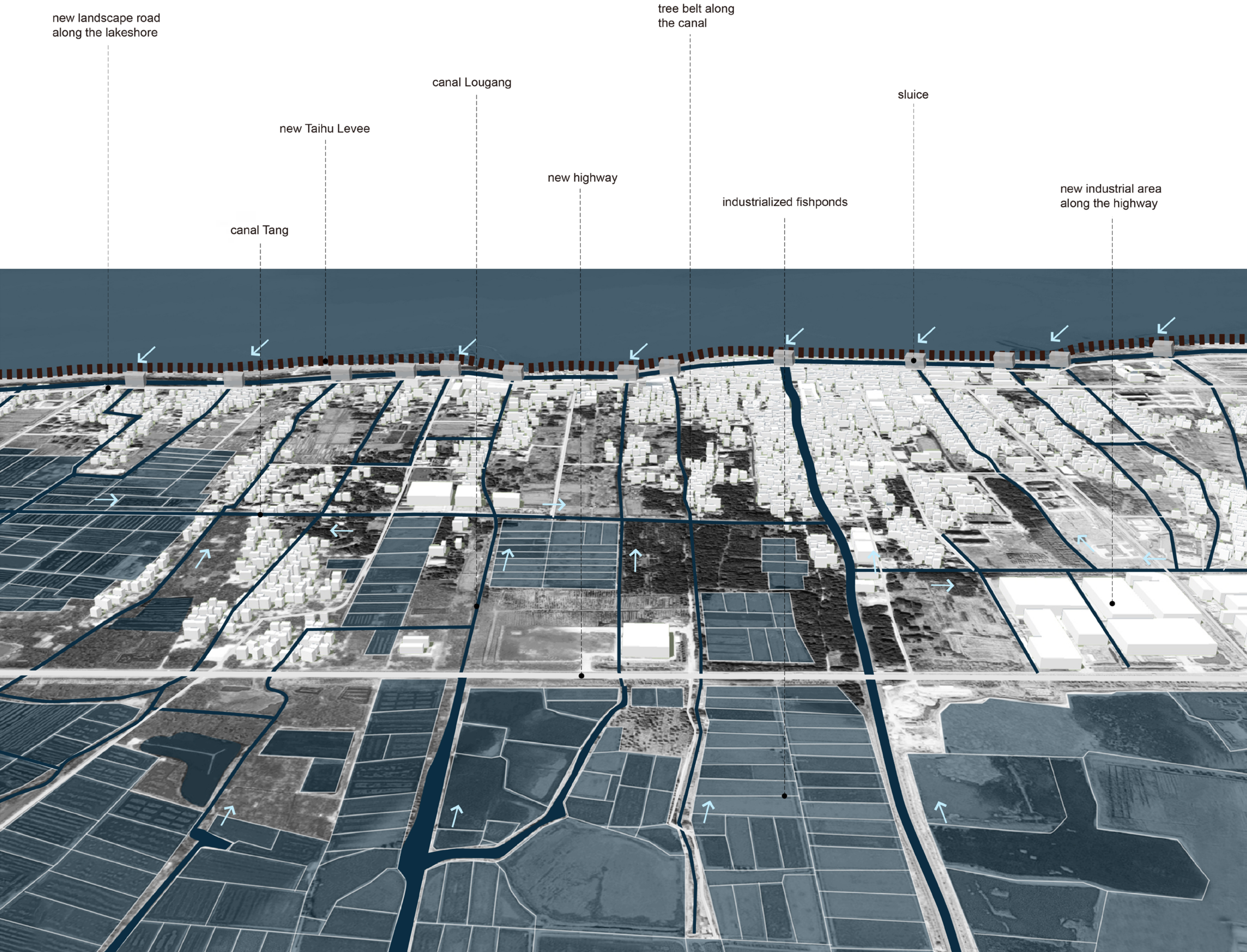
RESTRUCTURING CULTURAL LANDSCAPES IN METROPOLITAN AREAS

A TYPOLOGICAL APPROACH TO PERMANENT FORMS AND GREEN-BLUE INFRASTRUCTURE IN THE YANGTZE RIVER DELTA REGION IN CHINA

DOCTORAL THESIS

YUTING XIE



TECHNISCHE UNIVERSITÄT MÜNCHEN

Fakultät für Architektur

Professur für Landschaftsarchitektur regionaler Freiräume

RESTRUCTURING CULTURAL LANDSCAPES IN METROPOLITAN AREAS:

A TYPOLOGICAL APPROACH TO PERMANENT FORMS AND GREEN-BLUE INFRASTRUCTURE IN THE YANGTZE RIVER DELTA REGION IN CHINA

YUTING XIE

Vollständiger Abdruck der von der Fakultät für Architektur der Technischen Universität München zur Erlangung des akademischen Grades eines Doktor-Ingenieur (Dr.-Ing.) genehmigten Dissertation.

Vorsitzende: Prof. Sophie Wolfrum

Prüfer der Dissertation:

1. Prof. Dr. Sören Schöbel-Rutschmann

2. Prof. Dr. Johannes Küchler

Die Dissertation wurde am 07.09.2017 bei der Technischen Universität München eingereicht und durch die Fakultät für Architektur am 13.11.2017 angenommen.

RESTRUCTURING CULTURAL LANDSCAPES IN METROPOLITAN AREAS

A TYPOLOGICAL APPROACH TO PERMANENT FORMS AND GREEN-BLUE INFRASTRUCTURE IN THE YANGTZE RIVER DELTA REGION IN CHINA

YUTING XIE

Cover Figure: Model of the Networked Polder Landscape

ACKNOWLEDGMENTS

The accomplishment of this doctoral thesis is a dream come true: a dream work in a dream place with a dream team. It is a mission impossible, which would never have been realized without the support of the people I would like to thank here.

First of all, I would like to express my deepest gratitude to my supervisors Prof. Sören Schöbel and Prof. Johannes Küchler for their extraordinary support in the past six years. I still remember how excited I was in the Chinese New Year of 2011 when I received the offer from Sören Schöbel. I was then offered the opportunity to study and work at the professorship of LAREG and to gain precious life experience in Europe. It was an inspiring moment to meet Johannes Küchler at the ICOMOS conference in Florence. It was a shared passion and love for landscape in China that brought us together. I not only learnt academic and professional skills from them, but also the values for work and life, which have been of enormous benefit both in my academic career and my life in general.

Besides my supervisors, my gratitude is also due to my dear colleagues and friends, who provided their generous support with this thesis and accompanied and encouraged me throughout: Special thanks go to my colleagues Daniel Czechowski, Andreas Dittrich, Julian Schäfer, Michael Schmölz, Sabine Kern, Alexandra Bauer, and Kirstin Blaschke for their work together with me and for from whom I learned so much in discussions, projects and teaching; thanks to my dear friends Maider Uriarte, Kepa Iturralde, Parisa Vaziri, Xuan Liao, Yao Lv, Linlin Li, Chingning Huang, Zhuowei Wang, Shuangshuang Wu, Qiao Wu, Yuan Wang, Iris Dupper, Anke Müller, Philipp Hoß, Andrei Boreiko, and Pamela Durán Díaz's company and encouragement in the ups and downs of everyday life; thanks to Karl Hughes for professional English coaching in academic writing; thanks to Miao Yang, Yongbin Wang and Boyan Liu for their contribution in the mapping and research by design seminars.

Most of all, special thanks to my beloved parents Haiying Li and Aixiang Xie, aunt Aiyu Xie and brother Zhanwang Xie, who are always my spiritual support when I am thousands of miles away from my hometown.

After six years, I am returning home with precious experience and full of hope for the future in my career and life. This thesis is not an end. The work will continue in my beloved homeland.

Yuting Xie August 2017

SUMMARY

The Yangtze River Delta (YRD) is a physical and cultural geographical region as well as one of the megalopolises in China. The region consists mainly of low-lying alluvial plain and is annually under threat of flooding, waterlogging and typhoons. The delta region has had a long tradition of land reclamation and poldering, intensive agriculture, as well as urbanization, which together have consistently shaped its cultural landscapes. In the past decades, they have gradually been swallowed by reckless urban and industrial development. So far in China there is no optimal landscape analysis instrument for the study of landscape character, as well as their structural and functional changes. Hitherto, landscape architecture in China has played a fairly minor role in dealing with the loss of regional identity, cultural landscape degradation, and water issues in urbanizing deltas.

This research adapts the existing methods of Landscape Character Assessment (UK), Historic Cultural Landscape Elements (Germany), and Dutch polder classification to identifying landscape character areas and types at three scales. At the regional scale, 21 regional landscape character areas were classified for the complete YRD region. At the municipal scale, in the case of Suzhou, sections of selected landscape character areas as well as landscape changes were studied using a mapping approach. At the local scale, the landscape structures of these character areas were generalized to deduce their basic forms, based on which a combined qualitative and quantitative approach was implemented to describe and classify these areas by specific and type generating attributes. As a result, 13 landscape character areas of Suzhou were distinguished, 11 of which could be clustered into four landscape types by the criteria of basic forms (water system and parcellation patterns) but first of all polder technologies. The four identified polder landscape types in Suzhou fit into the four historic polder types described in the morphogenesis study of the delta landscape. These findings disprove the hypothesis that the formal variants of water elements and structures can classify landscape types in the delta region. In fact, *basic forms* and *polder technologies* form the implicit rules that predominantly shape the landscape characteristics and can be used as criteria to develop a typology for the delta region.

To validate these findings and to apply the outcomes of characterization in landscape practice, we developed a design for the networked polder landscape (one type in the study area) as permanent forms and potential green-blue infrastructure in the Taihu lakeshore area. A specific profile of this polder landscape type was developed to document its cultural meaning and social function, historical development, patterns, landscape changes, significance and vulnerability, as well as potential measures for landscape conservation, planning, and development. From this particular landscape type, the discussion was

extended to the other historic urban and polder landscape types and the metropolitan delta landscape in general. The type-specific measures for ensuring the permanence and resilience of historic cultural landscapes were summarized and categorized into three levels: conservation, transformation, and critical reconstruction. These results could be used as source materials and references to aid cultural landscape and heritage conservation, landscape management as well as planning and development in rapidly expanding metropolitan areas. In this way, a more integrative and resilient development model was developed for Suzhou and for the other YRD cities. This method could also serve for developing landscape characterization approaches for other cities or regions in China as well as for other densely urbanized and dramatically changing metropolitan (delta) areas around the world.

ZUSAMMENFASSUNG

Das Yangtze River Delta (YRD) ist eine physisch-geographische und kulturgeografische Region und zugleich eine der Metropolräume Chinas. Die Region ist überwiegend aus jungen Flusssedimenten aufgebaut und unterliegt entsprechend alljährlich der Gefahr von Überschwemmungen, Staunässe und Taifunen. Zugleich besitzt die Deltaregion eine lange Tradition der Landgewinnung und Eindeichung wie auch intensiver Landwirtschaft und Urbanisierung, die zusammen beständig die Charaktere und die Strukturen der Kulturlandschaften geformt haben. In den letzten Jahrzehnten wurden die Kulturlandschaften durch rücksichtslose urbane und industrielle Entwicklungen nach und nach absorbiert. Dessen ungeachtet existiert in China bisher kein optimales Instrumentarium zur Analyse und Untersuchung weder von Landschaftscharakteren, noch ihres strukturellen und funktionalen Wandels. Zudem fehlt im Umgang mit dem Verlust regionaler Identitäten, dem Zerfall von Kulturlandschaft und der Wasserproblematik in urbanisierten Deltas die Rolle der Landschaftsarchitektur.

