in direct dialogue with residents of the Daoqian community to support our understanding of their relative lack of satisfaction in comparison with the residents of Nanhuan. Members of the Daoqian community confirmed the answers given in the questionnaire and declared that they did not think that Nanhuan community provided better living conditions, although they expressed satisfaction with the size of their units. Personal attributes usually affect such assessments, but it is extremely relevant that the residents of Daoqian did not express satisfaction regarding the urban model they live in. In other words, although their living environment is defined by a completely different urban form, their satisfaction assessments about the living conditions and the size of their units were similar to those given by residents of Nanhuan. The former group was critical of public spaces and community management. Even green spaces were secondary is their assessments, despite the fact that such spaces make up less than 2% of the neighborhood. It can be concluded that the Daoqian community considers itself to be impacted mostly by what is outside of their homes, i.e., recreational spaces and the applied community management model.

The above comparison shows significant differences between the residential areas in the two environments. The historic urban area is made up of obsolete, low-rise, high-density blocks inhabited by low-income residents. Furthermore, all aspects concerning living conditions and supporting facilities were found to be far from satisfactory in this middle-class city. Despite the aging population in Suzhou, most of the residents there are long-term residents that enjoy the central location and are used to such a living environment.

The community is a typical neighborhood in Suzhou and, as such, is subject to historical-cultural protection and development control. Therefore, an acupuncture-style transformation model has to be implemented to improve the conditions and support the creation of recreational and communication spaces. Management has to be improved in order to maintain the area's environmental quality and public security. Finally, although the degree of possible transformation is limited, any action should seek to achieve social sustainable regeneration, that is to say, it should focus on increasing the livability of the local environment, considering which transformations will be accepted and focusing on the revitalization of the area, in order to attract young people and create opportunities and urban vitality.

More recent urban areas were built according to modern urban planning theory, in response to the "standardized" demands regarding infrastructure and facilities and green space–high rise settings with large areas being devoted to green spaces and public facilities. The incomes of residents are higher and their expectations are different from those of the Daoqian residents.

What is needed in such a setting is to create a differentiated communication space and to promote transformations focused on residents' perception. Regeneration strategies need

to meet the living and psychological needs of different groups, make full use of low land occupation rates, improve environmental protection measures, and to reduce urban noise and air pollution.

5. Conclusions

Evaluations of residents' satisfaction have recently become a more prominent part in the Chinese people-oriented regeneration approach to urbanization. This metric allows researchers to measure the efficacy of urban transformations and the regeneration process.

This research had the goal of assessing the satisfaction level of the residents of two communities in terms of their quality of life, as it relates to the built environment. Two typical communities with different urban forms were selected as the research objects. Within the framework of community regeneration, the goal of the research was to define a quantitative measurement method by which to obtain the most effective feedback on satisfaction, to understand the main factors which impact resident satisfaction assessments, and to provide suggestions for the design of regeneration initiatives and policy-making.

The contribution of this paper lies in the applied method, i.e., the careful adaptation to case studies of a process that is established in the literature, and in the comparison of the level of satisfaction associated with two different urban morphologies in the same city and the main indicators. This research is original and extremely relevant for the future development in China. On one hand, many projects that were realized after the initial opening-up of the nation are now obsolescent and must be regenerated. Such a process has to be discussed in detail. On the other hand, being socially sustainable implies serious consideration of residents' opinions. In addition to this, the quantity of land used for residential communities, that is to say, the density and compactness of dwellings, must be assessed. Different urbanization models must be taken into consideration and compared.

In detail, our comparison of the two communities' showed that all residents have the basic need for comfort, safety, and a variety of facilities; however, the needs of the two places were found to be different. Satisfaction in Daoqian is limited due to the current conditions, and the residents there urgently need new facilities and supporting services. The satisfaction in Nanhuan was found to be more closely related to individual and social network factors, i.e., the improvement of facilities and the diversity of space can significantly improve perceptions by residents of their urban environment. Regeneration initiatives need to create intangible community settings to enhance interactions between residents and the built environment.

Based on these findings, this research makes the following contributions to community regeneration through the prism of social sustainability. First, it establishes a community regeneration conceptual framework that links societies with QoL to achieve sustainable regeneration. Second, according to various factors influencing QoL, it proposes a systematic questionnaire method targeting the individual, built environment, and social interaction levels. The proposed method is of great significance, because there are no unified standards to analyze satisfaction in residential communities. Third, as for the resulting feedback, it was found that the people with different living experiences and individual characteristics and resources express differences in their yearning for space. In drafting policies and regeneration strategies to improve QoL for sustainable development, local satisfaction must be considered.

6. Limitations

As we were not able to obtain official population data, we could not precisely determine the correlated objects or the number of samples. Therefore, the residents' satisfaction results may have been influenced by one or more additional factors which were not tested. Future research could selectively use and input big data for more accurate analyses.

Author Contributions: Conceptualization, J.C. and P.P.; methodology, J.C. and P.P.; software, H.W.; validation, J.C., P.P. and H.W.; formal analysis, J.C. and H.W.; investigation, J.C. and P.P.; resources, J.C. and P.P.; data curation, H.W.; writing—original draft preparation, J.C.; writing—review and editing, P.P.; visualization, J.C. and H.W.; supervision, P.P.; funding acquisition, P.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by XJTLU Research Development Fund, grant number RDF-17-02-25; XJTLU SURF project 202010.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the XJTLU University Ethics Committee, number 21-01-03.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All data are available and can be requested to the authors.

Acknowledgments: Thanks for the data collection support from XJTLU undergraduate students Yihan Shi and Xiaoxiao Feng.

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

References

1. The State Council. Several Opinions of the State Council on Further Promoting the Construction of New Urbanization, 2 September 2016. Available online: http://www.gov.cn/zhengce/content/2016-02/06/content_5039947.htm (accessed on 16 June 2022).
2. Guo, S.; Guo, B. *China in Search of a Harmonious Society*; Lexington Books: Washington, DC, USA, 2008; ISBN 0739126245.
3. The Xinhua News Agency. *Outline of the Fourteenth Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Vision 2035*; People's Publishing House: Beijing, China, 2021.
4. Pellegrini, P.; Chen, J. Hypothesis of Densification for a Sustainable Urbanization in a Wealthy Chinese City. *IOP Conf. Ser. Earth Environ. Sci.* **2020**, *588*, 052029. [CrossRef]
5. Baiden, P.; Arku, G.; Luginaah, I.; Asiedu, A.B. An Assessment of Residents' Housing Satisfaction and Coping in Accra, Ghana. *J. Public Health* **2011**, *19*, 29–37. [CrossRef]
6. Peng, Y.; Bruyns, G.; Qu, L. Review of Chinese Megablock Urbanism: Case Study of Rapid Urbanization in the Greater Bay Area. In Proceedings of the 13th Conference of the International Forum on Urbanism, Katowice, Poland, 20–26 June 2021; pp. 421–430.
7. Pocock, J.; Steckler, C.; Hanzalova, B. Improving Socially Sustainable Design and Construction in Developing Countries. *Procedia Eng.* **2016**, *145*, 288–295. [CrossRef]
8. Hwang, J. Gentrification in Changing Cities: Immigration, New Diversity, and Racial Inequality in Neighborhood Renewal. *Ann. Am. Acad. Pol. Soc. Sci.* **2015**, *660*, 319–340. [CrossRef]
9. Hwang, J.; Sampson, R.J. Divergent Pathways of Gentrification: Racial Inequality and the Social Order of Renewal in Chicago Neighborhoods. *Am. Sociol. Rev.* **2014**, *79*, 726–751. [CrossRef]
10. Chen, J.; Pellegrini, P.; Ma, G. Identifying Resettlement Communities' Urban Regeneration Opportunity Through GIS-Based Spatial Analysis in Suzhou Metropolitan Area. *Urban Reg. Plan.* **2021**, *6*, 146–157. [CrossRef]
11. Sundelin, A. Reaching Social Sustainability in Residential Architecture. Master's Thesis, Chalmers University of Technology, Göteborg, Sweden, 2019.
12. Bramley, G.; Dempdey, N.; Power, S.; Brown, C.; Watkins, D. Social Sustainability and Urban Form: Evidence from Five British Cities. *Environ. Plan. A* **2009**, *41*, 2125–2142. [CrossRef]
13. Pareja-Eastaway, M. *Social Sustainability*; Elsevier Ltd.: Amsterdam, The Netherlands, 2012; Volume 6. ISBN 9780080471716.
14. McKenzie, S. Social Sustainability: Towards Some Definitions. *Univ. South Aust.* 2004, pp. 1–31. Available online: https://www.unisa.edu.au/siteassets/episerver-6-files/documents/eass/hri/working-papers/wp27.pdf (accessed on 16 June 2022).
15. Karuppannan, S.; Sivam, A. Social Sustainability and Neighbourhood Design: An Investigation of Residents' Satisfaction in Delhi. *Local Environ.* **2011**, *16*, 849–870. [CrossRef]
16. Diener, E.; Ryan, K. Subjective Well-Being: A General Overview. *South Afr. J. Psychol.* **2009**, *39*, 391–406. [CrossRef]
17. Felce, D.; Perry, J. Quality of Life: Its Definition and Measurement. *Res. Dev. Disabil.* **1995**, *16*, 51–74. [CrossRef]
18. Mohit, M.A. Present Trends and Future Directions of Quality-of-Life. *Procedia Soc. Behav. Sci.* **2014**, *153*, 655–665. [CrossRef]
19. Ma, L.; Woods, O.; Zhu, H. Restoration of an Ancestral Temple in Guangzhou, China: Re-Imagining History and Traditions through Devotion to Art and Creation. *Cult. Geogr.* **2019**, *26*, 141–149. [CrossRef]
20. Hopwood, B.; Mellor, M.; O'Brien, G. Sustainable Development: Mapping Different Approaches. *Sustain. Dev.* **2005**, *13*, 38–52. [CrossRef]
21. Littig, B.; Griessler, E. Social Sustainability: A Catchword between Political Pragmatism and Social Theory. *Int. J. Sustain. Dev.* **2005**, *8*, 65–79. [CrossRef]
22. Forrest, R.; Kearns, A. Social Cohesion, Social Capital and the Neighbourhood. *Urban Stud.* **2001**, *38*, 2125–2143. [CrossRef]
23. Burton, E.; Mitchell, L. *Inclusive Urban Design: Streets for Life*; Routledge: London, UK, 2006; ISBN 0080456456.

24. Pacione, M. Urban Environmental Quality and Human Wellbeing—A Social Geographical Perspective. *Landsc. Urban Plan.* **2003**, *65*, 19–30. [CrossRef]
25. Mohit, G.; Yadav, A.K.; Bisht, N.S.; Giresh, M. Valuation of Recreational Benefits from Valley of Flowers National Park. *Indian For.* **2008**, *134*, 26–35.
26. Zhan, D.; Meng, B.; Zhang, W.Z. A Study on Residential Satisfaction and Its Behavioral Intention in Beijing. *Geogr. Res.* **2014**, *33*, 336–348.
27. Lucht, F.; Frey, B.; Salmons, J. A Tale of Three Cities: Urban-Rural Asymmetries in Language Shift? *J. Ger. Linguist.* **2011**, *23*, 347–374. [CrossRef]
28. Carey, E.C.; Covinsky, K.E.; Lui, L.Y.; Eng, C.; Walter, L.C. Prediction of Mortality in Community-Living Frail Elderly People with Long-Term Care Needs. *J. Am. Geriatr. Soc.* **2010**, *56*, 68–75. [CrossRef]
29. Liu, Z.; Wang, X.; Ma, J. The Impact Mechanism of Beijing Community Public Space on Neighborhood Communication in the Transitional Period: A Comparative Analysis of Local Residents and Immigrants. *Geogr. Sci.* **2020**, *40*, 69–78.
30. Scott, M.J.; Lennon, M.; Douglas, O. Mainstreaming Green Infrastructure as a Health-Promoting Asset. *Ctry. Plan.* **2019**, *88*, 151–156.
31. Stevenson, B.; Wolfers, J. Subjective Well-Being and Income: Is There Any Evidence of Satiation? *Am. Econ. Rev.* **2013**, *103*, 598–604. [CrossRef]
32. Sacks, D.W.; Stevenson, B.; Wolfers, J. *Subjective Well-Being, Income, Economic Development and Growth*; National Bureau of Economic Research: Cambridge, MA, USA, 2010.
33. General Office of the State Council. Guidance of the General Office of the State Council on Comprehensively Promoting the Transformation of Old Urban Communities, 10 July 2020. Available online: http://www.gov.cn/zhengce/zhengceku/2020-07/20/content_5528320.htm (accessed on 16 June 2022).
34. Liu, J.; Tan, X.; Cheng, Q. Practice and Thinking of Participatory Community Planning under the Background of Transformation—A Case Study of Y Community, Qinghe Street, Beijing. *Shanghai Urban Plan.* **2017**, *6*, 23–28.
35. Lee, G.K.L.; Chan, E.H.W. The Analytic Hierarchy Process (AHP) Approach for Assessment of Urban Renewal Proposals. *Soc. Indic. Res.* **2008**, *89*, 155–168. [CrossRef]
36. Canter, D. *The Psychology of Place*; St Martin's Press: New York, NY, USA, 1977.
37. Etminani-Ghasrodashti, R.; Majedi, H.; Paydar, M. Assessment of Residential Satisfaction in Mehr Housing Scheme: A Case Study of Sadra New Town, Iran. *Hous. Theory Soc.* **2017**, *34*, 323–342. [CrossRef]
38. Muchadenyika, D.; Waiswa, J. Policy, Politics and Leadership in Slum Upgrading: A Comparative Analysis of Harare and Kampala. *Cities* **2018**, *82*, 58–67. [CrossRef]
39. Jeon, J.Y.; You, J.; Chang, H.Y. Sound Radiation and Sound Quality Characteristics of Refrigerator Noise in Real Living Environments. *Appl. Acoust.* **2007**, *68*, 1118–1134. [CrossRef]
40. Chen, F.; Drezner, Z.; Ryan, J.K.; Simchi-Levi, D. Quantifying the Bullwhip Effect in a Simple Supply Chain: The Impact of Forecasting, Lead Times, and Information. *Manag. Sci.* **2000**, *46*, 436–443. [CrossRef]
41. Geng, Y. Evaluation and Method of Residential Satisfaction. *J. Tsinghua Univ.* **1999**, *14*, 79–85.
42. Li, Z.; Wu, F. Residential Satisfaction in China's Informal Settlements: A Case Study of Beijing, Shanghai, and Guangzhou. *Urban Geogr.* **2013**, *34*, 923–949. [CrossRef]
43. Ma, B.; Zhou, T.; Lei, S.; Wen, Y.; Htun, T.T. Effects of Urban Green Spaces on Residents' Well-Being. *Environ. Dev. Sustain.* **2019**, *21*, 2793–2809. [CrossRef]
44. Zhang, Q.; Hiu-Kwan Yung, E.; Hon-Wan, C.E. Meshing Sustainability with Satisfaction: An Investigation of Residents' Perceptions in Three Different Neighbourhoods in Chengdu, China. *Land* **2021**, *10*, 1280. [CrossRef]
45. Chen, F.; Chen, H.; Zhu, Z.; Peng, B. Study on Evaluation of Urban Human Settlement Environment and Satisfaction. *Hum. Geogr.* **2000**, *15*, 20–23.
46. Du, H. Factors Influencing Residents' Satisfaction with Residential Environment Quality—A Case Study of Several Residential Areas in the Pearl River Delta. *Urban Plan. Forum* **2002**, *7*.
47. Li, H. Community Satisfaction of Urban Residents and Its Impact on Community Belonging. Master's Thesis, Huazhong University of Science and Technology, Wuhan, China, 2005.
48. Geng, J.; Gao, Q.; Zhang, S. Community Satisfaction Evaluation System Based on Analytic Hierarchy Process and Factor Analysis. *J. Syst. Manag.* **2007**, *16*, 673–677.
49. Lee, K.Y. Relationship between Physical Environment Satisfaction, Neighborhood Satisfaction, and Quality of Life in Gyeonggi, Korea. *Land* **2021**, *10*, 663. [CrossRef]
50. Cao, J.; Zhang, J. Built Environment, Mobility, and Quality of Life. *Travel Behav. Soc.* **2016**, *5*, 1–4. [CrossRef]
51. Diener, E.; Scollon, C.N.; Lucas, R.E. *The Evolving Concept of Subjective Well-Being: The Multifaceted Nature of Happiness*; American Psychological Association: Washington, DC, USA, 2009.
52. Li, G. Survey on Residents' Satisfaction with Living in Typical Areas of Shenzhen. *Urban Issues* **2015**, 72–77.
53. Kamiya, M.; Ni, P. *Global Urban Competitiveness Report (2019–2020) The World: 300 Years of Transformation into City*; UN-Habitat: Nairobi, Kenya, 2020.
54. Wang, J. A Study of Living Satisfaction in the Urban Village Relocation Areas: The Case of Zhengzhou Urban Villages. *Archit. J.* **2016**, *14*, 86–89.

55. Yuan, Y.; Ding, K.; Cao, X.; Wu, X. A Review of Neighborhood Satisfaction. *Urban Dev. Stud.* **2018**, *25*, 111–117.
56. Awotona, A. Nigerian Government Participation in Housing: 1970–1980. *Habitat Int.* **1990**, *14*, 17–40. [CrossRef]
57. Ozo, A.O. Low Cost Urban Housing Strategies in Nigeria. *Habitat Int.* **1990**, *14*, 41–54. [CrossRef]
58. Lee, S.-W.; Ellis, C.D.; Kweon, B.-S.; Hong, S.-K. Relationship between Landscape Structure and Neighborhood Satisfaction in Urbanized Areas. *Landsc. Urban Plan.* **2008**, *85*, 60–70. [CrossRef]
59. Mccrea, R.; Stimson, R.; Western, J. Testing a Moderated Model of Satisfaction with Urban Living Using Data for Brisbane-South East Queensland, Australia. *Soc. Indic. Res.* **2005**, *72*, 121–152. [CrossRef]
60. Riazi, M.; Emami, A. Residential Satisfaction in Affordable Housing: A Mixed Method Study. *Cities* **2018**, *82*, 1–9. [CrossRef]
61. Salleh, A.G. Neighbourhood Factors in Private Low-Cost Housing in Malaysia. *Habitat Int.* **2008**, *32*, 485–493. [CrossRef]
62. Huang, Z.; Du, X. Assessment and Determinants of Residential Satisfaction with Public Housing in Hangzhou, China. *Habitat Int.* **2015**, *47*, 218–230. [CrossRef]
63. Mohit, M.A.; Azim, M. Assessment of Residential Satisfaction with Public Housing in Hulhumale', Maldives. *Procedia Soc. Behav. Sci.* **2012**, *50*, 756–770. [CrossRef]
64. Speare, A. Residential Satisfaction as an Intervening Variable in Residential Mobility. *Demography* **1974**, *11*, 173–188. [CrossRef]
65. Malpass, P. *Housing and the Welfare State: The Development of Housing Policy in Britain*; Palgrave Macmillan Basingstoke: London, UK, 2005. ISBN 0333962095.
66. Mohit, M.A.; Ibrahim, M.; Rashid, Y.R. Assessment of Residential Satisfaction in Newly Designed Public Low-Cost Housing in Kuala Lumpur, Malaysia. *Habitat Int.* **2010**, *34*, 18–27. [CrossRef]
67. Tan, Y.; He, J.; Han, H.; Zhang, W. Evaluating Residents' Satisfaction with Market-Oriented Urban Village Transformation: A Case Study of Yangji Village in Guangzhou, China. *Cities* **2019**, *95*, 102394. [CrossRef]
68. Huang, X.; He, D.; Tang, S.; Li, X. Compensation, Housing Situation and Residents' Satisfaction with the Outcome of Forced Relocation: Evidence from Urban China. *Cities* **2020**, *96*, 102436. [CrossRef]
69. Galster, G. Identifying the Correlates of Dwelling Satisfaction: An Empirical Critique. *Environ. Behav.* **1987**, *19*, 539–568. [CrossRef]
70. Li, Y.; Luo, J. The Influence Factors of Residential Satisfaction of Urban Floating Population in China. *Chongqing Soc. Sci.* **2014**, *8*, 61–68.
71. Galster, G.C.; Hesser, G.W. Residential Satisfaction: Compositional and Contextual Correlates. *Environ. Behav.* **1981**, *13*, 735–758. [CrossRef]
72. Garrod, G.D.; Willis, K.G. Valuing Goods' Characteristics: An Application of the Hedonic Price Method to Environmental Attributes. *J. Environ. Manag.* **1992**, *34*, 59–76. [CrossRef]
73. Paris, D.E.; Kangari, R. Multifamily Affordable Housing: Residential Satisfaction. *J. Perform. Constr. Facil.* **2005**, *19*, 138–145. [CrossRef]
74. Hongfeng, L. Empirical Analysis and Countermeasures of Commercial Housing Residents' Satisfaction. *Stat. Theory Pract.* **2004**, 10–11.
75. Amole, D. Residential Satisfaction in Students' Housing. *J. Environ. Psychol.* **2009**, *29*, 76–85. [CrossRef]
76. Niu, J.; Zhao, M. Analysis on Factors Influencing of Yurts Residence Satisfaction Based on Structural Equation Model. *Sci. Dev.* **2018**, *14*, 750–756.
77. Baum, S.; Arthurson, K.; Rickson, K. Happy People in Mixed-up Places: The Association between the Degree and Type of Local Socioeconomic Mix and Expressions of Neighbourhood Satisfaction. *Urban Stud.* **2010**, *47*, 467–485. [CrossRef]
78. Wang, X.; Zhang, J.; Li, L. A Survey of College Graduates' Housing Satisfaction—A Case Study of Jiaxing Talent Apartment. *Urban Probl.* **2014**, 95–101.
79. Phillips, D.R.; Siu, O.-L.; Yeh, A.G.O.; Cheng, K.H.C. Factors Influencing Older Persons' Residential Satisfaction in Big and Densely Populated Cities in Asia: A Case Study in Hong Kong. *Ageing Int.* **2004**, *29*, 46–70. [CrossRef]
80. Wang, P.; Qin, X.; Li, Y. Satisfaction Evaluation of Rural Human Settlements in Northwest China: Method and Application. *Land* **2021**, *10*, 813. [CrossRef]
81. Sang, Z.; Xia, S. Community Awareness: Interpersonal Relationship, Social Embeddedness and Community Satisfaction—A Survey of Urban Residents' Community Identity. *Nanjing Soc. Sci.* **2013**, *7*.
82. Anderson, J.C.; Gerbing, D.W. Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. *Psychol. Bull.* **1988**, *103*, 411. [CrossRef]
83. Kearns, A.; Mason, P. Defining and Measuring Displacement: Is Relocation from Restructured Neighbourhoods Always Unwelcome and Disruptive? *Hous. Stud.* **2013**, *28*, 177–204. [CrossRef]

land

MDPI

Article

Social Media as a Medium to Promote Local Perception Expression in China's World Heritage Sites