Die vorgelegte Forschungsarbeit adaptiert bestehende Methoden der angelsächsischen Landscape Character Assessment, der deutschen Erfassung von Kulturhistorischen Landschaftselementen und einer niederländischen Poldersystematik, um auf drei Maßstabsebenen spezifische und typische Landschaftscharaktere zu identifizieren. In der YRD Region werden im regionalen Maßstab insgesamt 21 Charakterlandschaften unterschieden. Im kommunalen Maßstab werden in der als Vertiefungsgebiet ausgewählten Stadt Suzhou typische Abschnitte der skizzierten Charakterlandschaften anhand einer entwerfend-kartierenden Methode (*mapping)* untersucht. Auf der lokalen Maßstabsebene werden in einer Verbindung von quantitativen und qualitativen Verfahrensschritten die Landschaftsstrukturen dieser Gebietscharaktere verallgemeinert, um so grundlegende Formen abzuleiten, diese anhand von Einzelmerkmalen zu beschreiben sowie zusammenfassende Typen zu klassifizieren. Im Ergebnis ließen sich 13 Landschaftscharaktere unterscheiden, von denen 11 sich anhand der Grundformen ihrer Wasser- und Parzellierungssysteme, vor allem aber ihrer Poldertechnologien in vier verschiedenen Typen zusammenfassen ließen. Diese vier ‚Polder-Landschaften' entsprechen den vier historischen Poldertypen aus vorliegenden historisch-morphogenetischen Untersuchungen zur Delta-Region. So wird die These widerlegt, wonach sich die Landschaften der Delta-Region allein nach formalen Unterschieden ihrer hydrologischen Elemente und Strukturen klassifizieren ließen. Vielmehr sind es die grundlegenden Polder-Techniken, deren implizite Regeln charakteristische Landschaften der Delta-Region formen und als Kriterien für die Entwicklung einer entsprechenden Typologie herangezogen werden können.

Zur Überprüfung dieser Erkenntnisse und zur Anwendung der Ergebnisse der Landschaftscharakterisierung in der Planungspraxis, werden in Fallstudien die vernetzen Polder-Landschaften in den Ufergebieten des Taihu Sees als einer der Charaktertypen im Untersuchungsraum als permanente Form und potentielle ‚blau-grüne Infrastrukturen' entworfen. Im Zusammenhang mit den Ergebnissen der angewandten Methode zur Charakterisierung wird für diesen Typ ein spezifisches Profil erstellt, um die mit ihm verbundenen kulturellen Bedeutungen, sozialen Funktionen, historischen Entwicklungen, Muster, Veränderungen der Landschaft, Signifikanz und Vulnerabilität, wie auch potenzielle Landschaftsplanungs- und -entwicklungsmaßnahmen in der Praxis zu dokumentieren. Hiervon ausgehend wird die Betrachtung wieder auf die anderen historischen Stadt- und Polderlandschaftstypen ausgedehnt und auf die metropolitane Deltalandschaft im Allgemeinen. Die typenspezifischen Maßnahmen zu Sicherstellung von Permanenz und Resilienz historischer Kulturlandschaften, werden in drei Ebenen zusammengefasst: Konservierung, Transformation und Kritische Rekonstruktion. Diese Ergebnisse können als Quellenmaterial und Verweise bei der Pflege von Landschaft als kulturelles Erbe, im Landschaftsmanagement, wie in der Planung und Entwicklung schnell wachsender metropolitaner Gebiete helfen. Auf diese Weise wird für das Gebiet der Stadt Suzhou wie für die anderen Städte in der YRD Region eine besser integrierte und resiliente Entwicklung dargestellt. Diese Methode könnte auch als Vorbild für die Entwicklung von Methoden zur Landschaftscharakterisierung für andere schnell wachsende Städte oder Regionen in China dienen, wie auch weltweit für andere extrem urbanisierte und sich auf dramatische Weise verändernde Delta-Metropolregionen.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ASLA	American Society of Landscape Architects
CHSLA	Chinese Society of Landscape Architecture
ECLAS	European Council of Landscape Architecture Schools
ELC	European Landscape Convention
GIS	Geographic Information System
HLC	Historic Landscape Characterisation
LAREG	Landscape Architecture and Regional Open Space
LCA	Landscape Character Assessment
LID	Low Impact Development
NPS	National Park Service
KHLE	Historic Cultural Landscape Elements
VGE	Vector Graphics Editor
YRD	Yangtze River Delta

CHAPTER 1 INTRODUCTION

This chapter sets the scene for the dissertation project by introducing the research background, problem statements, research questions, and aims. It also explains the basic framework of research methodology and the achieved outcomes. Lastly, this chapter offers an overview of the main structure of this thesis.

1.1 SETTING THE SCENE

1.1.1 PROBLEM STATEMENTS

CULTURAL LANDSCAPE DEGENERATION IN CHINA

Landscape is a synthesis of physical environment and artificial spaces, which can function materially as infrastructure and also ideologically (Jackson, 1984). Landscape shaped and modified by human intervention will in turn reshape human identity by influencing perceptions, values and behaviors (Höfer & Trepl, 2010; Marston, Knox, & Liverman, 2002). It connects people and place (Spirn, 1998), and accomodates the physical and cultual character of a region.

China has abundant cultural landscapes in varied geographic regions, including agricultural landscapes, settlement landscapes, and industrial landscapes. As a *palimpsest* (Corboz, 1983), they all represent local context and reflect the process of landscape evolution in the dynamic interaction between natural and human forces through history. However, the existence and quality of these valuable historic cultural landscapes are under threat because of the impact of intensive urbanization and industrialization as well as modern agricultural practices which have been unfolding since the beginning of the reform era in the late 1970s. Nowadays, landscapes in China have experienced a loss of diversity, coherence, and identity, and it is difficult to appreciate the scale of ongoing chaotic fragmentation of traditional urban or rural landscapes and disregard for local physical and cultural conditions. Canals and lakes are filled in to accommodate the relentless expansion of built-up areas, highways constructed across fields, and traditional dwellings are demolished to allow the establishment of large-scale homogenous residential areas. We observe a wide-spread "cultural ignorance" about this ongoing transformation of traditional landscapes, whether of prominent cultural heritage or ordinary everyday landscapes (Groth, 1997, p. 1).

PROBLEMS IN THE YANGTZE RIVER DELTA

The Yangtze River Delta (YRD) covers 36,985 km^2 and has a population of 59.7 million (2013), accounting for 0.4% of the whole territory but accommodating 4.4% of the whole population of China. Most of the region is situated in a low-lying alluvial plain (about 2–7 m above sea level), of which 60% is occupied by polder areas (Wang, 2006). Water surface accounts for one sixth of the total area, including numerous lakes, crisscrossing rivers and canals. Because of the nearly flat topography and sub-tropical monsoon climate, it is under annual threat of flooding, waterlogging, and typhoons. Frequent floods in rainy seasons have caused disastrous damage and economic loss (Wang, 2006; Zhang, Gemmer, & Chen, 2008). Nevertheless, in China, climate adaptive planning and design, research into urban morphologies of delta cities and metropolitan delta landscapes, and related areas of investigation are still in their infancy. Landscape architects have not yet paid much attention to water issues in China’s rapidly changing metropolitan deltas.

The YRD has had a long tradition of human settlement, land reclamation, and intensive agriculture, which has turned the former marshes and peatlands into a highly productive area (China's Agricultural Heritage Research, 1990; Miao, 1982; Zheng, 1987). Physical conditions and hydraulic techniques together have consistently shaped the characteristics and structures of the delta landscape. During the past three decades, the YRD has undergone significant land use and land cover changes, leading to the deterioration of ecosystems and frequent occurrence of flooding (Gao, 2004; Pan, Yang, Su, & Wang, 2015). The current delta landscape is a highly dynamic and fragmented complex of degraded natural, vanishing historic rural, as well as mixed industrial and urban elements and structures. The accelerated industrialization and urbanization of recent decades has overlapped with and replaced historic landscape structures almost completely with modern functional approaches to land use via a generic and homogeneous “industrial logic” (Lefèbvre, 2003). Thus, the historic cultural landscapes in the delta region are particularly vulnerable to flooding and to change. There is an urgent need to study and protect the surviving cultural elements and structures.

RESTRUCTURING CULTURAL LANDSCAPES IN METROPOLITAN AREAS

Cultural landscape is not a prevalent concept or topic in spatial planning, heritage protection policies, or landscape architecture theory and practice in China. So far, the research on cultural landscape has been restricted to cultural heritage sites or national parks. Little attention has been paid to the development and state of traditional cultural landscapes, such as rural settlement patterns, let alone contemporary everyday landscapes. Landscape architects in China seldom have the opportunity to play a role in new town and urban development or regional planning, unlike their US and European colleagues. Their work currently is limited to the design of urban green spaces and residential quarters. With the exception of national parks and world heritage cultural landscapes, landscape planning projects such as urban green space systems and regional greenways are dominated and implemented by urban planners from municipal and regional planning institutes. Furthermore, most of the finished landscape projects claiming to be site-specific and representing the sense of place simply borrow symbolic elements derived from vernacular forms. Some even efface the original cultural landscapes entirely in order to build a completely new “vernacular landscape”. The link between historic cultural landscapes and urbanization in current landscape architecture practice in China is missing.

It is therefore necessary to address the cultural landscape as a design issue in landscape architecture when confronting the on-going degeneration of the cultural landscape, frequent urban flood disasters, and the mass expansion of urban-industrial land use in China. It is incumbent on landscape architects in China to consider new landscape forms to fulfill the ever-increasing demand for multifunctional spaces and to rethink the meanings of historic landscapes in compact and intensively used urban and rural spaces according to these new and emerging conditions. European countries also have a high diversity of historic cultural landscapes. Relevant theoretical research and practices on how to preserve a variety of landscape forms and meanings while simultaneously satisfying modern functions have made impressive progress. Therefore, this research will draw upon these experiences of Europe to provide references for landscape architecture in China.

LANDSCAPE ANALYSIS INSTRUMENTS FOR METROPOLITAN AREAS

In Europe, there are well-established, systematic landscape analysis instruments, such as *Historic Landscape Characterisation* (HLC) and *Landscape Character Assessment* (LCA) originating in the UK, as well as *Historic Cultural Landscape Elements* (KHLE) from Germany. These projects primarily deal with rural landscapes, and some extend to townscapes or urban landscapes, which still have distinguishable boundaries and characteristics from their neighboring rural landscapes. Unlike its already mature practice in Europe, there is no commonly recognized approach for landscape characterization in China. At the same time, the rapid urbanization in China limits the applicability of European analytic tools. Given the particularities of China's urban systems, especially in rapidly expanding metropolitan areas, the blurred urban, suburban and rural landscapes should be studied as a sequence on an urban-suburban-rural continuum, rather than discrete rural or urban landscapes considered as static or aesthetic entities. Another challenge in applying existing European tools to a specific region or city in China lies in the fact that population density, land use patterns, pace of development, planning and land ownership systems, and especially data availability are not comparable (Xie & Schöbel-Rutschmann, 2015). Thus new instruments are required for the study of landscape characteristics and changes in metropolitan areas in China.

1.1.2 AIMS AND OBJECTIVES

This research begins with the idea of improving people's understanding of cultural landscapes and provoking their concern about the dramatic changes in the everyday landscape. The main objective of this research is to develop a site-specific approach for mapping, describing and classifying landscape character areas and types in the YRD region. By developing this tool, we seek to generate type-specific measures to ensure the permanence (Rossi, 1984) and resilience of historic cultural landscapes to new urban development in landscape architecture practice.

This could stimulate the potential use of these cultural landscape elements and structures as permanent forms for landscape conservation and management, as well as for future urban development, in order to maintain and redevelop regional identity. Special emphasis will be given to water issues to explore the possibilities of combining historic cultural landscapes as green-blue infrastructure with new urban fabrics *qua* spatial qualities and identities, and of integrating flood management systems into open space systems.

1.1.3 RESEARCH QUESTIONS

According to the problem statements and objectives above, we arrived at three essential questions guiding this research. Each central question comprises several sub-questions:

- What are the landscape characteristics and design issues in the YRD region?
  - What defines the landscape characteristics of this region?
  - How did the forms and structures of historic cultural landscapes take shape?
  - How do these structures affect spatial qualities and identities?
  - How have urbanization and industrialization influenced the historic landscape characteristics?
- How to structure landscape character and landscape changes?
  - Are there primary structures that define the character? Are all these landscape characteristics associated with water? If so, which spatial variations of water elements and structures can be identified?
  - Do these forms and structures have an implicit logic that could explain these spatial phenomena in certain landscape types?
  - What tools are already available and/or optimal for the study of landscape characteristics and landscape changes in metropolitan regions?
  - What kind of different or additional tools do we need for landscape character study in this delta region? Is there a shortfall in existing methods and approaches?
- How to protect or reuse historic cultural landscapes in landscape architecture practice?
  - What kind of existing international strategies and measures can be transferred to the YDR region?