Xiaoxu Liang [1], Naisi Hua [2,3], John Martin [4], Elena Dellapiana [1], Cristina Coscia [1] and Yu Zhang [2,3,*]

[1] Department of Architecture and Design, Politecnico di Torino, Viale Mattioli, 39, 10125 Turin, Italy; xiaoxu.liang@polito.it (X.L.); elena.dellapiana@polito.it (E.D.); cristina.coscia@polito.it (C.C.)
[2] School of Architecture, Harbin Institute of Technology, Harbin 150001, China; 19b934018@stu.hit.edu.cn
[3] Key Laboratory of Cold Region Urban and Rural Human Settlement Environment Science and Technology, Ministry of Industry and Information Technology, Harbin 150001, China
[4] Sustainable Earth Institute, University of Plymouth, Plymouth PL4 8AA, UK; j.martin-2@plymouth.ac.uk
* Correspondence: yu.zhang@hit.edu.cn

Abstract: The assessment of public participation is one of the most fundamental components of holistic and sustainable cultural heritage management. Since the beginning of 2020, the COVID-19 pandemic became a catalyst for the transformation of participatory tools. Collaboration with stakeholders moved online due to the strict restrictions preventing on-site activities. This phenomenon provided an opportunity to formulate more comprehensive and reasonable urban heritage protection strategies. However, very few publications mentioned how social networking sites' data could support humanity-centred heritage management and participatory evaluation. Taking five World Cultural Heritage Sites as research samples, the study provides a methodology to evaluate online participatory practices in China through Weibo, a Chinese-originated social media platform. The data obtained were analysed from three perspectives: the users' information, the content of texts, and the attached images. As shown in the results section, individuals' information is described by gender, geo-location, celebrities, and Key Opinion Leaders. To a greater extent, participatory behaviour emerges at the relatively primary levels, that being "informing and consulting". According to the label detection of Google Vision, residents paid more attention to buildings, facades, and temples in the cultural heritage sites. The research concludes that using social media platforms to unveil interplays between digital and physical heritage conservation is feasible and should be widely encouraged.

Keywords: cultural heritage management; inclusive governance; public participation; social media; Weibo; pandemic

Citation: Liang, X.; Hua, N.; Martin, J.; Dellapiana, E.; Coscia, C.; Zhang, Y. Social Media as a Medium to Promote Local Perception Expression in China's World Heritage Sites. *Land* **2022**, *11*, 841. https://doi.org/10.3390/land11060841

Academic Editors: Pasquale De Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 13 April 2022
Accepted: 31 May 2022
Published: 3 June 2022

1. Introduction

With the emergence of social network sites (SNSs) in China, new media has growing importance in the traditional urban planning system and has facilitated the development of new types of planning [1,2]. In the recent ten years, the Chinese government has tried several times to employ the use of Information and Communication Technologies (ICTs) tools for provoking more citizen engagement in heritage conservation to create a positive impact. For instance, the Dashilar website, app, and navigate application have developed with the support of the Xicheng District Government of Beijing and were put into use in 2013. It shows that ICTs are gradually becoming important methods of public consultation and supervision during the urban renewal project [3]. On the other hand, experts and civic groups utilized Weibo to criticize "the regeneration projects of Beijing's bell and drum tower neighborhood" proposed by the local government [4]. However, there is a lot of optimism in this emerging field of study, although little quantitatively validated knowledge is available to support this view. Thus, the main research question addressed is whether social media and mobile technologies have measurable impacts on citizens'

engagement beyond the traditional mobilization and participation approaches. In the context of urban inclusivity and sustainable planning, the study explores how digital technology can encourage ordinary citizens to express their perceptions and opinions to manage their own heritage and achieve greater inclusive governance of cultural heritage. The research investigates the challenges in the application of open-source ICTs for citizen engagement in heritage conservation and possible coping strategies.

Following the introduction section, the article presents a comprehensive summary of the current use of ICT in heritage management. The details concerning common features and impacts of applying digital technology to involve audiences in cultural heritage conservation are included. The contributions of social media platforms to enhance stakeholders' communication and collaboration are also highlighted. The third part of this article explains the necessity to introduce social media tools in the rapid urbanization of Chinese cities. This is followed by a description of the open data acquisition process from Weibo which details the post screening and collection process through to the final analysis. The fifth part focuses mainly on the result generating and demonstration procedure. The outcomes detail and further explain the data regarding Weibo posts and users' general information, assessment of normalized messages, and mapping of uploaded pictures.

2. Research Background

2.1. Current ICTs Which Enhance Cultural Heritage Participatory Management

Various digital products can improve our understanding of people-centred heritage and encourage the public to take part in heritage conservation (see Figure 1). Augmented Reality, Virtual Reality, and 3D modelling help audiences experience the heritage site more intuitively, so that they can better understand the multi-level value of cultural heritage [5–7]. ICT also makes it easier for residents to participate in the co-design and co-production process and collaborate with professionals [8]. At the Bishops' House Museum, located in Sheffield, UK, digital augmentation helps engage visitors, in a co-design way, with architectural heritage [8]. Three-dimensional printing technology allows models of buildings to be constructed from archaeological drawings [9], which allows the recovery of more precise architectural details and reduces the damage to on-site exhibits significantly. Geographic Information Systems (GIS) assist with mapping and archiving of rural and urban heritage sites, utilising big data [10,11]. In Marmo Platano, the northwestern part of the Basilicata Region (Italy), a website which provides urban planning information to the public is combined with a web-based GIS tool and a blog to obtain citizens' feedback [12]. Location-based mobile apps, as well as some websites, promote the output of cultural heritage values with a very important educational function [13–16]. For instance, an app is developed to let the visitors learn historical facts by playing a mobile game while visiting the museum Palazzo Madama in Italy [13]. The Kampung Dolanan project, which is a valuable historic village in Indonesia, was created to encourage children to study heritage, histories, and traditional customs while playing games located in their own residential area [14].

As a function of the Internet, social media has greatly enhanced residents' public voice, making communication and collaborative planning easier to achieve [17]. Social media can also foster the expression of various viewpoints and support cultural event management in the decision making process [18,19]. In the northeast of Scotland, the Buckie and District Fishing Heritage Centre on the Moray Firth coast employs multiple social media apps and a dynamic web map to update resources from local residents to academic institutes [20]. It uses a double-way information transfer platform to realize co-curation activities.

The participation of additional stakeholders, such as those involved in an organisation's most basic level and professionals of more advanced levels in the conservation of cultural heritage, is encouraged by social media platforms [21]. In this present digitalised era, social networking sites are crucial in the promotion of communication and collaboration between companies invested in acquiring financial gain. Social media users assemble on this platform to achieve certain goals or arrange their practices, gather viewpoints, or

swap knowledge on a particular topic [22]. Location, time, job, age, or other obstacles do note bind the online community. Despite the need for stakeholders to access the internet, social media platforms bring about great advantages by allowing easy communication and discussion amongst people from various interest communities.

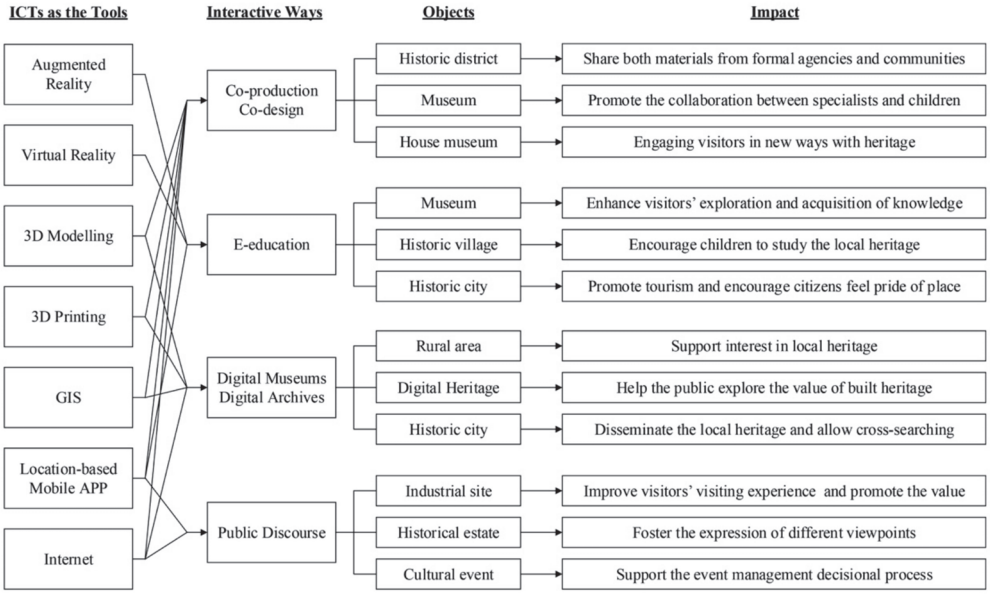


Figure 1. Current digital tools applied on involving public to cultural heritage.

Research concerning social media's role in cultural heritage conservation is largely based in Western countries. Social media can help analyse residents' behaviour or attitude in order to understand the users' landscape preferences, opinions, and perceptions, avoiding some of the drawbacks of traditional survey methods [23]. The colour of tweeted pictures from smart cities, with variations in colour saturation and brightness, has also been used as an effective way to present the affected territorialization in urban life. [24]. Effective communication amongst the government and citizens concerning the planning of Jordan's city has been aided by Facebook [25]. The collection of unauthenticated histories as digital records has also been implemented based on Facebook in the northwest of Ireland [26]. Computational analysis of more than 400,000 geotagged images from Instagram have been supplemented with interviews from 16 active users to reveal the social–spatial inequality in the city of Amsterdam [27]. The politics, religion, and residents' and tourists' likings in Lebanon's city of Tripoli, rich with history, are shown through Flickr's photos, tags, and real-time geo-location [28]. A Weibo post may serve as a complaint towards China's government to cease removal of Guangzhou's Dafo temple [29]. Thus, it is evident that given China's rapid urbanisation, there is a pressing need for the use of social media to aid in cultural heritage management.

2.2. Cultural Heritage Management in Chinese Cities: The Need to Involve Social Media

There has been a vast amount of research completed on the adaptation of influence and evolution of trends in Western online social networks [30–32]. In particular, applying social media apps, such as Twitter, Facebook, and Instagram, to qualitative geography research is becoming increasingly popular [24,27,33,34]. Even if some researchers point out that social media apps have a lower penetration and a potential bias toward younger populations [35], some governments are still utilising social media as an important way to reach out to citizens. For example, the New York Digital City program complements the NYC.GOV

portal with social media venues [36]. Noveck created the first social networking system in the United States, Peer-to-Patent, to break the obstacle and time-assuming communicative mode between "expertise of the many to the power of the few" [37].

In China, online social networks have become a major platform for the younger generation to share, disseminate, and receive information from others and meet like-minded individuals. As of June 2021, instant messaging users in China reached 983 million people, up 97.3% of all Internet users [38]. Some studies have mentioned the application of Chinese social platforms in cultural heritage protection research, indicating that it is feasible to introduce social media to promote public participation in Chinese contexts [29]. Data mining techniques could enable researchers to gain a more comprehensive and precise understanding of the Chinese public attitudes toward a specific issue [39]. The pictures obtained from Weibo can be analysed to understand public perception in Chinese historical and cultural block studies [2]. However, research regarding the evaluation and illustration of the governing of participation is still limited. Useful online instruments to encourage citizens' participation in decision-making processes are also yet to be properly surveyed.

The reason why the research scope is framed on urban heritage rather than general landscape heritage or rural heritage is as follows. Firstly, compared with rural areas, the proportion of Internet users in Chinese cities is higher. According to the CNNIC's Statistical Survey on China's Internet Development, as of June 2021, the size of urban Internet users was 714 million, making up 70.6% of the total. As of June 2021, the Internet's penetration in China's urban areas was 78.3%, while that in rural areas was 59.2%, up 3.3 percentage points over December 2020 [38]. This means that selecting research objects in cities can reach a wider range of people. Secondly, the construction and development in cities is faster and the land used for newly built residential areas in China continues to expand every year, leading to a greater threat to heritage conservation. The 2021 statistical report of the National Bureau of Statistics of China shows that from January to August 2021, the floor space of houses completed nationwide was 467.39 million square meters, an increase of 26% year-on-year [40]. The aggressive eroding of urban heritage land makes the protection of cultural heritage urgent. Thirdly, because the economy of urban areas is usually more developed, there is more sufficient funds to manage and maintain the urban landscape. At the same time, relevant cultural heritage protection laws and regulations are more complete than those in relatively underdeveloped rural areas, and more in-depth urban renewal strategies have been formulated. This is more conducive to obtaining raw data on heritage protection and provides a good basic condition for the advancement of this study. In summary, urban heritage was the best starting point to conduct this research, and the results could hopefully continue to be promoted and applied in rural areas.

2.3. The Interpretation of Chinese Social Media Platforms: The Choice of Weibo

Parallel to well-known western online social networks, such as Facebook, Twitter and Instagram, there are a series of popular social media platforms in China, as well. Among these, WeChat is undoubtedly China's largest social media platform, as a representative of instant messaging tools [41]. According to Tencent's unaudited financial report data for the fourth quarter and full year of 2021, Wechat has more than 1.2 billion monthly active users [42]. Following that, Douyin (TikTok) and Xiaohongshu are social-network applications recently counted among the fastest-growing applications in China. What is worth highlighting is that Sina Weibo is the second-largest social media platform and the most popular microblog platform in China, which has been developed and operated by Sina Corporation since 2009 [43]. It is an open platform for information dissemination based on social relations and socializing with strangers with short-form web messages, comparable with Twitter and Facebook [41]. According to the number of active users published by Sina Corporation, it reached at least 573 million monthly active users by the end of 2021 [44]. The majority of the users are located on China's mainland and post in Mandarin, while citizens from special administrative regions, such as Hong Kong and

Macau, are more likely to use Western social media platforms, which may cause a limitation on this research investigation.

Although urban-heritage related data should be examined on other social media platforms in China as well, this article uses Weibo for its research for the following two reasons. On one hand, Weibo is a relatively open real-time information network platform. Most of the time, users can get information shared by other bloggers without being online friends. This means that ordinary users can be reached through a simple search, allowing us to collect more extensive information. On the other hand, Weibo users are allowed to post small essays of more than 140 words with pictures and videos. Therefore, compared with other social platforms, using Weibo can help us judge the views and experiences of the posters more comprehensively. Above all, using Weibo to study and unveil interplays between the digital and physical worlds, which are strongly relevant to urban development or planning, is the best choice.

3. Method: Open Data Acquisition and Analysis for Policy Recommendations

Based on the influence and adoption of Weibo in China, the brief roadmap of this research can be demonstrated in the following four significant courses of action. Firstly, specific cultural heritage articles are collected based on the most updated World Heritage List (WHL) in 2020. In total, five Chinese heritage sites located in the cities were extracted from the world's tangible cultural heritage section. Following that, the searching code is assembled into two parts: the name of the city plus a keyword (a series of synonyms of urban heritage in Chinese, see Table 1). The Application Programming Interface (API) of Weibo is accessed to obtain the needed content. All data collection and privacy protection rules and regulations were addressed in this phase. Following content recovery, an examination process was carried out, both through computing and manually, to remove repeated posts. Finally, the characteristics in each of these corresponding tweets were analysed by identifying text and image content information and their geo-location information. A pilot study as a trial of the research assessment framework was undertaken with a smaller dataset in 2021 [17].

Table 1. The unprocessed database with a time restriction from 1 January 2020 to 31 December 2020 from Weibo.

Keywords	Keywords for Search (in Pinyin)	Lijiang	Pingyao	Suzhou	Macau	Kulangsu	SUM
Urban Heritage	Chengshi Yichan	138	97	90	66	26	417
Architectural Heritage	Jianzhu Yichan	56	41	123	73	59	352
Historic City	Lishi Mingcheng	722	515	586	77	157	2057
Historic District	Lishi Jiequ	6	12	575	27	35	655
Historical Buildings	Lishi Jianzhu	105	119	705	163	287	1379
Urban Regeneration	Chengshi Gengxin	11	1	110	20	251	393
Traditional Architecture	Chuantong Jianzhu	49	54	607	5	134	849
Traditional District	Chuantong Jiequ	1	0	25	37	15	78
Cultural Relic Protection	Wenwu Baohu	105	93	768	5	145	1116
Heritage Sites Conservation	Yizhi Baohu	7	1	24	12	15	59
Old District	Laojiequ	4	0	108	16	74	202
Old City	Laochengqu	11	5	522	149	346	1033
Old House	Laofangzi	35	83	336	12	162	628
Old Building	Laojianzhu	14	47	143	2	19	225
SUM		1264	1068	4722	664	1725	9443

3.1. Case Determination

Chinese World Cultural Heritage Sites were used in the design and development of this study. According to information made public on UNESCO's webpage, China owns 56 inscribed world heritage properties (second only to Italy in the WHL) in 2021, in which 38 are cultural heritage, 14 are natural heritage, and 4 are hybrid properties [45]. With a

metropolitan heritage as the focus point, a filter was implemented to identify urban areas with a population of more than 500,000 residents (by January 2021) to make certain the data was sufficient and the samples were diverse. After screening, locations that fulfilled such requirements were Yunnan's Old Town of Lijiang (1997), Shanxi's Ancient City of Pingyao (1997), Jiangsu's Classical Gardens of Suzhou (1997, 2000), Macau's Historic Centre (2005), and Fujian's Kulangsu Historic International Settlement (2017). Figure 2 shows the geographical distribution of China's Urban Heritage and Other World Heritage Sites.

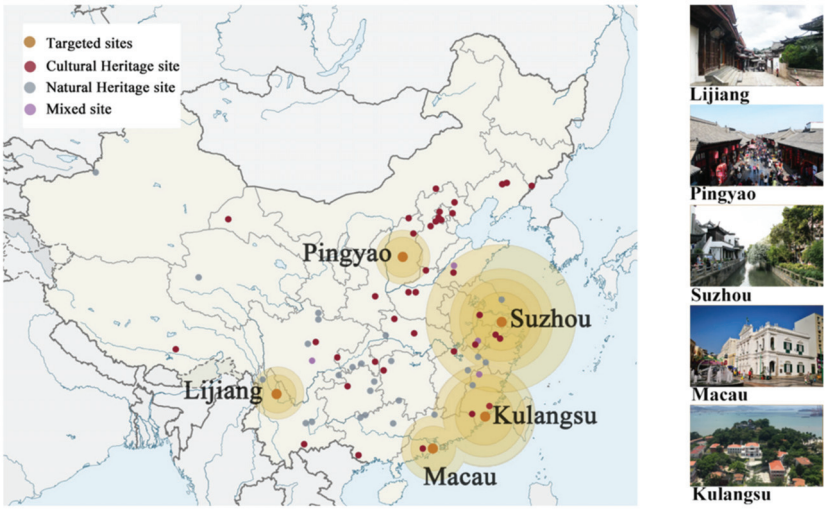


Figure 2. Geographical Distribution of China's Urban Heritage and Other World Heritage Sites (the author draws according to the UNESCO World Heritage List 2021).

3.2. Data Acquisition

The searching procedure ensued with a set of keywords that contained suitable geographical details and the location distribution of metropolitan heritage. Boolean Operators were utilised to connect each word. Based on this string of search codes, a time restriction (1 January 2020 to 31 December 2020) database was compiled and processed. It is important to note that the data acquisition is based solely on extensive searches on Weibo.cn.

The REST API was accessed to obtain posts, comments, and other official analysis data within the operation of authorised access to Weibo. The data fields obtained include user ID, publisher nickname, gender, region, number of followers and followers' posts' text and pictures, releasing time, number of likes, reposts, and comments, geo-location, and much more. The study examined and acquired the API interface and related interface frameworks from the Google Chrome browser by using Python programming and cookies to obtain browser access. The Python library was used to send requests. Obtained data were initially cleaned: missing values, duplicate fields, empty strings, and garbled data were deleted. More than 9000 posts with data source information under urban heritage topics were acquired to build the database.

3.3. Data Selection

Firstly, 1204 duplicated posts with similar content from the same user were ruled out automatically via coding. Subsequently, four other steps were needed to purify the acquired posts by both programming and manual filtering. The data cleaning program was run in the Xlwings library environment. By judging whether the content of the current line and the comparison line was equal, repeated text parts found in the microblogs obtained were marked. However, the disadvantage of this method was that it could not deal with text similarity issues, hence, the database was checked manually to validate the results.

The framework of stakeholders in the urban heritage management process involves a broad range of elements: management and organisation, technology, governance, policy context, people and communities, economy, infrastructure and the natural environment. However, in this research, local residents are selected as key players. Thus, the third step aimed to earn recognition from local residents. From the features of the posters, 1977 selected posts were revealed to be sourced from local users. At this point, users would be regarded as locals if they were registered in the same province as the selected heritage sites.