- Which specific design strategies or measures are appropriate for particular landscape types?

From these research questions, we can draw two hypotheses:

– Landscape types can be identified according to the forms and patterns of their water elements and structures, as these predominately shape the characteristics of the delta landscape.

– Water elements and structures can be protected or redeployed as spatial qualities and identities in regenerative landscape architecture practice.

1.2 RESEARCH METHODOLOGY AND OUTCOMES

This research developed a typological approach that is specific to the YRD region by adapting the basic framework of LCA, in combination with the HKLE and Dutch polder classification. The overall process of this approach is structured in five stages, namely: define purpose and scope, visual identification and field survey, classification, mapping and description, and practice. Both qualitative and quantitative approaches are used in this process.

The typological approach was conducted at three scales. At the regional scale (approx. 1:2,500,000), 21 landscape character areas were classified for the YRD region by overlaying a physiographic map and a hydraulic map. At the municipal scale (1:50,000 or 1:25,000), in the case of Suzhou, sections of selected landscape character areas were focused on and studied using a mapping approach. At the local scale (1:5,000), the landscape structures of these character areas were generalized to deduce the basic forms, based on which a combined qualitative and quantitative approach was implemented to describe and to classify these areas. For this reason, we were able to distinguish 13 landscape character areas of Suzhou; we classified four polder landscape types occurring in 11 polder areas according to the criteria of basic forms (related to water system and parcellation patterns) and polder technologies. The four polder landscape types, which we identified in Suzhou, fit into the four historic polder types found in the morphogenesis study of the delta landscape. These outcomes show that basic forms and related polder technologies form the implicit rules that predominantly shape the characteristics of polder landscapes and can be used as criteria to classify polder landscape types.

More specifically, we conducted the mapping and research by design projects in seminars that were held at the Professorship of Landscape Architecture and Regional Open Space (LAREG) at the Technical University of Munich. In the mapping section, we analyzed the cultural landscape elements and structures at multiple scales and documented significant cultural landscape changes by overlaying natural morphology, historic cultural landscape (pre-1978), and contemporary urban/industrial landscape (post-1978). In the classification section, 105 historic cultural landscape elements were collected as analytic items for landscape structures, and were classified into seven function types and three form types. In the practice section, we developed a design for the networked polder landscape (as one type in the study area) as permanent forms and potential green-blue infrastructure in the Taihu lakeshore area. In combination with the results from the characterization approach, a specific profile of this polder landscape was developed to document its cultural meaning and social function, historical development, patterns, landscape changes, significance and vulnerability, as well as potential measures for landscape practice. From the practice applied to this particular landscape type, we extend the discussion to other historic urban and polder landscape types or the metropolitan delta landscape in general. The type-specific measures for ensuring the permanence and resilience of historic cultural landscapes were summarized and categorized into three levels: conservation, transformation, and critical reconstruction (Schöbel, 2016).

1.3 DISSERTATION OUTLINE

This dissertation is divided into four main sections:

The first section, the introduction sets the scene by introducing the background, problem statements, and research questions and objectives. It also explains the research methodology, achieved outcomes, and the structure of this monograph.

The second section includes the second and third chapters, which develop the research context in China. Chapter 2 interprets the key concepts used in this research by comparing definitions provided by various languages and dictionaries, professional conventions, and multidisciplinary literature. This could help to elucidate the research background and build a Sino-European context. Chapter 3 is divided into four parts. The first part, *Cultural Landscape and Urbanization: An Introduction*, compares the theoretic studies of cultural landscape in Europe, the US and in China and also discusses the new spatial forms of the rapidly expanding metropolitan regions in the world and in China in particular. The second part, *Landscape Analysis Instruments—the State of the Art*, reviews the current existing research methods dealing with the character of historic cultural landscapes and its relics. This review serves as an inspiration and basis for developing a specific landscape analysis instrument for the YRD region discussed later in Chapter 5. The third part, *Permanent Forms and Green-Blue Infrastructure—the Role of Landscape Architecture*, reviews the current practices of postmodernism, regionalism, critical regionalism, critical reconstruction, green-blue infrastructure, and delta urbanism, all of which deal with the loss of regional identity, cultural landscape degradation, and the water issue in urbanizing deltas. Most importantly, the fourth part concludes with a critical assessment of the missing role of landscape architecture in all these discourses, especially the potential offered by cultural landscape in metropolitan areas.

The third section includes Chapters 4 and 5, focusing on landscape character study. Chapter 4 demonstrates the temporal-spatial morphogenesis of cultural landscapes in the YRD region from the historic polder landscape to the contemporary metropolitan delta landscape. The historical study shows the morphological and functional changes of these historic cultural landscapes. Five basic forms of polder systems were discovered as forming the implicit logic behind the spatial organization of the polder landscapes, which assists the identification and classification of polder landscape types in Chapter 5. Chapter 5 introduces the process of developing the multi-scale typological approach for studying landscape character in the delta region. The methods and outcomes are displayed in five subchapters according to the five research stages. Furthermore, based on such a typological approach, this chapter discusses the type-specific measures for restructuring cultural landscapes as permanent forms and potential green-blue infrastructure in landscape architecture practice at the three levels of conservation, transformation, and critical reconstruction.

The last section, Chapter 6 summarizes the conclusions drawn from each chapter and was structured in four subchapters. The first subchapter, *Bridging Research Gaps*, sums up the contribution of this research to the issues of cultural landscape in the ongoing urbanization of China, as well as cultural landscape as a design issue emphasizing permenant forms and green-blue infrastructure in the delta region. The second subchapter, *Research Findings*, presents the outcomes of the morphogenesis study of cultural landscapes in the delta region and of the typological approach. The third subchapter is a reflection on the research methods including the innovative aspects of this inclusive and integrated instrument for landscape characterization in the rapidly expanding delta cities, and also the limitations and potential improvements of this instrument. The last subchapter introduces the potential applications of the research outcomes in landscape conservation, planning, management, and future development.

CHAPTER 2 BUILDING THE RESEARCH CONTEXT

This chapter offers an overview of the key concepts used in this research to elucidate the research background and to build a Sino-European context. As there are no generally accepted definitions for key concepts such as *landscape*, *landscape structure*, *cultural landscape*, *landscape architecture*, *region* and *regional character*, the appropriate way to interpret them is by a comparative study. Based on the definitions provided by various languages and dictionaries, professional conventions and multidisciplinary literature, conclusions can be drawn as to which definitions better explain the research context.

2.1 LANDSCAPE

The definition of *landscape* is a fundamental issue in the discipline and profession of landscape architecture. Starting from an interpretation of this concept will help us build the foundation of the research context.

2.1.1 DICTIONARIES

According to *The Oxford English Dictionary* (Simpson & Weiner, 1989), landscape is “a picture representing natural inland scenery, as distinguished from a sea picture, a portrait, etc.” Similarly, *Webster’s New World Dictionary* (Guralnik, 1984) describes landscape as “an expanse of natural scenery seen by the eye in one view.” Both dictionaries define landscape as a scenic view of land.

2.1.2 MEANINGS IN VARIOUS LANGUAGES

The term *landscape* can be additionally interpreted as the combination of two separate word roots, *land* and *scape*, which have similar meanings in various languages. Spirn (1998) writes in *The Language of Landscape*,

> Landscape associates people and place. Danish *landskab*, German *landschaft*, Dutch *landschap*, and old English *landscipe* combine two roots. “Land” means both a place and the people living there. *Skabe* and *schaffen* mean “to shape”; suffixes -*skab* and -*schaft* as in the English “-ship,” also mean association, partnership. (pp. 16-17)

Thus, landscape here is not merely a scenic view of the land, but also describes the association between place and people living there and shaping it.

In Chinese, the word *landscape* is traditionally translated as *Fengjing* (scenery). While *Jingguan* as a comparatively recent concept originated from geographers’ perception of landscape. It became widely used with the development of landscape architecture in China. *Jingguan* may be viewed as an assembly of visually perceived objects, a habitat for living, an ecosystem as well as a setting of symbolic items (Lin, 2006; Yu, 2002).

2.1.3 LANDSCAPE CONVENTIONS

The European Landscape Convention (ELC) defines landscape as “an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors” (Council of Europe, 2000). This broad definition includes all ordinary everyday landscapes as well as specific cultural landscapes, and brings landscape back to its initial meaning as “a unique synthesis between the natural and cultural characteristics of a region” (Antrop, 2006, p. 34). The American Society of Landscape Architects (ASLA) publishes a glossary in which the definition of *landscape* is: “the amount of countryside and/or city that can be taken in at a glance. Also, an area of land or water taken in the aggregate” (American Society of Landscape Architects, n.d.-a).

Both definitions above reveal that landscape is, first of all, an objectively existing item perceived by humans rather than a merely scenic view. By comparison, the ELC’s definition emphasizes the natural and cultural attributes of landscape, as well as the driving forces shaping landscape and the distinct character that results, whereas the ASLA’s definition is more concerned with the span of objects perceived as landscape.

2.1.4 MULTIDISCIPLINARY LITERATURE

In geography, the classic definition of landscape as “*der Totalcharakter einer Erdgegend*” (ascribed to Alexander von Humboldt, literally means “the total character of a region of the Earth”, translated by Zonneveld, 1995, p. 27). This definition implies that regional character and diversity are expressed in the landscape. Humboldt also emphasized the cultural dimension and the aesthetic value of landscape in his scientific work (Antrop, 2006).

From the perspective of cultural geographers, Cosgrove and Daniels (1988) describe a landscape as “a cultural image, a pictorial way of representing, structuring or symbolising surroundings” (p. 1). The American cultural geographer and landscape historian, J.B. Jackson (1984) states the global dynamics of urbanization and industrialization in the last half century have contributed to a new professional approach: landscape architects have developed their concept of landscape away from landscape painting (“a picture of a scenic view”, p. 3) by dealing with rising ecological and environmental issues instead of the designing of picturesque gardens or parks. Thus, Jackson formulates landscape as “a composition of man-made or man-modified spaces to serve as infrastructure or background for our collective existence” (ibid., p. 8). This new definition emphasizes the fact that landscape, as a synthetic system, can function materially as infrastructure and also culturally for a community.

2.2 LANDSCAPE ELEMENTS, STRUCTURE, CHARACTERISTICS AND CHARACTER: IN SEARCH FOR LANDSCAPE INVENTORIES

Since we arrive at a “modern” definition of landscape, the following section will discuss what constitute the forms and character of a landscape and the method of documenting the character by illustrating the hierarchical relations of elements, structure, features, characteristics, and character.

2.2.1 ELEMENTS, CHARACTERISTICS AND CHARACTER: A HIERARCHICAL APPROACH

Landscape elements are the “individual components which make up the landscape including, for example, hills, valleys, rivers, woods, trees, hedges, buildings and roads” (Scottish Natural Heritage, 2017). These elements are visible and exist materially, they can be perceived and described in an objective manner (ibid.). Furthermore, the spatial and social interaction between elements make landscape a holistic system, and landscape elements are the basic items for defining and describing landcape characteristics as well as for landscape protection, management and planning practices (Council of Europe & European Landscape Convention, 2013).

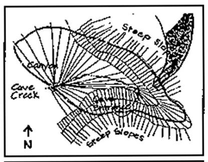
In the glossary of “A Guide to Cultural Landscape Reports”, the National Park Service (NPS) defines *landscape characteristics* as “the tangible and intangible characteristics of a landscape that define and characterize the landscape and that, individually and collectively give a landscape character and aid in understanding its cultural value” (Page, Gilbert, & Dolan, 1998, p. 139). Moreover, the guide offers an overview of landscape characteristics that should be recorded in a cultural landscape report (Figure 2.1).