To obtain clean data, posts that were not identical but contained a content overlap rate of more than 90% (possibly from different users) were also screened out manually. Thereafter, the remaining posts were standardised manually according to the contents and categorised into 14 sections. The subject of content selection is also restricted to government–citizen communication and collaboration related texts under the holistic cultural heritage management topic. Thus, any documentation of daily life, simple accounts on restoration construction, emotional expression and memory, commercial advertisement, as well as other irrelevant topic posts were excluded at this phase of screening. As a result, 905 posts that were considered to have a strong association with creating dialogues among stakeholders were remained to be used for further analysis. Table 2 presents a summarised picture of the data selection process.

Table 2. The process of selection and purification of the relevant Weibo posts.

No.	Cultural Heritage Site Location	Listed Year as WHL	Original	Step 1	Step 2	Step 3	Step 4
1	Old Town of Lijiang	1997	1264	1101	130	84	65
2	Ancient City of Pingyao	1997	1068	869	153	87	80
3	Classical Gardens of Suzhou	1997; 2000	4722	4123	1078	903	538
4	Historic Centre of Macau	2005	664	553	55	49	31
5	Kulangsu: A Historic International Settlement	2017	1725	1593	561	458	191
	SUM		9443	8239	1977	1581	905

3.4. Data Analysis

A lesson from governance is to evaluate and classify the level of public participation, which builds the studying framework to analyse obtained text data. The consultative and informing activities are determined as a relatively elementary level in public participation [46]. Effective communication, including a certain amount of complaints as a kind of feedback, is determined as a crucial phase in the reinforcement progress. Raising the citizen's awareness by educating, such as giving lectures, workshops, social media broadcasting, and building their capacity to take part in the decision-making process of their local environment, will be the final goal and the highest participatory level. It is accessible for both short-term and long-term benefit and responsibility-sharing [47,48]. Collaboration and empowerment are recognized as the highest level of government-community cooperation in integrated heritage management [3,49,50].

The data were analysed from three criteria, namely the users' general profile, texts, and pictures. The general profile of the users will be presented with the monthly number of posts, gender representation, the provenance of users, and posts by celebrities. The users' basic information was obtained automatically through computer operations, while the microblog content and image recognition were achieved mainly through manual screening. According to recent research, the Key Opinion Leader (KOL) is also an important promoter of network information dissemination in specific groups and has an important influence on the reposting and commenting behaviour of other users [51]. The leadership of KOL is 'significantly and positively associated with online civic participation', and ordinary users are very susceptible to the influence of opinion leaders [52,53]. KOL is an important part of the information dissemination of social networks. However, according to Huang, identifying KOL requires a complex recognition model [54]. The indicator used to determine

KOL was that they should be identified as a celebrity with at least 50 reposts, 100 likes, and 100 comments in the selected post.

To identify the texts content, the posts were manually tagged and categorised by the context and content of the post. The posts were divided into 16 groups (see Table 3). Among these categories, collective experiences and memories, daily activities documentation, advertisements, and reports on restoration projects were considered to have no contribution to the participatory and communication activities. The remaining twelve categories were further fitted to a framework. This grading system is structured with five levels: inform, consult, include, cooperate, and empower, which aimed to provide a structured assessment of participation level through social networks [17,55].

Table 3. The identification and labelling framework for content categorization.

Participatory Level	Keywords	Definition
Inform	Exhibition	Museum exhibits, performances, photo exhibitions, etc. related to cultural heritage.
	Heritage value sharing	The introduction and detailed description of the cultural heritage itself, the purpose is to promote the value of the heritage.
	Lectures	Related education and publicity activities such as conferences, seminars, and symposiums, etc.
	Official announcement	A top-down notification from the government or authority, usually about a certain policy or verified important event.
	Archive	Records of interviews and visits by authorities, community activities, or other activities that are not easily classified.
Consult	Complaints	Bottom-up way to present suggestions or feedbacks from residents who are dissatisfied with a certain problem.
	Feedback on questioning	The response and explanation of the government or authoritative organization to the residents' suggestions or complaints.
	Interviews	Activities where authorities or experts collect opinions from the masses through questionnaire surveys and interviews.
	Suggestions	A bottom-up way of expressing opinions, mainly refers to proposals from residents on urban planning or renovation projects.
Involve	Workshops	Interactive methods organized by third parties or professionals for the purpose of promoting heritage values and heritage protection methods.
Collaborate	Collaborative planning	The co-design activities and events intending to involve multi-stakeholders taking part in heritage protection.
Empower	Empower	Agencies provide the public with the opportunity to make decisions for themselves.

After removing duplicates, more than 6000 images were labelled by accessing the Google Vision API. In order to verify the accuracy of the machine's image recognition, 10% of the images and their labels were manually checked. The labels were sorted into two groups: spatial and morphological catalogue, and other scenarios. The spatial and morphological catalogue contains a series of architectural spaces corresponding to urban scale: city, natural landscape, public place, neighbourhood, building, façade, interior design, building material landmarks, and rural landscape. By mapping the posted pictures, the study aims to cognize the local users' interests and concerns on the selected heritage sites.

4. Results

Classified statistics based on the public data released by Weibo users constitute the database of this study. The users' profile page of Sina Weibo displays the nickname with a short description, the number of fans or followers, the number of accounts followed, and the total number of posts the user had made [56]. As shown in Figure 3, Sina Weibo users can post texts with embedded pictures or videos. When reposting a certain post, users can add their comments on the reposted content without changing the original structure and content. The results of this study visualize the relevant number of posts of the intended

heritage sites, examine the content and number of selected posts and further categorize them into five participatory levels, and, lastly, sort out the main targets of the selected pictures into 16 sub-categories under two domains.

Figure 3. A reposted Weibo by Suzhou Gardens (verified as official account) commenting "don't miss the autumn" with pictures. Source: Weibo.com (https://weibo.com/suzhouyuanlinlvhua (accessed on 1 November 2021)).

4.1. The General State of Weibo Posts and Posters

Table 3 shows that the garden of Suzhou attracts the most attention of the Weibo users and ranks first place, with 4722 searching results. Lijiang, Pingyao, Kulangsu are in the middle position with 1264, 1068, and 1725 posts, respectively, but are far behind Suzhou, with almost 50% fewer posts. Macau has received less data than all the other selected heritage sites. This may be due to the tendency of using Western social media platforms in Macau.

In terms of the total volume of results, the search results obtained by the keyword Historical City (Lishi Mingcheng) were the largest, with 2057 obtained. Next, Historical Buildings (Lishi Jianzhu), Cultural Relics Protection (Wenwu Baohu), and the Old City (Laochengqu) were considered the second echelon, with 1379 posts, 1116 posts, and 1033 posts, respectively; there is very little difference between the quantities of posts. This shows that the protection of cultural relics and the protection of the old city are closely related to the user's impression and have received widespread attention. In contrast, the keyword Heritage Site Conservation (Yizhi Baohu) has received the least attention from users, with 59 posts, putting it in the last position.

Users who shared their viewpoints regarding certain urban heritage sites online are composed of a niche online society. The result shown in Figure 4 illustrates the proportion and number of both genders, the number of locals and visitors, and the number of defined celebrities and KOLs. Among the 8239 users found, male users consisted of 4738 people, accounting for 58%, while female users consisted of 3901 people, accounting for 42%.

The gender ratio of male to female users is calculated to be 135%. Compared with the data collected in the 2021 China Seventh National Census Bulletin, which shows 105%, the proportion of men is significantly higher in this case [57]. In addition, according to the collected region information from the users' profile, only one-quarter of users were considered as locals, indicating that most users were comprised of tourists from other regions. At the same time, nearly a third of the participants with more than 20,000 followers were defined as celebrities in this study, which was a lot more than the overall registration proportion, that was estimated to be around 0.3%. Due to Weibo's data-sharing restriction, the priority of accessing API is to obtain the account information of well-known individuals who have been authenticated. In other words, in the complete dataset of Weibo, the proportion of online celebrities will be much lower. A total of 10 KOLs were screened out, accounting for 0.1% of all acquired users. This article only makes simple judgments based on the number of reposts, likes, and comments, which has certain flaws. Further work should explore discussions relating to the KOLs' influence and the identification of KOLs.

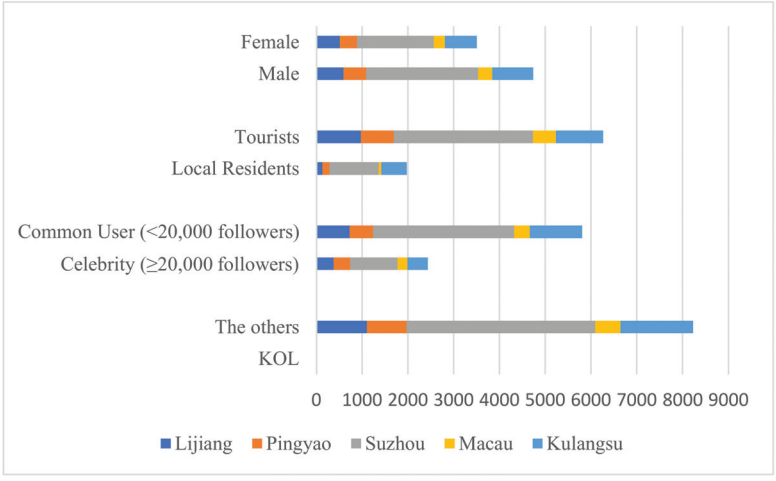


Figure 4. Components of Weibo users under the urban heritage conservation topic.

Figure 5 presents an apparent rising inclination in the number of Weibo posts over twelve months in 2020, following the strict lockdown policy that was implemented as a countermeasure for COVID-19. The data were maintained at a low quantity in the first half of 2020. Along with the reopening of regional boundaries after the drastic period, the number started to increase exponentially. The total number of posts in July was 922, which was twice that of the posts in January and corresponded with the brief period of ease followed by the loosened restrictions of intra-urban traffic movement. As the seasons gradually entered the time of winter, the country was struck with a second wave of the pandemic, causing the national pandemic control to grow stricter. Therefore, following the peak of data collection in July and August, the total amount of Weibo posts showed a mild downward trend. At the end of December, the number of posts reduced to 781, which was 80% of the number of posts in July. Although residents were still permitted to travel freely between regions with their green pass until December, the state government implemented a strict lockdown policy in January 2021 due to the impact of the pandemic. Due to this policy, all students staying on university campuses returned to their hometowns, and all workers were not allowed to return to work unless they were key workers.

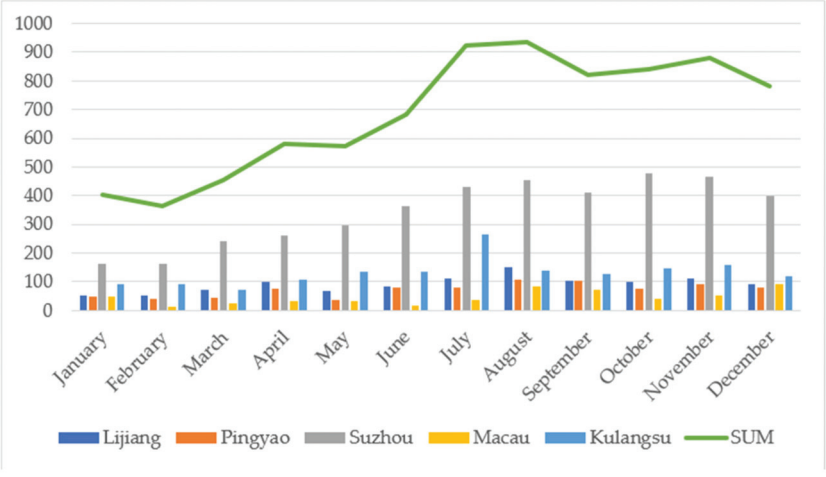


Figure 5. Monthly Weibo posts during the pandemic period in China (1 January 2020–1 January 2021).

4.2. Evaluating Participatory Degrees According to the Texts

The contents of the texts were analysed manually and categorised into five levels of engagement score. It was encouraging to discover findings that were qualified to be categorised at the involving and collaborating level, which was designed to be an advanced engagement score. In general, many common users were interested in sharing heritage cultures with the public. Most governments authorised accounts focused on posting official announcements about administrative activities and establishment of policies, while celebrities tend to publish education-oriented information on cultural heritage.

From ten users, eight were categorised into the one-way communicative level, which is the most fundamental engagement score of this evaluation structure (see in Table 4). From the perspective of information, what users do the most is to share the value of cultural heritage, such as historical allusions, poems, local folk customs, and architectural features of the heritage site. Many people also attended lectures and exhibitions related to cultural heritage and felt the charm of intangible cultural heritage, architectural heritage, and urban landscape heritage. Moreover, the number of posts reaching the consultation level was 132, reaching 14.6% of the total 904, including bottom-up feedback, complaint (n = 36), responses to residents' complaints from authorities, and feedback on question (n = 4), etc. Among them, the records of on-site investigation activities by representatives of authorities and experts are the main part. It can also be seen that the public actively complained and responded to the problems in the architectural heritage renewal project. Even though the number of users that engage with the means of involvement and collaboration is comprised of only 2%, it still holds significant value as an approach of two-way communication. After a long series of uncovering and filtering data, it is regrettable that no posts were found to be deemed eligible for the empowering level in terms of engagement. Several factors that may be relevant to this occurrence are namely the dependence of documents, the wider target population of the elderly, and restricted engagement levels.

Table 4. Participatory Degrees Assessment on Weibo in the Cultural Heritage Management Process in China.

Keywords	Lijiang	Pingyao	Suzhou	Macau	Kulangsu	Participatory Level	SUM
Exhibition	2	3	20	2	6	Inform	754
Heritage value sharing	47	52	370	18	110		
Lectures	2	3	24	3	7		
Official announcement	7	10	41	7	20		
Archive	4	8	32	1	24		
Complaints	0	0	24	0	12	Consult	132
Feedback on questioning	1	1	1	0	1		
Interviews	0	0	4	0	7		
Suggestions	0	2	9	0	1		
Workshops	1	1	7	0	1	Involve	10
Collaborative planning	0	0	6	0	2	Collaborate	8
Empower	0	0	0	0	0	Empower	0
SUM	64	80	538	31	191	0	904

4.3. Reading and Mapping of the Pictures

With a special hot topic list mechanism, Weibo posts with more popular tags tends to attract more users' attention. Some users may add more popular tags to their posts based on this feature, even if these tags are not related to their posts, so that they can spread more widely and receive more attention. However, in the process of obtaining data, the keywords contained in the tag content were retrieved and identified, so they were included in the research database during the initial data collection stage. This means that the acquired microblogs with pictures need to be filtered out manually.

In the database acquired in Table 1, around 18% of the microblogs are embedded with pictures. Table 5 shows the screening process of images starting from the obtained raw data. The first step of image analysis was to manually read the associated text in the obtained Weibo data with images and roughly filter out the strongly irrelevant data, such as the content of the image is a historical site in Wuhan (not a research object), etc. In the second step, the VisiPics image recognition tool was used to further check and sort the image data. VisiPics is a free software developed by Guillaume FOUET (Ozone). It was used to identify pictures with duplicate or similar content based on the size of the picture. Pictures with similar content but different watermarks were identified and removed at this stage. In the third step, Google Vision was used to tag the image classification.

Table 5. The process and result of screening obtained images.

Heritage Site	Step 1	Step 2	Step 3
Lijiang	600	557	451
Pingyao	408	406	367
Suzhou	3876	3709	3495
Macau	223	212	198
Xiamen	2197	2074	1931
SUM	7304	6958	6442

By accessing the Google Vision API, this research has carried out label detection on the obtained pictures, as shown in Figure 6. The default label set for detection because the number of images obtained was less than 7000, which is not enough for Google Vision to perform machine learning based on the division of spatial categories. In response to the issue of machine errors, after obtaining a dataset containing label descriptions, a manual selection of 700 pictures were randomly sampled for a second verification. The number of labels assigned to each picture is different, fluctuating from a few to even more than thirty. Eventually, 64,285 labels were detected and obtained on 6442 annotated images that made up the dataset. On average, each picture was accompanied by 9.98 labels. After the dataset

was processed by the pivot table and count function, it was further classified into 1530 tags, such as Building, Plant, Sky, Tree, Window, etc.

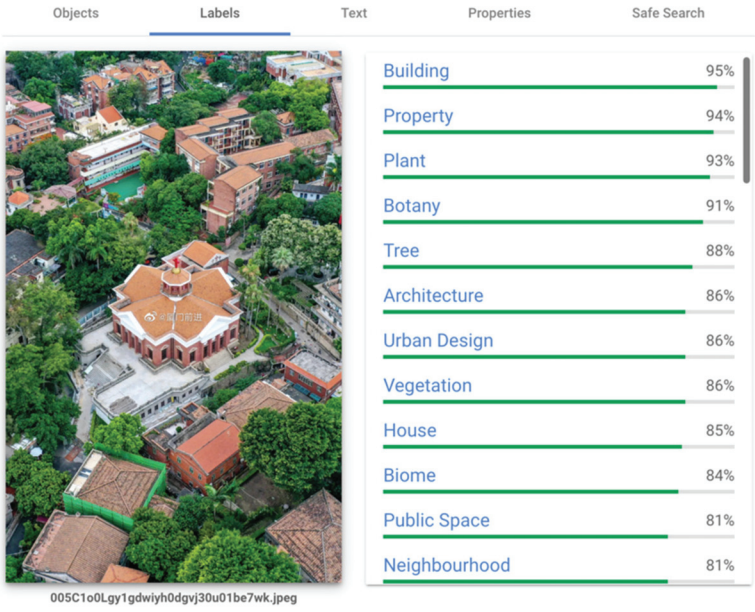


Figure 6. An example of using Google Vision to label images using a picture of the bird's-eye view of the Kulangsu Historic Settlement obtained from Weibo.

Due to the complexity of the labelling algorithm and the multi-label attribute of the image, no further classification or merging was undertaken on 1530 label types, but 20 labels relating to the morphological space were extracted, as presented in Table 6. In order to identify the users' preferences on heritage sites more accurately, other tags such as wood, leisure, water, etc., that are considered irrelevant to the description of the urban architectural space, were excluded. The information extracted from images indicates the people's attention and interest in urban heritage. Based on this table, it is evident that locals are mainly fascinated with various types of architecture, such as temples and pagodas. The specific structures of a building's exterior, such as doors, windows, and bricks, were among the most photographed objects. Although the attention paid to the city and the streets precedes the natural landscape itself, there is still a big gap of attention compared with the buildings. The number of pictures tagged under the city and urban design consists of only half of the pictures tagged with the buildings. The other features of the area were almost in the same range of concern, while the commercial buildings attracted the least attention, as the design features were the rarest among the five sites. From the perspective of spatial scale, it seemed that physical spaces and features that were close to the human body in scale received more attention. From the perspective of building types, the audience seemed to prefer buildings with traditional Chinese architectural elements and characteristics. From the perspective of architectural function, residential areas and traditional settlements were more attractive to bloggers than some noisy and bustling commercial districts. It can also be seen from several lists that landmarks and rural landscapes were also popular topics among social media users.

Table 6. Top 20 labels related to the morphological space.

No.	Labels	Amount
1	Building	2950
2	Facade	962
3	Temple	959
4	City	819
5	Urban design	747
6	House	675
7	Natural landscape	605
8	Architecture	597
9	Chinese architecture	582
10	Landscape	557
11	Interior design	463
12	Neighbourhood	376
13	Residential area	215
14	Public space	198
15	Landmark	190
16	Pagoda	158
17	Room	115
18	Building material	75
19	Rural area	55
20	Commercial building	51

5. Discussion

Even though public participation in inclusive heritage management in China is still in its early stages, the existing condition still highlights a growing interest that is only likely to increase due to the generalization of smart devices and the internet. This paper offers a new approach to examine and present the level of public engagement through social media in China. The result has shown that the number of participants may have a great relationship with the financial condition of the city. Urban heritage sites which are in more developed areas would have a greater degree of attention [17]. In addition, the fashion of posting on social media is closely associated with the rules and policies made as a countermeasure for the COVID-19 pandemic.

5.1. Utilization of Digital Technologies to Promote Public Participation

Due to the high attrition rate of digital citizen science projects, more work is needed on the factors that attract and retain participants [58,59]. As a medium, social media has certain limitations and cannot be used as a representative of the collective consciousness of local people, but it can still reflect the current public attitude and participation status to a certain extent. This paper attempts to provide a new perspective and quantitative research method for Chinese urban heritage management through data (both texts and photos) analysis of Weibo.

The result of this research suggests that the participatory level in the World Cultural Heritage site in China is near informing and consulting. Generally speaking, the extent of Chinese public participation in heritage protection practices is relatively weak. With the increase in the participatory level, the number of related posts tends to decrease. The lack of public empowerment posts may be evoked by poor successful cases, low awareness of residents' participation, or certain communication restrictions on Weibo. However, in the process of urban management, the perception of public opinion cannot be ignored. Therefore, analysing social media data to understand the perception of the public and further support decision makers' decision is vital for a successful management process. It is foreseeable that empowering the public to truly participate in heritage conservation research and projects can enhance their sense of shared responsibility for the heritage environment in which they live and become more active in participating in collaboration driven by common interests.

At the government level, multiple stakeholders should be encouraged to participate in the heritage protection decision-making process in order to better balance the interests of all parties [60]. ICTs such as social media could be applied to enrich the construction of third-party platforms that promote the communication between citizens and the government. In addition to legislation, decision-makers should also provide an open digital platform for communicative collaboration and encourage citizens to use it. Concerning the urban renewal strategy, in the process of cultural heritage management, the fundamental interests and choices of residents should be widely considered [61]. Furthermore, lectures, exhibitions, and other public events could be a powerful approach to publicise cultural conservation due to the gradual popularisation of online activities. Virtual exhibitions are also methods that could potentially attract a great number of audiences online, hence, should be recommended to be held frequently. Online mechanisms should also be effectively utilised to offer recurrent access to the establishment of a structured cultural conservation system.