In the *Landscape Character Assessment: Guidance for England and Scotland* (Swanwick & Land Use Consultants, 2002), *elements*, *features*, *characteristics*, and *character* could be interpreted in a hierarchical manner:

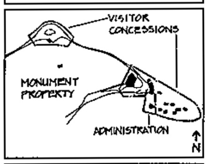
> Elements: Individual components which make up the landscape, such as trees and hedges.
>
> Features: Particularly prominent or eye catching elements, like tree clumps, church towers, or wooded skylines.
>
> Characteristics: Elements, or combinations of elements, which make a particular contribution to distinctive character.
>
> Character: A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse. (p. 8)

Overview of Landscape Characteristics

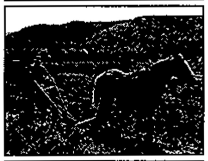
Landscape characteristics include tangible and intangible aspects of a landscape from the historic period(s); these aspects individually and collectively give a landscape its historic character and aid in the understanding of its cultural importance. Landscape characteristics range from large-scale patterns and relationships to site details and materials. The characteristics are categories under which individual associated features can be grouped. For example, the landscape characteristic, vegetation, may include such features as a specimen tree, hedgerow, woodlot, and perennial bed. Not all characteristics are always present in any one landscape. The following landscape characteristics may be documented in a CLR.



Natural Systems and Features
Natural aspects that often influence the development and resultant form of a landscape.

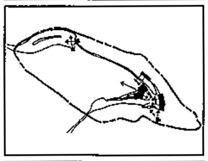


Spatial Organization
Arrangement of elements creating the ground, vertical, and overhead planes that define and create spaces.

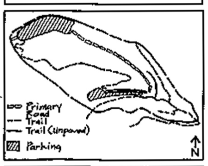


Land Use
Organization, form, and shape of the landscape in response to land use.

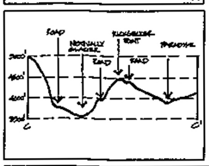
Cultural Traditions
Practices that influence land use, patterns of division, building forms, and the use of materials.



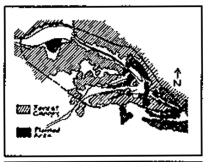
Cluster Arrangement
The location of buildings and structures in the landscape.



Circulation
Spaces, features, and materials that constitute systems of movement.

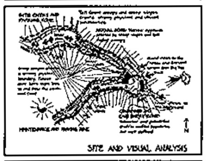


Topography
Three-dimensional configuration of the landscape surface characterized by features and orientation.

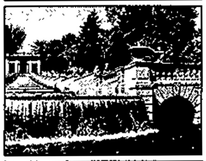


Vegetation
Indigenous or introduced trees, shrubs, vines, ground covers, and herbaceous materials.

Buildings and Structures
Three-dimensional constructs such as houses, barns, garages, stables, bridges, and memorials.

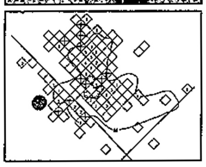


Views and Vistas
Features that create or allow a range of vision which can be natural or designed and controlled.



Constructed Water Features
The built features and elements that utilize water for aesthetic or utilitarian functions.

Small-Scale Features
Elements that provide detail and diversity combined with function and aesthetics.



Archeological Sites
Sites containing surface and subsurface remnants related to historic or prehistoric land use.

Figure 2.1 Overview of Landscape Characteristics

Source: Retrieved from Page et al. (1998, p. 53).

Alternatively, Jessel (2006) specifies the element, shape, and space levels corresponding to the three categories of elements, characteristics and character for monitoring the changes in the visual landscape. According to this hierarchical system: the combination of elements constitutes the characteristics of a landscape unit; and the perception, classification and description of overall characteristics of similar landscape units turn out to be landscape character.

These are important pioneering works in the hierarchical study of landscape character, but their shortcomings are also quite evident. In Landscape Character Assessment (LCA), the *features* and *characteristics* of a specific landscape cannot be clearly identified; the three levels of Jessel's approach are clear and applicable. In the Chinese context, the meanings of these terms and the way of using them are hardly transferable: *Landscape elements* (*Jingguan yuansu*) is a commonly used term; while *features*, *characteristics*, *character* are all translated as the same term *Tezheng*, and cannot be distinguished from each other as they do not have similar hierarchical meanings as defined in LCA or in Jessel's approach.

2.2.2 LANDSCAPE STRUCTURE

Landscape structures (*Jingguan jiegou*) are the results of spatial and cultural interaction between landscape elements, and they are a manifestation of landscape characteristics, by which different landscape types showing similar landscape structures can be identified and studied in groups (Council of Europe & European Landscape Convention, 2013). The landscape structure is a focus of interest in landscape protection, management or planning activities promoted by the ELC. It is the interaction between component elements rather than the elements themselves that deserve attention during the analysis of landscape structures, in which landscape is both a complex system and a holistic systhesis (ibid.). Similarly, Antrop (2000, 2006) comments that landscape is merely a combination of individual elements, and the interrelation between elements, which constitute the characteristics of a specific landscape structure, is more significant.

2.2.3 LANDSCAPE CHARACTERIZATION

Characterization (*Tezheng miaoshu*) is “the process of identifying areas of similar character, classifying and mapping them and describing their character” (Swanwick & Land Use Consultants, 2002, p. 8). Historic Landscape Characterisation (HLC) is a systemic methodology promoted by the English Heritage for characterizing historic cultural landscapes, and monitoring and managing their changes (Clark, Darlington, & Fairclough, 2004). The main tasks of landscape characterization are the identification and description of landscape attributes listed as follows (Table 2.1):

Table 2.1 Examples of Features to be Mapped and of Source Materials for Historic Landscape Characterisation

Source: Retrieved from Clark et al. (2004, p. 7).

Examples of HLC Attributes
• Current land use
• Past land use
• Field morphology (size, shape, group patterns)
• Boundary types
• Distribution and types of other resources (e.g. woodland, water, minerals)
• Distribution and types of buildings
• Placenames and earliest references
• Settlement types and patterns
• Communication types and patterns
• Archaeological and historic sites recorded on the SMR Common Sources
• Modern OS mapping (usually GIS-based)
• Modern land use and thematic mapping (e.g. Phase 1 Habitat Survey)
• Geological, soil, hydrological and topographical mapping
• Comprehensive historic mapping (e.g. OS First Edition)
• Selected historic mapping (e.g. Enclosure Awards, Estate Maps and Tithe Maps)
• Aerial photographs
• Documentary sources (e.g. VCH, place name surveys)
• SMR data (especially designations)
• Other research

2.3 CULTURAL LANDSCAPE

Cultural landscape is not a commonly used term in either heritage protection or landscape architecture practice in China. Here we discuss the prevalent understandings of cultural landscapes as both heritage and everyday landscape worldwide, which will help develop a common understanding of cultural landscapes in China.

2.3.1 CULTURAL LANDSCAPE AS EVERYDAY LANDSCAPE

In the 1920s and 1930s, the term *cultural landscape* was introduced by Carl Sauer and the Berkeley School of human geography in the USA (Fowler, 2003). Sauer's definition is still frequently quoted—"the cultural landscape is fashioned from a natural landscape by a culture group. Culture is the agent, the natural area is the medium, the cultural landscape the result" (Sauer, 1925, p. 103).

Today, landscapes in Europe as well as globally are all cultural to the extent that they have been entirely or at least partly influenced and shaped by human activities. The ELC states that cultural landscapes today embrace any land surface, no matter whether we think of "natural", rural, urban or suburban areas, no matter how outstanding, everyday, or degraded (Council of Europe, 2000). On the one hand, this allows for a new and open perspective and approach to landscape maintenance and development but it also entails a wide range of concomitant challenges (Ermischer, 2005).

2.3.2 CULTURAL LANDSCAPE AS HERITAGE SITE

Since the 1980s, cultural landscapes have aroused widespread concern and become an important category in the world of heritage protection (Page et al., 1998). In the United States, the NPS has recognized and protected cultural landscapes as a type of cultural resource in the National Park System (National Park Service, n.d.-a). The NPS defines a cultural landscape as "a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein), associated with a historic event, activity, or person, or that exhibit other cultural or aesthetic values" (National Park Service, n.d.-b) and listed four general categories of cultural landscapes: *historic sites*, *historic designed landscapes*, *historic vernacular landscapes*, and *ethnographic landscapes* (Birnbaum, 1994, p. 1).

In 1992, the World Heritage Convention became the first international agreement to identify and protect cultural landscapes (UNESCO World Heritage Centre, n.d.). The convention adopted operational guidelines for three categories of cultural landscapes on the World Heritage List (WHL), namely:

- *the clearly defined landscape designed and created intentionally by man* (e.g. classic parks and gardens associated with monumental buildings and ensembles);
- *the organically evolved landscape*: *a relict (or fossil) landscape* (e.g. archaeological sites); *continuing landscape* (e.g. vineyards, rice terraces);
- and *the associative cultural landscape* (e.g. national parks, ancient settlements) (UNESCO World Heritage Centre, 2015, p. 71)

The nomination of cultural landscapes as world heritage sites should be based on "their outstanding universal value and of their representativity in terms of a clearly defined geo-cultural region and also for their capacity to illustrate the essential and distinct cultural elements of such regions" (ibid.). These criteria identify and limit the span of cultural landscapes as a particular type of world heritage. Therefore, by 2015, there were only 88 properties (with four transboundary, one delisted) on the WHL listed as cultural landscapes all over the world (UNESCO World Heritage Centre, n.d.).

2.4 REGION AND REGIONAL CHARACTER

Landscape is a synthesis of natural and cultural characteristics of a specifc region and a medium that accommodates regional character. Thus, landscape, under certain conditions may have a similar meaning to *region*, which distinguishes itself from neighboring regions by certain characteristics. The following section examines the interrelated meanings of landscape, region, and regional character.

2.4.1 DEFINITION OF REGION IN GEOGRAPHY

In geography, *region* is a fundamental concept and object of research as this discipline deals with territorial areas through regional approaches (Claval, 2007). *The Dictionary of Human Geography* describes a region as “a more or less bounded area possessing some sort of unity or organizing principle(s) that distinguish it from other regions” (Johnston, Gregory, Pratt, & Watts, 2000, p. 687). Furthermore, Claval (2007) states that the prevalent understanding of a region is an objective entity and the main issue in regional studies is to define boundaries. Gilbert (1988) stresses that a region can be understood as a collection of cultural relationships between people and places, which emphasizes the cultural aspect of regional research.

2.4.2 LANDSCAPE AS DISTINCT FROM REGION

By comparing the definitions of landscape and region, landscape, as a segment of the land, has a similar while not identical meaning to terms like *area* or *region* (Meinig, 1979a). The German word *Landschaft*, while sharing the meaning of the English term *landscape*, also incorporates the sense of a region that distiguishes itself from other neighboring regions by its chatacteristic features (Claval, 2007; Hard, 1970; Olwig, 1996). But region covers a wider range of spatial units, whether in terms of scale (the Pacific Region, Central Asia as a Region, the YRD region) or in terms of content (regions characterized by socio-economic indicators and dynamics etc.) than landscape.

2.4.3 REGIONAL CHARACTER

The word *regional character* has been frequently used in geography, architecture, and landscape architecture to focus on research topics such as regionalism, vernacular architecture, cultural landscape, and landscape characterization[1]. Regional character denotes “the essential characteristics of a particular region” (Berry, 1964, p. 9). In contrast with Humboldt’s and Antrop’s definitions of landscape as a synthesis of natural and cultural characteristics of a specific space, landscape here is identified as the medium that accommodates regional character. The classification of regional character could refer to the elements of geographic character (or features) of the existing classification system. In *Elements of Geography: Physical and Cultural*, geographic character of a region consisting

[1] The summary here comes from the results by searching Google Scholar with the keywords “regional character” in combination with “landscape” or “architecture”.

of two sets of features: (i) *physical or natural features*, such as climate, landforms, water resources, original vegetation cover and animal life; and (ii) *cultural features*, such as population, settlement, agriculture, manufacturing, and communication, transportation, and trade. Additionally, there is a third type of characteristics with both natural and cultural origin, including, for instance, cultivated soil and most vegetation (Finch & Trewartha, 1942).

2.5 URBAN, SUBURBAN, AND RURAL LANDSCAPE

So far we have discussed the general terms landscape, region, cultural landscape, landscape character, etc. This section elucidates the unconventional situations of China's urban systems, urban-rural continuum, i.e. the blurred urban, suburban and rural landscapes in its dynamic metropolitan regions. This will serve to link to all landscape-related discussions in the specific urban context of Chinese cities or metropolitan regions.