5.2. Reflects on Design and Conservation Planning

The user's preference profile identified through the pictures can show that the residents pay more attention to traditional Chinese buildings compared with cities and streets. The focuses of the citizens are mainly on the human-friendly elements, such as the details of the built environment and architectural materials. Modern commercial buildings did not become the focus of the audience, ranking behind the residential areas by a clear gap. Generally speaking, social media users pay much more attention to outdoor elements in urban heritage, such as natural landscapes and building facades, than interior design, while rural landscapes have received very little attention. Therefore, in the transformation and renewal of urban heritage, the protection of the exterior of the building and the preservation of traditional features should be listed first. The interior design of the building has little effect on the overall urban landscape and can be handled more personally. The features and structures of heritage sites and historic buildings should be conserved while taking into account the restoration of the interior living space. Therefore, a feasible strategy is to carry out the functional transformation of indoor space while preserving the appearance of the building as much as possible, bringing great benefit to both the improvement of the residents' quality of living as well as the conservation of cultural heritage.

5.3. The Current Policy System and Practical Challenges

China's cultural heritage protection has gone through a complicated process, in part due to the emphasis on economic and urban expansion, which led to considerable pressure to develop in areas containing historical monuments during the second half of the 20th century. However, the overall trend of Chinese cultural heritage management is gradually becoming more sustainable and holistic. The Chinese government's insistence on holistic cultural heritage protection can be found in the laws and regulations promulgated in the recent fifteen years. In 2008, the "People's Republic of China Urban and Rural Planning Law" stipulated that public participation should be included in the process of planning [62]. In the official notice of the 14th Five-Year Plan for Cultural Relics Protection and Technological Innovation, issued in November 2021, the Central Government of China pointed out that in the overall planning of urban and rural areas, we must adhere to the overall protection of the system and improve the cultural relics protection mechanism [63].

It is necessary to protect and continue the urban context with cultural relic resources as the carrier and to combine the protection of cultural relics with the protection of old cities and urban renewal. Nevertheless, public participation is facing many difficulties at the actual operational level and has not been fully promoted [64]. Some scholars pointed out that the low empowerment level (both on social media and general) in decision-making is mainly due to the government's excessive emphasis on economic interests, the inadequate implementation of planning regulations and rules, and the weak involving awareness [65]. Wu pointed out that the protection of urban heritage in China has been facing the dilemma

of diversified property rights [65]. In Li's opinion, coordinating the property rights of buildings requires more clarification of the legislative details [66].

5.4. Limitations

There are several limitations in the current study. Firstly, the study is restricted by the method of accessing the Weibo open dataset, some users' data, especially the ones that do not have account verification, are absent to a certain degree. In addition, some critical comments may be censored and then banned due to the strict monitoring system on social media in China, which may lead to the underutilization and inadequate analysis of a certain amount of the data. Secondly, some mis-estimation of the users' perception may have been caused by the dataset of the study, which is not based on their self-evaluation. A mass survey on the cultural heritage preservation and management process, such as online questionnaires, is still needed to fill this gap. Thirdly, the manual label filing, which is based on subjective judgment, which was used in the current study is relatively limited when analysing a big dataset. More advanced analytic deep-learning models, such as Convolutional Neural Networks, could deepen and improve this research. Lastly, variables that may influence the users' attitudes, such as economic development, collaboration tightness with government, and other cultural and social indicators should also be better investigated.

6. Conclusions

Due to the diversity of cultural backgrounds, social systems, economic models, and social development levels, it is not only necessary to carry out extensive discussions on the role of social media in promoting public expression at the theoretical level but also to conduct small-scale tests and experiments on it. The main purpose of the article is to explore a way to evaluate the degree of public participation through Chinese social media platforms by obtaining big data. The final result is based on a series of purification and interpretation based on the posting data of Weibo users during the 2020 epidemic. The results of this study can lead to a new viewpoint for professionals and researchers in the field of heritage conservation to further acknowledge the factors of cultural diversity and general participation in relation to the managerial process of heritage management.

Social media, as a medium, offers a platform to enhance the voice of the people and actively promote the formation of diversified participation. Weibo to a certain degree build a channel between the government and the local for dialogues. The study on users' data and posts on Weibo can offer some valuable information on the participatory status quo, possible collaborative trends, and citizens' preferences to support decision-making in the urban conservation process. In order to enhance the level of public participation, corresponding legislation and policies should be adopted to ensure the citizens' participatory activities in the decision-making process, rather than only feedback and expression of attitudes. At the level of national and local policy implementation, laws and regulations related to urban heritage conservation should be further deepened and improved to enhance the public's right to input into urban protection decisions. In addition, the filter of the dataset should be carefully processed considering the limitations of the current study in future research. Another investigation to let the locals express their opinion in a more substantial and consciously way is also encouraged as a supplement to the current study.

Author Contributions: Conceptualization, X.L. and N.H.; methodology, X.L., N.H., J.M., C.C., E.D. and Y.Z.; software, X.L. and N.H.; validation, X.L., N.H. and Y.Z.; formal analysis, X.L. and N.H.; investigation, X.L. and N.H.; resources, X.L.; data curation, X.L. and N.H.; writing—original draft preparation, X.L.; writing—review and editing, J.M., C.C., E.D. and Y.Z.; visualization, X.L. and N.H.; supervision, J.M., C.C., E.D. and Y.Z.; project administration, X.L., N.H. and Y.Z. All authors have read and agreed to the published version of the manuscript.

Funding: Harbin Institute of Technology 51878201.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We thank Guang Cai from Harbin Institute of Technology for assistance with accessing the API of Weibo, and Yuan Li, Xiamen University for comments that greatly improved the manuscript. We also thank reviewers for their insights.

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

References

1. Zuo, J.; Li, C.; Dong, J. Green Space System Planning Practices of Multidimensional Network Construction in High-Density Areas Under the Coexistence Trend of Incremental Planning and Existing Stock Planning. In *Green City Planning and Practices in Asian Cities: Sustainable Development and Smart Growth in Urban Environments*; Strategies for Sustainability; Shen, Z., Huang, L., Peng, K., Pai, J., Eds.; Springer International Publishing: Cham, Switzerland, 2018; pp. 175–191. ISBN 978-3-319-70025-0.
2. Chen, S.; Meng, B.; Liu, N.; Qi, Z.; Liu, J.; Wang, J. Cultural Perception of the Historical and Cultural Blocks of Beijing Based on Weibo Photos. *Land* **2022**, *11*, 495. [CrossRef]
3. Fu, Z.; Bu, Y. Constructing the Research Model of Beijing Neighborhood Through the Living Lab Method. In *Proceedings of the Cross-Cultural Design*; Rau, P.-L.P., Ed.; Springer International Publishing: Cham, Switzerland, 2016; pp. 527–539.
4. Bideau, F.G.; Yan, H. Historic Urban Landscape in Beijing: The Gulou Project and Its Contested Memories. In *Chinese Heritage in the Making*; Maags, C., Svensson, M., Eds.; Experiences, Negotiations and Contestations; Amsterdam University Press: Amsterdam, The Netherlands, 2018; pp. 93–118. ISBN 978-94-6298-369-4.
5. Arrigoni, G.; Schofield, T.; Pisanty, D.T. Framing Collaborative Processes of Digital Transformation in Cultural Organisations: From Literary Archives to Augmented Reality. *Mus. Manag. Curatorship* **2019**, *35*, 424–445. [CrossRef]
6. Beel, D.E.; Wallace, C.D.; Webster, G.; Nguyen, H.; Tait, E.; Macleod, M.; Mellish, C. Cultural Resilience: The Production of Rural Community Heritage, Digital Archives and the Role of Volunteers. *J. Rural Stud.* **2017**, *54*, 459–468. [CrossRef]
7. Champion, E.; Rahaman, H. 3D Digital Heritage Models as Sustainable Scholarly Resources. *Sustainability* **2019**, *11*, 2425. [CrossRef]
8. Claisse, C.; Ciolfi, L.; Petrelli, D. Containers of Stories: Using Co-Design and Digital Augmentation to Empower the Museum Community and Create Novel Experiences of Heritage at a House Museum. *Des. J.* **2017**, *20*, S2906–S2918. [CrossRef]
9. Cooper, C. You Can Handle It: 3D Printing for Museums. *Adv. Archaeol. Pract.* **2019**, *7*, 443–447. [CrossRef]
10. Batty, M.; Dodge, M.; Jiang, B.; Hudson-Smith, A. *GIS and Urban Design*; Working Paper. CASA Working Papers (3); Centre for Advanced Spatial Analysis (UCL): London, UK, 1999.
11. Batty, M.; Doyle, S. *Visual Communication in Urban Planning and Urban Design. GIS and Urban Design*; CASA Working Papers; Centre for Advanced Spatial Analysis University College London: London, UK, 1998.
12. Murgante, B.; Tilio, L.; Lanza, V.; Scorza, F. Using Participative GIS and E-Tools for Involving Citizens of Marmo Platano–Melandro Area in European Programming Activities. *J. Balk. Near East. Stud.* **2011**, *13*, 97–115. [CrossRef]
13. Rubino, I.; Barberis, C.; Xhembulla, J.; Malnati, G. Integrating a Location-Based Mobile Game in the Museum Visit: Evaluating Visitors' Behaviour and Learning. *J. Comput. Cult. Herit.* **2015**, *8*, 15. [CrossRef]
14. Prastyawan, A.; Isbandono, P. The Efforts of Joyoboyo Citizens in Preserving Traditional Children's Games Through Dolanan Village. In *Proceedings of the 1st International Conference on Social Sciences (ICSS 2018), Medan, Indonesia, 14–15 November 2018*; Witjaksono, A.D., Tandyonomanu, D., Awaru, A.O.T., Pangalila, T., Tsuroyya, Fauzi, A.F., Eds.; Atlantis Press: Amsterdam, The Netherlands, 2018; Volume 226, pp. 378–381.
15. Yamamura, T. Revitalization of Historical Heritage Using Pop Culture in Japan: Shiroishi City and the Game/Anime Sengoku Basara. *Tour. Anal.* **2015**, *20*, 327–332. [CrossRef]
16. Yeates, R.; Guy, D. Collaborative Working for Large Digitisation Projects. *Program-Electron. Libr. Inf. Syst.* **2006**, *40*, 137–156. [CrossRef]
17. Liang, X.; Hua, N.; Zhang, Y. *Chinese Social Media (Weibo) as a Tool to Advance Participatory Management during the Pandemic Period*; Yang, X.-S., Sherratt, S., Dey, N., Joshi, A., Eds.; Springer: Singapore, 2022; pp. 983–993.
18. Aigner, A. Heritage-Making 'from below': The Politics of Exhibiting Architectural Heritage on the Internet—A Case Study. *Int. J. Herit. Stud.* **2016**, *22*, 181–199. [CrossRef]
19. Corallo, A.; Trono, A.; Fortunato, L.; Pettinato, F.; Schina, L. Cultural Event Management and Urban E-Planning Through Bottom-Up User Participation. *Int. J. E Plan. Res.* **2018**, *7*, 15–33. [CrossRef]
20. Hood, C.; Reid, P. Social Media as a Vehicle for User Engagement with Local History: A Case Study in the North East of Scotland. *J. Doc.* **2018**, *74*, 741–762. [CrossRef]
21. Liang, X. Participatory Management for Cultural Heritage: Social Media and Chinese Urban Landscape. Available online: https://www.springerprofessional.de/en/participatory-management-for-cultural-heritage-social-media-and-/18172900 (accessed on 15 July 2020).
22. Giaccardi, E. *Heritage and Social Media: Understanding Heritage in a Participatory Culture*; Routledge: New York, NY, USA, 2012; ISBN 978-0-415-61662-1.