2.5.1 URBAN SYSTEMS IN CHINA

Traditionally, the Chinese term for city would be *Cheng*, indicating a fortified settlement. In contemporary China's administration, *Cheng* has been partly replaced by *Shi*, a term which was originally equivalent to a market place. But today *Shi* is usually translated as "municipality", a separate partly autonomous administrative body describing a city region including the urban core, suburban areas, towns, villages and their surrounding farmland. According to China's administrative system[2], a prefecture-level city (*Diji shi*) is normally subdivided into urban districts (*Chengqu*), county-level cities (*Xianji shi*) and counties (*Xian*)[3]. The current urban system of China includes designated cities (*Jianzhi shi*) and designated towns (*Jianzhi zhen*). Consequently, the urban population (*Chengzhen renkou*) consists of the population of these two administrative units, urban districts (*Chengqu*), and towns (*Zhenqu*).

---

[2] The five hierarchical levels of China's administrative division system: province, prefecture, county, township, and village.

[3] A county governs townships in rural areas of a city. With rapid urbanization, a county will be upgraded to a county-level city and further to a district if it reaches the criteria set by the State Council, such as density of population, industrial output and public infrastructure. Therefore, the number of districts reflects the urbanization rate of a city. For more details see the *Guowuyuan 2005 chexian jianshi (xianji shi) jianyi biaozhun* [Suggestion of the State Council on the Standards for Upgrading Counties to County-level Cities 2005] (The State Council of the P.R. China, 2005).

2.5.2 URBAN, SUBURBAN, AND RURAL DIVISION

According to the CEMAT[4] Spatial Development Glossary by the Council of Europe (2006),

- An urban area is an area which physically forms part of a town or city and is characterised by an important share of built-up surfaces, high density of population and employment and significant amounts of transport and other infrastructure;
- Rural areas are sparsely settled areas without significant large city or town;
- Peri-urban areas are areas that are in some form of transition from strictly rural to urban. These areas often form the immediate urban-rural interface and may eventually evolve into being fully urban. (pp. 19, 23, 31)

Thus, by definition, urban and rural areas of Europe differ with respect to density of population, built-up areas, and infrastructure, whereas suburban areas, as a result of urban sprawl, are something in-between.

In comparison to these relatively distinct urban-rural divisions of European territories, the boundaries of urban, suburban, and rural areas of contemporary China are extremely complex, owing to booming urbanization and suburbanization since the 1980s. However, the urban population, accessibility to infrastructure, the urbanization policies, and the urban planning system in China still conform to the conventional concept of a rural-urban division (Herrle, Fokdal, & Ipsen, 2014), although it is not appropriate to work with the current urban system and urbanization pattern. Especially in some developed metropolitan regions, there are multiple special transition zones between urban and rural areas. The traditional urban-rural dichotomy hereby loses its significance, whereas new territorial concepts such as *desakota*, *urban-rural transition zone*, and *metropolitan interlocking region*[5] should be referred to when studying topics related to the urban-rural division of cities and regions in China.

2.5.3 URBAN, SUBURBAN, AND RURAL LANDSCAPES

Urban landscape can be understood as "the existing landscape of urban settlements and its surroundings especially marked by urban land use forms", and it is not limited to the administrative boundaries of existing cities and towns (Breuste, 2004, p. 440). This term is

[4] CEMAT stands for Council of Europe Conference of Ministers Responsible for Spatial/Regional Planning.

[5] See the discussion of *desakota*, *urban-rural transition zone*, and *metropolitan interlocking region* in Chap. 3, Sect. 3.3.

similar to but not identical with terms like *cityscape*, *city region*, *suburban area*, *in-between-city* (*Zwischenstadt*), *urban sprawl,* and *urban periphery*. It is frequently used to express the blurred urban, suburban, and rural landscapes in current complex urban systems as the traditional dualism of urban and rural no longer exists (Ipsen, 2005). The term *urban landscape* is translated as *Chengshi jingguan* (literally means "city landscape") in Chinese, which is quite often used in architecture, urban planning and landscape architecture in China. As the literal meaning suggests, *city landscape* still addresses the conventional landscape associated with urban land uses. Its meaning has not been extended to describe the ubiquitous blurred urban, suburban, and rural landscapes in China. At the same time, when a city expands further to be a city region or a metropolitan region, or when a chain of cities grows to a megalopolis, the term *urban landscape* becomes insufficient to illustrate the new emerging spatial patterns. New terms like *metropolitan landscape*, *megalopolitan landscape*, and *mega-urban landscape* have been coined to describe this new type of urban landscape of an entire region (Frampton, 1999; Hartz & Kestermann, 2004; Herrle et al., 2014). Herrle et al. (2014) use the term *mega-urban landscape* to precisely discuss the landscape shaped within the special urban formation of the Pearl River Delta. Herrle et al. stress that compared to the classic concepts like urban landscape, metropolitan landscape, or *desakota*, the term mega-urban landscape better explains the spatial features as well as the cultural and socio-economic aspects of the urban landscape in the entire delta.

A suburban landscape (*Chengjiao jingguan*) is often considered as degraded because of its restricted social, ecological, and aesthetic qualities. Thus, suburban areas nowadays are a matter of concern both in research and practice as the accelerated socio-economic transformations since the second half of the last century have led to dramatic changes in these areas. For example, suburbanization in China has rapidly demolished high quality rural landscapes and has caused a loss of diversity and a complete change of landscape character. The evolving suburban landscape of Chinese cities is characterized by a dense and hybrid structure as well as chaotic or unplanned character, neither urban nor fully suburban (Campanella, 2007). It is a mixture of fragmented fields, new gated residential areas, historic villages, rural factories, and large transport infrastructure with limited accessible open spaces and public service facilities.

A rural landscape (*Xiangcun jingguan*) encompasses more than a rural area, and its features are shown in the form of a landscape structure created and managed by agricultural activities (Council of Europe & European Landscape Convention, 2013). The richness and diversity of rural landscapes always reflect the distinctive character of local areas and regions, as in Europe (Stanners & Bourdeau, 1995). Therefore, the transition of traditional rural landscapes to contemporary urban and industrial landscapes are normally seen as a negative process or even considered as a crisis of landscape. In the face of this seemingly irreversible trend, the diversity and identity of existing rural landscapes have become a central topic for the ELC, for European landscape researchers, and for local cultural and environmental organizations.

Furthermore, studying and documenting the structural and functional changes in these landscapes are vital for their future management and development (Antrop, 2005).

2.6 CONCLUSION

The definitions adopted in this dissertation are mainly derived from the European literature. Landscape elements, structures, and the character of cultural landscapes are the focus of theoretical debate, and these terms are essential for the practices of landscape protection, management and landscape architecture in Europe. According to the analysis above, these key terms, generally accepted and used by professionals in Europe, are still new topics in the Chinese context. Thus, this chapter specifies these key concepts and adapts their meanings for the Chinese context instead of using and quoting them directly from the literature without discussion.

LANDSCAPE

In summary, landscape has the classic definition as a perceptual view of scenery, or a visual representation of an area. It is an objectively existing entity that could serve as a habitat or infrastructure while also having cultural and symbolic meanings for social collectives. Moreover, landscape accomodates the total character of a region and connects people and place. In China, landscape is still predominantly understood as a perceptual view of scenery (*Fengjing*) rather than as a habitat or infrastructure that accommodates regional character and everyday life. Thus, the term *Jingguan* fits better to the research context and extends the scope of landscape that should be discussed in China's specific urban context.

LANDSCAPE ELEMENTS, STRUCTURE, CHARACTERISTICS, AND CHARACTER

Landscape elements are components that comprise a landscape. They are basic analytic items for landscape protection, management, or planning activities. Landscape structures are formed by landscape elements and their perceivable and comprehensible relationships. It is noteworthy that the interrelation between elements instead of elements themselves should be considered during the analysis of landscape structure as this reveals landscape as both a complex system and a holistic synthesis. Landscape elements, characteristics, and character are key to the study of the structure of a specific landscape type. In LCA, *features* and *characteristics* cannot be clearly identified; the three levels of Jessel's approach are applicable. Thus, this research adopts Jessel's hierarchical approach (similar in LCA) of elements, characteristics and character in studying the landscape structures of the YRD (see Sect. 5.3 and 5.4.5).

CULTURAL LANDSCAPE

According to the definitions in the literature and from organizations like the ELC, World Heritage Convention, and NPS, cultural landscape could be either understood as a category of heritage sites with outstanding universal value documenting representative cultural elements of a geo-cultural region, or as ordinary everyday landscape, no matter how outstanding, everyday, or degraded. In the Chinese context, there is limited understanding of cultural landscape either as a category of cultural heritage or as a dynamically shaped ordinary everyday landscape.

REGION AND REGIONAL CHARACTER

Landscape is a synthesis of natural and cultural characteristics of a specifc region and a medium that accommodates regional character. Thus, *landscape* may share a similar meaning with *region*, which distinguishes itself from neighboring regions by certain characteristics. But *region* covers a wider range of spatial units, whether in terms of scale or in terms of content than landscape.

URBAN, SUBURBAN, AND RURAL LANDSCAPES

To understand contemporary Chinese cities, knowledge of China's administrative and urban systems, and the new emerging spatial patterns of blurred urban, suburban, and rural landscapes is required. Nowadays, it is difficult to talk about exclusively homogeneous urban, suburban or rural landscapes. Especially when dealing with rapidly changing metropolitan regions, the traditional urban-rural dichotomy no longer functions. New territorial concepts like *desakota*, urban-rural transition zone, and metropolitan interlocking region could be applied to describe these spaces. Terms like *metropolitan landscape* or *mega-urban landscape* could be used to describe these new patterns of spatial organization. From this perspective, urban, peri-urban, rural, and natural landscape elements and structures should be considered as components of an entire region rather than distinguishing one from the other when we study the landscape character of metropolitan regions in China.

CHAPTER 3 RESTRUCTURING CULTURAL LANDSCAPES IN METROPOLITAN AREAS. THEORY, METHODOLOGY, AND PRACTICE.

This chapter will review the existing theories, methodologies, and practices dealing with cultural landscape guided by two different yet mutually reinforcing motivations. On the one hand, when addressing topics such as the loss of regional identity, cultural landscape degradation, we argue in support of the thesis that the quality of cultural landscape of a given area is a common good. It should not be arbitrarily changed or even destroyed, and if this has happened, there is an urgent need for the conservation of any remaining cultural landscape relics. On the other hand, local governments and planning institutes are obliged to increase the resilience of historic cultural landscapes by improving green-blue infrastructure and guiding delta urbanization in a sustainable way. At the same time, we are led by the assumption that water elements and structures can be protected or redeployed as spatial qualities and identities by a cautious reconstruction of the *status quo ante* of the pre-industrial cultural landscape in landscape architecture practice. With these motives in mind, we look for landscape analysis instruments, which may be suitable for the metropolitan areas of the YRD, and seek to identify the historic cultural landscape as a design issue in landscape architecture practice.

PART I CULTURAL LANDSCAPE AND URBANIZATION: AN INTRODUCTION

This part will compare the theoretical studies of cultural landscape in Europe, the US, and in China and will also discuss the special new spatial forms of rapidly expanding metropolitan regions in the world and in China.

3.1 CULTURAL LANDSCAPE STUDIES

3.1.1 IN EUROPE

In the European context, the core discourses on cultural landscapes mainly focus on the diversity and identity of landscape character, and monitoring the accelerated landscape changes due to the new forms of transportation, urbanization, and globalization (Antrop, 2000, 2004, 2005). This process has been accompanied by the fragmentation and disappearance of traditional cultural landscapes and the emergence of new but generic cultural landscape elements and structures (Antrop, 2004, 2005). Moreover, for the field of maintenance and future development of historic cultural landscapes in Europe, the way to endow them with new functions while simultaneously conserving their character is another noteworthy topic (Vos & Meekes, 1999).

Thus, discussion of the divison between historic (traditional) and modern, or old and new elements and structures of cultural landscapes is warranted. Antrop (2005) identifies three periods germane to analyzing the significant changes in cultural landscapes in Europe:

- "Pre-industrial traditional landscapes" (pre-18th century, p. 24), of which traces of landscape structures still remain and are visible;
- "Landscapes of the revolution age" (19th century to World War II, p. 23), which normally overlapped with and led to the destruction of traditional landscapes completely due to the development of industrial technologies and socio-economic changes, as well as the booming industrialization and urbanization;
- "*Post-modern new landscapes*" (post-World War II, p. 23), which are highly dynamic and have been created by wiping way the traditional landscapes to fulfill the new functions for urban life resulting from accelerated globalization and urbanization.

However, one should keep in mind that in reality the above described periodization is far too simple for the reality of the diverse areas of Europe. This applies also to the classification from Vos and Meekes (1999), which distinguishes six phases in the evolution of cultural landscapes in Europe:

- Natural/prehistoric landscape (from Palaeolithic till ancient Greek times);
- Antique landscape (from ancient Greek times till early Mediaeval times);
- Mediaeval landscape (from early Mediaeval times till Renaissance);
- Traditional agricultural landscape (from Renaissance till 19th century, sometimes till today);
- Industrial landscapes (mostly from mid-18th till mid-20th century, in many places till today);
- Postmodern landscapes, which are a complex mosaic of industrial production landscapes, overstressed multifunctional landscapes, archaic traditional landscapes, marginalized vanishing landscapes, and natural relict landscapes. (pp. 4-8)

Furthermore, there are several trans-regional and -national projects addressing European cultural landscape deserving our attention. Since 1995, British local authorities cooperating with the English Heritage, have established the program of Historic Landscape Characterisation (HLC) to identify, document and map historic character within contemporary urban and rural landscapes, as well as to monitor the ongoing process of landscape changes (Clark, Darlington, & Fairclough, 2004; Crowther & Clarke, 2012; Darlington, 2002; Fairclough, Lambrick, & Hopkins, 2002). The results of the HLC have served as guidelines for academic research, landscape conservation and management, and spatial planning at district and county levels. In 2000, the ELC (European Landscape Convention) formulated a three-year network project of European Pathways to the Cultural Landscape to increase public attention to marginal/ordinary landscapes, whose cultural and historic value have been overlooked and which are vulnerable to change, as well as to foster sustainable strategies for landscape management (Clark, Darlington, & Fairclough, 2003). Ten European countries were involved in this project and twelve partner project areas characterized by diverse and distinctive landscape types were included.

3.1.2 IN THE UNITED STATES

In the 1920s and 1930s, Carl Sauer and the Berkeley School of human geography promoted the study of cultural landscape in the US (Fowler, 2003). Since the 1970s, cultural geographers like J.B. Jackson, Pierce Lewis, David Lowenthal, and Donald Meinig have published their critical writings on the American ordinary (or everyday) landscape (Meinig, 1979b). These researchers were important landscape-readers at a time when most Americans were not used to reading and interpreting landscape and ignored the value of ordinary landscapes (Lewis, 1979).

J. B. Jackson (1984) recalls the value of *vernacular landscape* with spaces that are "usually small, irregular in shape, subject to rapid change in use, in ownership, in dimensions" (p. 151). Jackson also defines another type of landscape, *political landscape*, which in contrast, consists of "spaces and structures designed to impose or preserve a unity and order on the land, or in keeping with a long-range, large-scale plan" (ibid., p. 150). *Mobility* and *diversity* are the essential features of vernacular landscape, while political landscape is identified with permanent spaces enclosed by visible boundaries (ibid., p. 154). Höfer and Trepl (2010) hold the view that Jackson valued the quality and experience of changing everyday landscapes rather than the customary concern of the aesthetic value of harmonious and picturesque landscapes, by which Jackson brought landscape research into a "modern" era.

Apart from theoretical research, the NPS (National Park Service) has played the most important role in the US in the preservation of cultural landscapes by developing its own definition and categories, as well as approaches to documentation, evaluation, and treatment since the 1980s (Jain & Clancy, 2008; Page, Gilbert, & Dolan, 1998). The NPS Park Cultural Landscapes Program was established subsequently to deal with associated activities of research, planning, and stewardship of cultural landscapes (Page et al., 1998). Specifically, the Cultural Landscape Inventory and the Cultural Landscape Report are two primary tools in this program for documenting detailed information on cultural landscapes and establishing guidelines for future mangement and development (Page et al., 1998; Page, Killion, & Hilyard, 2009).

3.1.3 IN CHINA

Cultural landscape, unlike in the United States or Europe, is neither a prevalent concept or topic in spatial planning or heritage protection policies, landscape theory or practice, nor in everyday life in China. Researchers like cultural geographers have started to introduce the concept and meaning, classification, and history and evolution of cultural landscapes from western cultural geography to China since the 1990s (Tang, 2000). However, the definition and meaning of the translated Chinese term *Wenhua jingguan* (or *Renwen jingguan*) is ambiguous and still currently under debate. For the character of China's cultural landscapes, American geographer George Cressey (1934) stresses that "the most significant element in the Chinese landscape is thus not the soil or vegetation or the climate, but the people […] In this old, old land, one can scarcely find a spot unmodified by man and his activities" (p. 1). Similarly, Laing (2012) concludes that in China, the character and appearances of cultural landscapes are fundamentally influenced by population density and limited arable land, and the primary feature of the contemporary built environment is mobility and change. Furthermore, Laing discusses the driving forces of landscape change and their impact on cultural landscapes in two eras: *the pre-reform Communist era (1949–1979)* and *the reform era (post-1979)*.

Apart from this discussion in the academic world of cultural geography, the idea of cultural landscape as world heritage was subsequently introduced by those in charge of heritage preservation in China. Cultural Landscape researchers started to implement the working system of the World Heritage Convention for inscribing cultural landscapes on the World Heritage List, including categories, criteria, and operational guidelines (Han, 2007; Hu & Tang, 2006; Zhou, Yu, & Huang, 2006). However, there is widespread misunderstanding and ignorance of the value of cultural landscapes because of the gap between the systems of China's National Parks (*Fengjing mingshengqu*)[6] and Cultural Relics Protection Units (*Wenwu baohu danwei*) and the World Heritage System (Wu, 2011). By 2015, there were only four properties from China listed on the world heritage list: Lushan National Park, Mount Wutai, West Lake Cultural Landscape of Hangzhou, and Cultural Landscape of Honghe Hani Rice Terraces. Fowler (2003) and Han (2007) address the absence of China's cultural landscapes on the WHL, and the opportunity and challenge of China's contribution to the conservation of world heritage cultural landscapes in the Asia-Pacific region. Besides the discussion in world heritage context, Jixiang Shan (2010), the director of the State Bureau of Cultural Relics, defines eight types of cultural landscape heritage[7] in the Chinese context and describes their character. Shan also proposes specific strategies for the protection of cultural landscape heritage in China.

As for the landscape architecture field, the topic of *vernacular*, *ordinary* or *everyday landscape* (translated as *Xiangtu, Xunchang* or *Richang jingguan*) has generated increasing interest. The vernacular landscape research has concentrated on popularizing its aesthetics and application both in landscape design and in regional planning projects (Yu, 2005; Yu, Wang, & Huang, 2005). In practice, a group of Chinese landscape architects has attempted to imbue landscape design with genius loci by referring to the forms of existing vernacular landscape in the design process (Lin & Wang, 2005; Liu, Fan, & Zou, 2012; Sun, Wang, & Li, 2008). However, most of these projects claiming to be site-specific and representing the sense of place simply use symbolic elements derived from vernacular forms. Some even

---

[6] In the Chinese context, the *National Scenic Area* or *National Scenic and Historic Interest Area* (*Guojia ji fengjing mingshengqu*) is the equivalent of the *National Park* applied in the rest of world. See the report of *Zhongguo fengjing mingshengqu xingshi yu zhanwang* [Situation and Prospects of China's Scenic Areas] (Ministry of Construction P.R. China, 1994).

[7] The eight types of cultural landscape heritage include: urban, rural, *Shanshui* (literally means "mountain and water"), relic, religeous, folk, industial, and military (translated by the author).

demolish the original cultural landscapes entirely to build a completely new "vernacular landscape". Critics have pointed out that the newly built vernacular landscapes are not real vernacular once out of their original context. Marc Treib (2002) questions the possibility of built new landscapes having semantic meaning for the local inhabitants with the prevalent trend of referring to the genius loci, the *Zeitgeist* (spirit of the time), and the vernacular landscape in landscape architecture. Treib further argues that vernacular materials and forms might provide inspirations for landscape design; however, these vernacular forms inevitably lose their meanings when designers reframe and transform them into High Style projects.

For the study of landscape changes, the Graduate School of Landscape Architecture at Peking University have gained rich experience in quantitative research on the evolution of patterns of agricultural and coastal landscapes through GIS by landscape ecology approach, while the qualitative and aesthetic changes in landscape character have been overlooked.

3.2 LANDSCAPE AS A PALIMPSEST

According to the Oxford English Dictionary, the term *palimpsest* initially refers to "a manuscript or piece of writing material on which later writing has been superimposed on effaced earlier writing", and the content of this term extends to "something reused or altered but still bearing visible traces of its earlier form" ("Palimpsest," 2015) .

Meinig (1979a) writes in *The Interpretation of Ordinary Landscapes* that a landscape is "a panorama, a composition, a palimpsest, a microcosm" (p. 6). By the word palimpsest, Meinig means that landscape shows the ceaseless accumulation of creations superimposing new elements on the historic structure via everyday life, and this temporal process of making landscape should be interpreted and studied. The same term is used by Corboz (1983), who titles a publication "The Land as Palimpsest". He describes the traces of human intervention adding new layers to the land while simulaneously erasing older historic layers. A new development placed on the surface of land should integrate the shape of land into the design and make the traces or multi-layers visible again to meet the growing demands of new functions. Mitin (2010) stresses that palimpsest is a widespread metaphor for cultural landscapes and could be understood as "a conceptual model of a place as a multilayered structure that emphasizes the coexistence of multiple visions and impacts of different cultures on the landscape" (p. 2111).

3.3 RAPIDLY EXPANDING METROPOLITAN REGIONS

As stated in Sect. 3.1 and 3.4, cultural landscape studies, such as HLC and Landscape Character Assessment (LCA) in UK, are primarily dealing with rural landscapes, and to some extent with townscapes and urban landscapes, which still have distinguishable boundaries and characteristics from their neighboring rural landscapes. Given the particularities of China's urban systems (see Sect. 2.5), especially in rapidly expanding metropolitan areas, the blurred urban, suburban and rural landscapes should be studied as an urban-suburban-rural continuum, rather than focusing on discrete rural or urban landscapes perceived as static, aesthetic entities. This section elucidates the particular spatial structures of rapidly expanding metropolitan regions, such as megalopolises, extended metropolitan regions, and *desakotas* in the world and in China. It will bring the discussions of cultural landscape, water issues in the delta (Sect. 3.10), and landscape practice (Sect. 3.6) together in the specific urban context of Chinese cities or developed metropolitan regions.

3.3.1 MEGALOPOLIS

Jean Gottmann (1957, 1961) coins the term *megalopolis* to describe the continuous stretch of urban and suburban areas along the American Northeastern Seaboard and to address the new spatial pattern of massive urban development in the US. A megalopolis is a highly urbanized multi-metropolitan region composed of a chain of large cities instead of a single large urban or metropolitan area (Ginsburg, 1991). In Gottmann's later work, he sets the minimum of population for a megalopolis at 25 million and listed six examples of megalopolitan systems in the world: *the American Northeastern Megalopolis*, *the Great Lakes Megalopolis*, *the Tokaido Megalopolis*, *the megalopolis in England*, *the megalopolis of northwestern Europe*, and *the Urban Constellation in Mainland China centered on Shanghai*[8] (Gottmann, 1976). He also states that these megalopolises are characterized by a large population density, densely intertwined networks of cities and towns, transportation and other infrastructures, as well as no distinguishable boundaries between rural and urban areas (Gottmann, 1961, 1976).

3.3.2 EXTENDED METROPOLITAN REGIONS IN ASIA

Since the 1980s, the Canadian geographer Terry McGee (1989, 1991) has explored the rapid urbanization of densely populated rural regions adjacent to and between the major cities in many Asian countries. The spatial configuration of these urban-rural transition zones in Asian developing countries seem to be comparable to those in the megalopolises in the western developed countries, whilst the components and patterns of connection between core cities and peripheral areas are quite different (Zhou, 1991).