23. Lopez, B.E.; Magliocca, N.R.; Crooks, A.T. Challenges and Opportunities of Social Media Data for Socio-Environmental Systems Research. *Land* **2019**, *8*, 107. [CrossRef]
24. Rose, G.; Willis, A. Seeing the Smart City on Twitter: Colour and the Affective Territories of Becoming Smart. *Env. Plan D Soc. Space* **2018**, *37*, 411–427. [CrossRef]
25. Rania, Q. Using Social Hub Media to Expand Public Participation in Municipal Urban Plans. *Procedia Eng.* **2017**, *198*, 34–42. [CrossRef]
26. Purkis, H. Making Digital Heritage about People's Life Stories. *Int. J. Herit. Stud.* **2017**, *23*, 434–444. [CrossRef]
27. Boy, J.D.; Uitermark, J. Reassembling the City through Instagram. *Trans. Inst. Br. Geogr.* **2017**, *42*, 612–624. [CrossRef]
28. Ginzarly, M.; Pereira Roders, A.; Teller, J. Mapping Historic Urban Landscape Values through Social Media. *J. Cult. Herit.* **2019**, *36*, 1–11. [CrossRef]
29. Deng, Z.; Lin, Y.; Zhao, M.; Wang, S. Collaborative Planning in the New Media Age: The Dafo Temple Controversy, China. *Cities* **2015**, *45*, 41–50. [CrossRef]
30. Asur, S.; Huberman, B.; Szabó, G.; Wang, C. Trends in Social Media: Persistence and Decay. In Proceedings of the International AAAI Conference on Web and Social Media, Barcelona, Spain, 17–21 July 2011. [CrossRef]
31. Cici, B.; Gjoka, M.; Markopoulou, A.; Butts, C.T. *On the Decomposition of Cell Phone Activity Patterns and Their Connection with Urban Ecology*; ACM: New York, NY, USA, 2015; pp. 317–326.
32. De Nadai, M.; Staiano, J.; Larcher, R.; Sebe, N.; Quercia, D.; Lepri, B. The Death and Life of Great Italian Cities: A Mobile Phone Data Perspective. In Proceedings of the 25th International Conference on World Wide Web: WWW 2016, Montreal, QC, Canada, 11–15 May 2016; pp. 413–423. [CrossRef]
33. Hawelka, B.; Sitko, I.; Beinat, E.; Sobolevsky, S.; Kazakopoulos, P.; Ratti, C. Geo-Located Twitter as Proxy for Global Mobility Patterns. *Cartogr. Geogr. Inf. Sci.* **2014**, *41*, 260–271. [CrossRef]
34. Jong, A.D. Using Facebook as a Space for Storytelling in Geographical Research. *Geogr. Res.* **2015**, *53*, 211–223. [CrossRef]
35. Gesenhues, A. Study: Mobile Users & Older Generations Are Driving Social Media Growth Around the World. Available online: https://marketingland.com/study-social-network-growth-across-the-globe-driven-by-mobile-users-older-generations-41982 (accessed on 28 February 2019).
36. Harmon, R.R.; Castro-Leon, E.G.; Bhide, S. Smart Cities and the Internet of Things. In Proceedings of the 2015 Portland International Conference on Management of Engineering and Technology (PICMET), Portland, OR, USA, 2–6 August 2015; pp. 485–494.
37. Noveck, B.S. *Wiki Government: How Technology Can Make Government Better, Democracy Stronger, and Citizens More Powerful*; Brookings Institution Press: Washington, DC, USA, 2010; ISBN 978-0-8157-0510-9.
38. CNNIC. *The 48th Statistical Report on China's Internet Development*; China Internet Network Information Center: Beijing, China, 2021.
39. Zheng, Q.; Guo, Y.; Wang, Z.; Andrasik, F.; Kuang, Z.; Li, J.; Xu, S.; Hu, X. Exploring Weibo Users' Attitudes toward Lesbians and Gays in Mainland China: A Natural Language Processing and Machine Learning Approach. *Comput. Hum. Behav.* **2022**, *127*, 107021. [CrossRef]
40. NBSC. *National Real Estate Development Investment Report from January to August 2021*; National Bureau of Statistics of China: Beijing, China, 2021.
41. CNNIC. *2016 China Social Application User Behavior Research Report*; China Internet Network Information Center: Beijing, China, 2017.
42. Tencent Holdings Limited. *Tencent Announces 2021 Fourth Quarter and Full Year Results*; Tencent Holdings Limited: Hong Kong, China, 2022.
43. Hu, S. Weibo—How Is China's Second Largest Social Media Platform Being Used for Social Research? *Impact of Social Sciences*. Available online: https://blogs.lse.ac.uk/impactofsocialsciences/2020/03/26/weibo-how-is-chinas-second-largest-social-media-platform-being-used-for-social-research/ (accessed on 30 November 2021).
44. Sina Finance Weibo Announces Fourth Quarter and Full Year 2021 Financial Results. Available online: https://finance.sina.com.cn/stock/usstock/c/2022-03-03/doc-imcwiwss3985845.shtml (accessed on 14 May 2022).
45. UNESCO, World Heritage Centre. World Heritage List. Available online: https://whc.unesco.org/en/list/ (accessed on 21 December 2021).
46. Li, J.; Krishnamurthy, S.; Pereira Roders, A.; van Wesemael, P. State-of-the-Practice: Assessing Community Participation within Chinese Cultural World Heritage Properties. *Habitat Int.* **2020**, *96*, 102–107. [CrossRef]
47. Borona, G.; Ndiema, E. Merging Research, Conservation and Community Engagement. *J. Cult. Herit. Manag. Sustain. Dev.* **2014**, *4*, 184–195. [CrossRef]
48. Ferreira, T.C. Bridging Planned Conservation and Community Empowerment: Portuguese Case Studies. *J. Cult. Herit. Manag. Sustain. Dev.* **2018**, *8*, 179–193. [CrossRef]
49. MacRae, G. Universal Heritage Meets Local Livelihoods: 'Awkward Engagements' at the World Cultural Heritage Listing in Bali. *Int. J. Herit. Stud.* **2017**, *23*, 846–859. [CrossRef]
50. Verdini, G.; Frassoldati, F.; Nolf, C. Reframing China's Heritage Conservation Discourse. Learning by Testing Civic Engagement Tools in a Historic Rural Village. *Int. J. Herit. Stud.* **2017**, *23*, 317–334. [CrossRef]

51. Chen, C.P.; Weng, J.-Y.; Yang, C.-S.; Tseng, F.-M. Employing a Data Mining Approach for Identification of Mobile Opinion Leaders and Their Content Usage Patterns in Large Telecommunications Datasets. *Technol. Forecast. Soc. Change* **2018**, *130*, 88–98. [CrossRef]
52. Park, C.S.; Kaye, B.K. The Tweet Goes on: Interconnection of Twitter Opinion Leadership, Network Size, and Civic Engagement. *Comput. Hum. Behav.* **2017**, *69*, 174–180. [CrossRef]
53. Weeks, B.E.; Ardèvol-Abreu, A.; Gil de Zúñiga, H. Online Influence? Social Media Use, Opinion Leadership, and Political Persuasion. *Int. J. Public Opin. Res.* **2017**, *29*, 214–239. [CrossRef]
54. Huang, C.-C.; Lien, L.-C.; Chen, P.-A.; Tseng, T.; Lin, S.-H. *Identification of Opinion Leaders and Followers in Social Media*; Science and Technology Publications, Lda.: Hampshire, UK, 2017; pp. 180–185.
55. Ross, H.; Baldwin, C.; Carter, R.W. Subtle Implications: Public Participation versus Community Engagement in Environmental Decision-Making. *Australas. J. Environ. Manag.* **2016**, *23*, 123–129. [CrossRef]
56. Yu, L.; Asur, S.; Huberman, B.A. What Trends in Chinese Social Media. *arXiv* **2011**, arXiv:1107.3522.
57. NBSC. *Communiqué of the Seventh National Population Census (No. 4)-Sex Composition*; Office of the Leading Group of the State Council for the Seventh National Population Census; National Bureau of Statistics of China: Beijing, China, 2021.
58. Nov, O.; Arazy, O.; Anderson, D. Dusting for Science: Motivation and Participation of Digital Citizen Science Volunteers. In *Proceedings of the 2011 International Conference on Communication, Computing & Security, Rourkela Odisha, India, 12–14 February 2011*; Association for Computing Machinery: New York, NY, USA, 2011; pp. 68–74.
59. Ponciano, L.; Brasileiro, F. Finding Volunteers' Engagement Profiles in Human Computation for Citizen Science Projects. *Hum. Comput.* **2014**, *1*, 245–264. [CrossRef]
60. Serrano-Jiménez, A.; Barrios-Padura, Á.; Molina-Huelva, M. Sustainable Building Renovation for an Ageing Population: Decision Support System through an Integral Assessment Method of Architectural Interventions. *Sustain. Cities Soc.* **2018**, *39*, 144–154. [CrossRef]
61. Wang, Z.; Marafa, L. Tourism Imaginary and Landscape at Heritage Site: A Case in Honghe Hani Rice Terraces, China. *Land* **2021**, *10*, 439. [CrossRef]
62. Central People's Government of the People's Republic of China Urban and Rural Planning Law of the People's Republic of China (Chairman Order No. 74). Available online: http://www.gov.cn/zhuanti/2007-10/28/content_2624319.htm (accessed on 14 May 2022).
63. Central People's Government of the People's Republic of China the General Office of the State Council Issued the "14th Five-Year Plan for Cultural Relics Protection and Scientific and Technological Innovation". Available online: http://www.gov.cn/xinwen/2021-11/08/content_5649838.htm (accessed on 14 May 2022).
64. Qi, R.; Zhou, T.; Dong, W.; Pan, Y.; Qin, Y. A Review on the Research of Public Participation in Urban and Rural Heritage Protection in China in Recent 20 Years. *China City Plan. Rev.* **2021**, *45*, 105–118.
65. Wu, Z. Effect of Third-Party Participation in Urban Planning: A Case Study on Enning Road in Guangzhou. *China City Plan. Rev.* **2014**, *38*, 62–75.
66. Li, A. Practices and Reflections on Residents' Participation in Heritage Conservation: A Case Study of Courtyard Reorganisation in Dashilar, Beijing. *Herit. Archit.* **2018**, *8*, 76–83. [CrossRef]

MDPI AG
Grosspeteranlage 5
4052 Basel
Switzerland
Tel.: +41 61 683 77 34

Land Editorial Office
E-mail: land@mdpi.com
www.mdpi.com/journal/land

Academic Open
Access Publishing

mdpi.com

ISBN 978-3-7258-1610-1