This rural urbanization in the late 20th century resulted in the emergence of a new morphological pattern named the *extended metropolitan region*, *metropolitan interlocking*

[8] The urban constellation in mainland China centered on Shanghai is situated in the YRD region.

region or *desakota*[9], which is characterized by a dense rural population living on rice cultivation, a blurring of the traditional distinction between urban and rural land uses, and mixed agricultural and non-agricultural acitivities (Ginsburg, 1991; McGee, 1991; Zhou, 1991). Moreover, McGee (1991) rediscovered Gottmann's research on the megalopolis and developed his own theory and hypothetical spatial model for the ermerging pattern of urbanization in Asia based on his case studies of the well-developed metropolitan regions of Indonesia, Thailand, India, mainland China, Taiwan and so on (Figure 3.1). According to the McGee-Ginsburg model (Figure 3.2), the complex regional system of such Asian countries consists of core cities, peri-urban areas, small cities and towns, *desakota* areas, densely populated rural areas, and sparsely populated rural areas (ibid.).

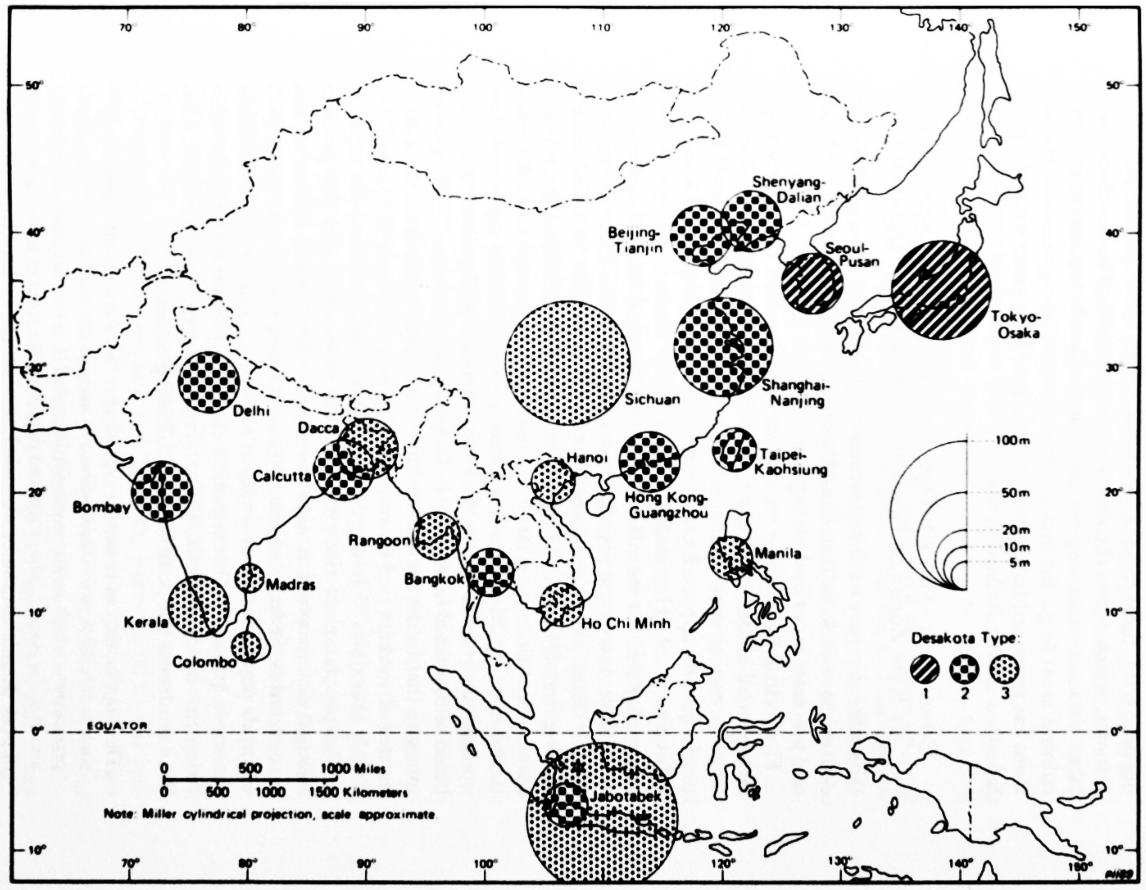


Figure 3.1 Extended Metropolitan Regions in Asia as Grouped into Three *Desakota* Types

Source: Retrieved from McGee (1991, p. 13). Note: Type 1, the countries have experienced rapid urbanization and "a transformation of the spatial economy", while the agricultural land use remains consistent, such as in Japan and South Korea; Type 2, regions have undergone a rapid economic growth in the past three decades, such as Taiwan; Type 3, regions characterized by a fast-growing population and a slower

[9] McGee (1989) coins the term *Desakota* with two combined Indonesian words *desa* for village, and *kota* for town to describe the newly emerging interlocking metropolitan regions in Southeast Asia.

spatial and economic growth when compared with Type 2, such as the Sichuan Basin in China (ibid., p. 12).

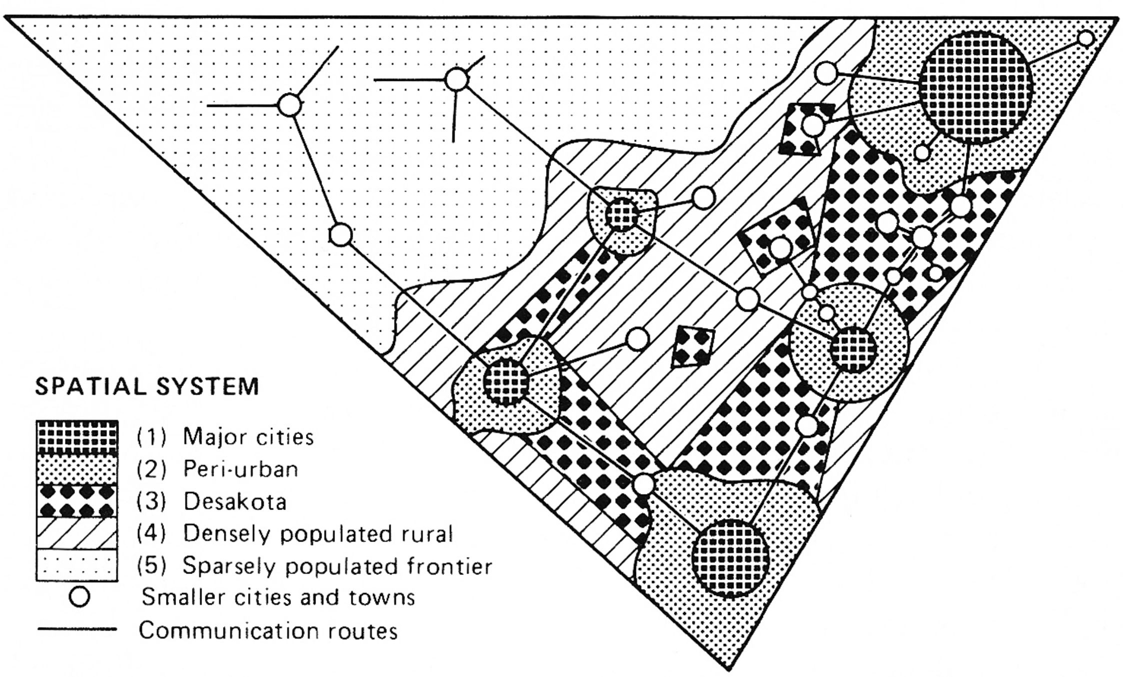


Figure 3.2 McGee-Ginsburg Model: Spatial configuration of a hypothetical Asian country

Source: Retrieved from McGee (1991, p. 6). Note: (1) The major cities of the urban hierarchy, which are often dominated in the Asian context by one or two extremely large cities. (2) The peri-urban regions, which are those areas surrounding the cities within a daily commuting reach of the city core… (3) The regions labeled *desakota*, which are regions of an intense mixture of agricultural and nonagricultural activities that often stretch along corridors between large city cores… (4) Densely populated rural regions, which occur in many Asian countries, particularly those practicing wet-rice agriculture. (5) The sparsely populated frontier regions found in many Asian countries that offer opportunities for land colonization schemes and various forms of agricultural development. (pp. 6-7)

McGee and Ginsburg's theories and model have enriched our understanding of the urbanization pattern in Asia and have provoked a growing discussion about the validity of this assumption in various Asian regions. More case studies in Asian countries have been made to prove this urbanization model and contributed to establishing specific strategies and policies for the *desakota* areas (Sorensen, 2003; Sui & Zeng, 2001; Yu & Zhang, 2010). Sui and Zeng (2001) studied the dynamic transformation of landscape structure in *desakota* areas in Shenzhen and simulated the characteristics of future urbanized areas by GIS-based spatial analysis and modeling. However, this research only quantified and simulated one single land use—urban built-up areas—according to current urban development without further elaborating the dynamics of other land use types such as agriculture or forestry.

3.3.3 METROPOLITAN INTERLOCKING REGIONS OF CHINA

Zhou (1991) uses the term *metropolitan interlocking regions* to refer to the six large urban clusters along the eastern coastline of China, including four emerging regions and two potential ones[10]. In his article, the basic requirements and the formative mechanism of these metropolitan interlocking regions are discussed: each region should have two or more core cities with a population of over one million; large international ports and efficient transportation lines between core cities and ports; a network of small and middle-sized cities and towns along the development corridor between core cities; and intimate economic interaction between urban and rural areas (ibid.).

3.3.4 YANGTZE RIVER DELTA REGION

Among the six metropolitan interlocking regions of China, the YRD region has the longest history of urbanization, the largest size, the most diversified economic base, and the highest population density. The YRD region has Shanghai as the leading city, Nanjing, Hangzhou, Wuxi, Suzhou, and Changzhou as the other core cites, as well as an urban network of numerous small and middle-sized cities and towns. The advanced and efficient railway, highway, and waterway systems that reach all towns, market towns, and rural areas sustain the intensive economic interaction between large cities and their peripheral areas (ibid.). Ginsburg (1991) explains the basic conditions for the emergence of this metropolitan interlocking region: the transformed urban administrative system in the 1980s, and intimate economic interaction of the urban network.

[10] Four emerging metropolitan interlocking regions include *Nanjing-Shanghai-Hangzhou in the Yangtze Delta*, *Hong Kong-Guangzhou-Macao in the Pearl River Delta*, *Beijing-Tianjin-Tangshan*, *Shenyang-Dalian in central and southern Liaoning Province*; two potential metropolitan interlocking regions include *Shandong peninsula* and *the seaboard of Fujian Province from Fuzhou to Xiamen*.

PART II LANDSCAPE ANALYSIS INSTRUMENTS: THE STATE OF THE ART

Landscape analysis, its theoretical foundation as well as its methodology has been under constant discussion throughout the 20^{th} century. This part seeks to review the current measure-oriented research methods for studying landscape character, elements and structures, and types, which will serve as the basis for developing a specific landscape analysis instrument for the YRD region.

3.4 LANDSCAPE CHARACTER ASSESSMENT

European countries have a tradition of historic cultural landscape analysis. Their methodological approach varies, but is comparable: In some cases, there is a greater emphasis on environmental aspects (e.g. biodiversity); some other cases focus more on the evolution of land use systems over time. For the study of historic landscape character, LCA, which originated from the UK, is the most consistent and widely accepted analysis instrument in Europe. Landscape researchers have utilized this tool widely in England and Scotland since the 1990s (Swanwick, 2002), and subsequently developed and adapted this methodology to study numerous European regions and countries (European Landscape Character Assessment Initiative, 2005).

LCA is “the process of identifying and describing variation in the character of the landscape. It seeks to identify and explain the unique combination of elements and features (characteristics) that make landscapes distinctive” (Tudor & Natural England, 2014, p. 54). *Landscape Character Assessment: Guidance for England and Scotland* published by the Countryside Agency and the Scottish Natural Heritage in 2002 and *An Approach to Landscape Character Assessment* published by the Natural England in 2014 are two most influential technical guidances for LCA. As an analytic tool for landscape characterization, LCA has been applied to studying primarily natural and rural landscapes, and increasingly urban and peri-urban landscapes, townscapes, and seascapes (Natural England, 2012; Tudor & Natural England, 2014).

3.4.1 PROCESS OF LANDSCAPE CHARACTER ASSESSMENT

There are four steps in the process of LCA, and the targets for each step are illustrated in Figure 3.3. As this figure illustrates, LCA combines qualitative and quantitative approaches: The procedure of developing a draft characterization map in the step of desk study by map overlays of pre-defined natural or cultural factors, such as landform, hydrology, land use, and enclosure, is a quantitative approach assembling evidence based data; the other procedures (value judgments) are organized by a qualitative approach.

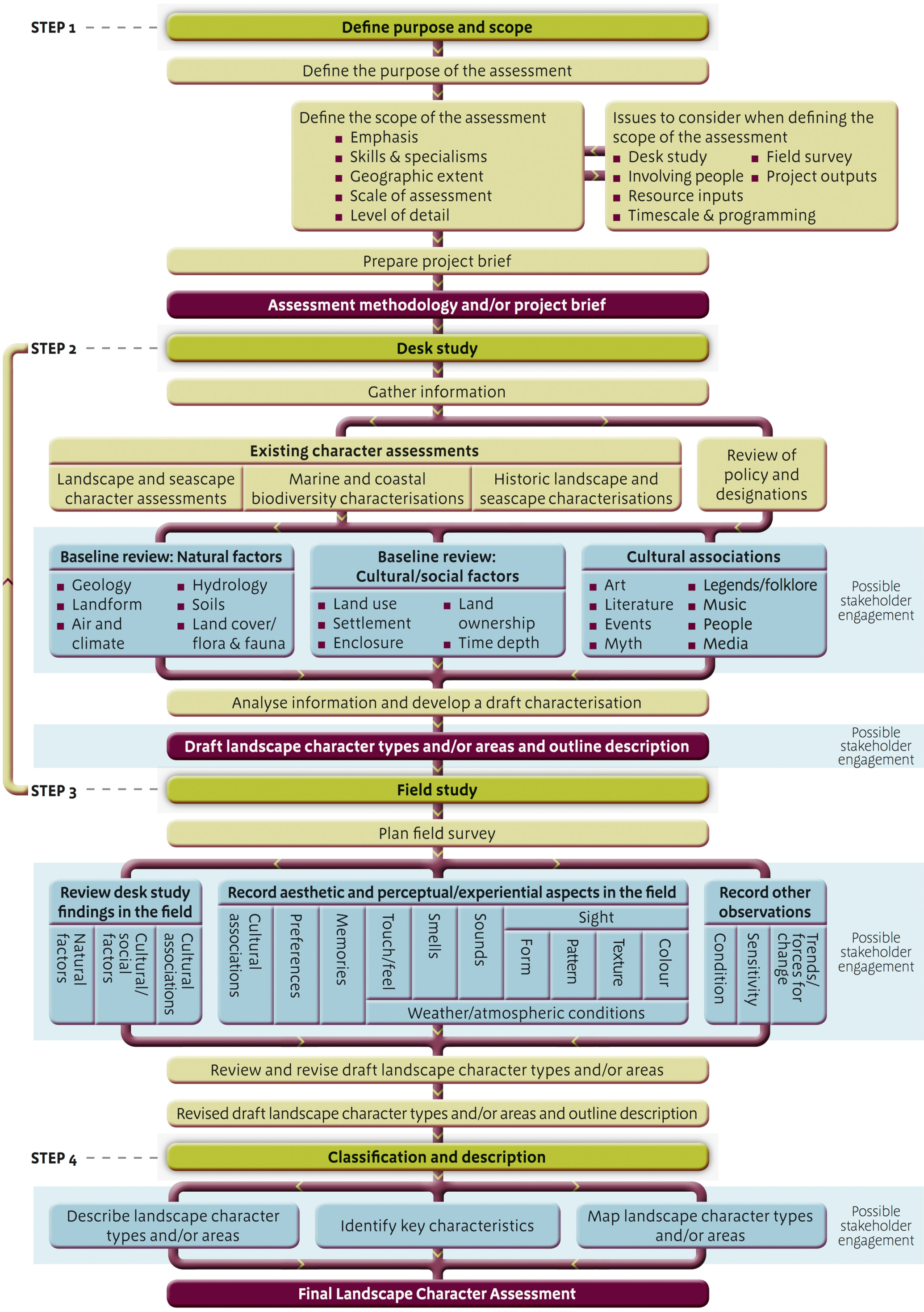


Figure 3.3 Four Steps of the Landscape Character Assessment

Source: Retrieved from Tudor and Natural England (2014, p. 15).

3.4.2 DATA GATHERING

Landscape character and patterns are influenced by *natural factors* like *geology*, *landform*, *hydrology*, *air and climate*, *soils*, *and land cover/flora and fauna,* as well as *cultural/social factors* like *land use (and management), settlements*, *enclosure*, *land ownership*, and *time depth* (Tudor & Natural England, 2014, p. 29). Compared to the guidance published in 2002, the 2014 version requires consideration of *cultural associations* (e.g. *literature*, *people*, *events*) and *perceptual and aesthetic factors* that are associated with landscape character during the desk study.

Furthermore, the LCA guidance (2014) lists available data sources in the UK for developing a draft characterization in the desk study step in categories of each factor. A series of paper maps or digital GIS maps corresponding to national and cultural/social factors enable the analysis and the overlay of these layers to produce a draft classification of landscape character areas and/or types (Swanwick & Land Use Consultants, 2002; The Countryside Agency & Scottish Natural Heritage, 2002; Tudor & Natural England, 2014) (Figure 3.4).

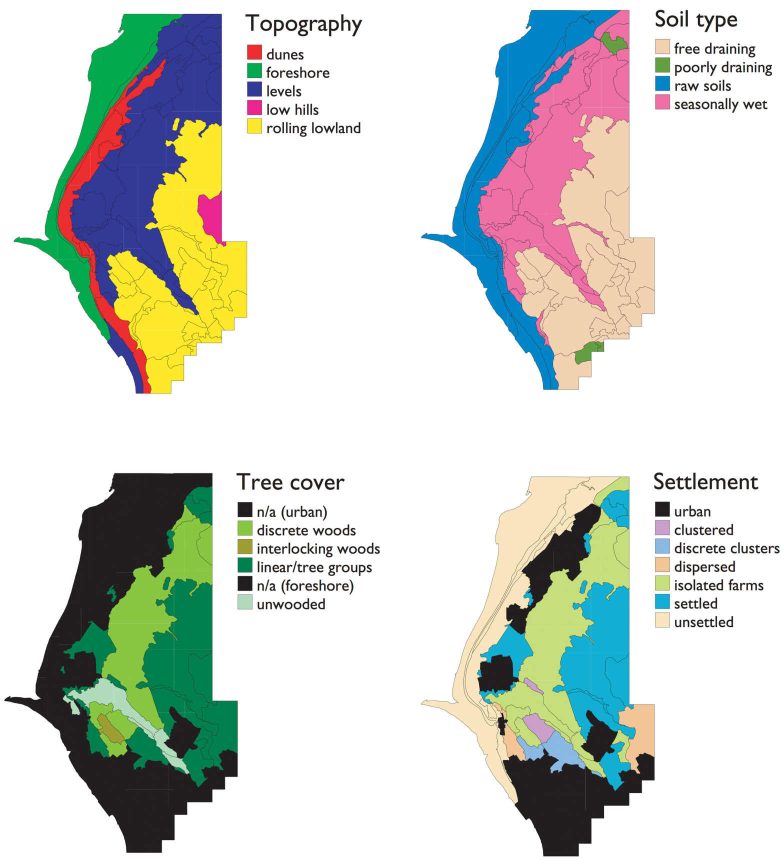


Figure 3.4 Map Overlays from Sefton Landscape Assessment

Source: Retrieved from Warnock and Parker (1999).

3.4.3 SCALES OF LANDSCAPE CHARACTER ASSESSMENT

LCA could be carried out at any scale from national scale to local scale depending on the anticipated use of the outcomes (Tudor & Natural England, 2014). The three key levels identified in the new guidance for the UK, following the spatial planning hierarchy, are:

- National and regional scale, typically at 1:250,000 identifying broad patterns in the variation of landscape character;
- Local authority scale, applied at the county, unitary authority or district level, at 1:50,000 or 1:25,000 identifying landscape types and/areas;
- Local scale or site level, at 1:10,000 or larger scales. (p. 13)

3.4.4 LANDSCAPE ATTRIBUTES AND INDICATORS

The character of a landscape is specified by its attributes. Attributes are the "individual qualities" that constitute an indicator; and indicators are the "individual aspects that make up landscape character" (Worcestershire County Council, 2012, pp. 99, 101). Usually, the structure and the number of attributes and indicators used in LCA vary depending on the scale of the research project and the landscape character under investigation. The case study of Worcestershire develops six definitive and six descriptive indicators[11] and their accompanying attributes to define the boundaries of landscape character areas (Table 3.1). During the analysis and evaluation, the indicators are illustrated regarding "their significance to landscape character and their vulnerability, tolerance and resilience to change", which lead to type-specific landscape strategies (ibid., p. 37).

This way of using indicators, as both aspects of attributes and indications of change, is ambiguous. The distinction between definitive and descriptive indicators also leaves much space for discussion. The two types of indicators overlap with each other, such as the tree cover character and tree cover pattern. The criteria for selecting pre-determined indicators are not clear: the descriptive indicators, such as enclosure and tree cover patterns, indicative ground vegetation, could also serve as definitive indicators. Thus, when adapting this approach to a site in China, the method of selecting pre-determined indicators/attributes or developing site-specific ones should be transparent and reasonable, and in accord with the aims of LCA.

---

[11] In the case of Worcestershire, landscape indicators are divided into two main types: *definitive indicators (those that define landscape character)* and *descriptive indicators (those that provide additional detailed description)* (Worcestershire County Council, n.d.).

Table 3.1 Indicators and Their Accompanying Attributes

Source: Produced based on Worcestershire County Council (2013, pp. 9-14).

Definitive Indicators	Physiographic Indicators			Cultural Indicators		
	Geology	**Topography**	**Soils**	**Tree Cover Character**	**Settlement Pattern**	**Land Use**
Attributes	• Pre-Cambrian • Lower Palaeozoic • Upper Palaeozoic • Mesozoic • Lower Jurassic • Till • Alluvial	• High land • Upstanding • Sloping • Rolling /Undulating • Low lying	• Wetland • Gleyed • Clay • Mixed • Brown • Sandy • Impoverished Shallow • Limestone	• Unwooded • Ancient • Planned • Trees	• Unsettled • Scattered • Dispersed • Wayside • Clustered • Nucleated	• Rough grazing • Pastoral • Mixed • Woodland • Cropping • Arable
Descriptive Indicators	**Field Boundaries**	**Enclosure Pattern**	**Tree Cover Pattern**	**Characteristic Features**	**Spatial Character**	**Indicative Ground Vegetation**
Attributes	• Hedges • Hedges/ditch • Walls	• Unenclosed • Organic • Variable • Sub-regular • Planned	• Continuous • Linked • Discrete • Linear • Tree groups • Scattered trees	• Building style • River • Parks	• Exposed • Large • Medium-open Medium-framed • Small • Intimate • Variable	• Heathy/acid grassland • Wetland

3.4.5 LANDSCAPE CHARACTER AREAS AND TYPES

The guidance defines *Landscape character areas* as “single unique areas which are the discrete geographical areas of a particular landscape type”, and *landscape character types* are “distinct types of landscape that are relatively homogeneous in character […] they share broadly similar combinations of geology, topography, drainage patterns, vegetation, historical land use, and settlement pattern” (Swanwick & Land Use Consultants, 2002, p. 9). Thus, at a same level, one single landscape character area represents one particular type, while one landscape character type could occur in several different areas.

As final products of LCA, landscape character types and areas could be identified and described at all levels, and the relationship of landscape character types and areas between different levels are explained in Figure 3.5. Furthermore, defining boundaries around landscape character types and areas is a noteworthy procedure. The boundaries of landscape character types and areas normally do not follow administrative boundaries, and the accuracy of boundaries varies with the levels of LCA (Swanwick & Land Use Consultants, 2002; Tudor & Natural England, 2014). Sometimes, depending on the data obtained, it is reasonable to have overlapped boundary lines or even wide boundary zones to show the transition, rather than precise lines (Tudor & Natural England, 2014). In any case, the process of defining boundary lines should be transparent. Recording the determination and limitations of defining boundary lines is necessary, as these statements could constitute meaningful results of LCA (ibid.).

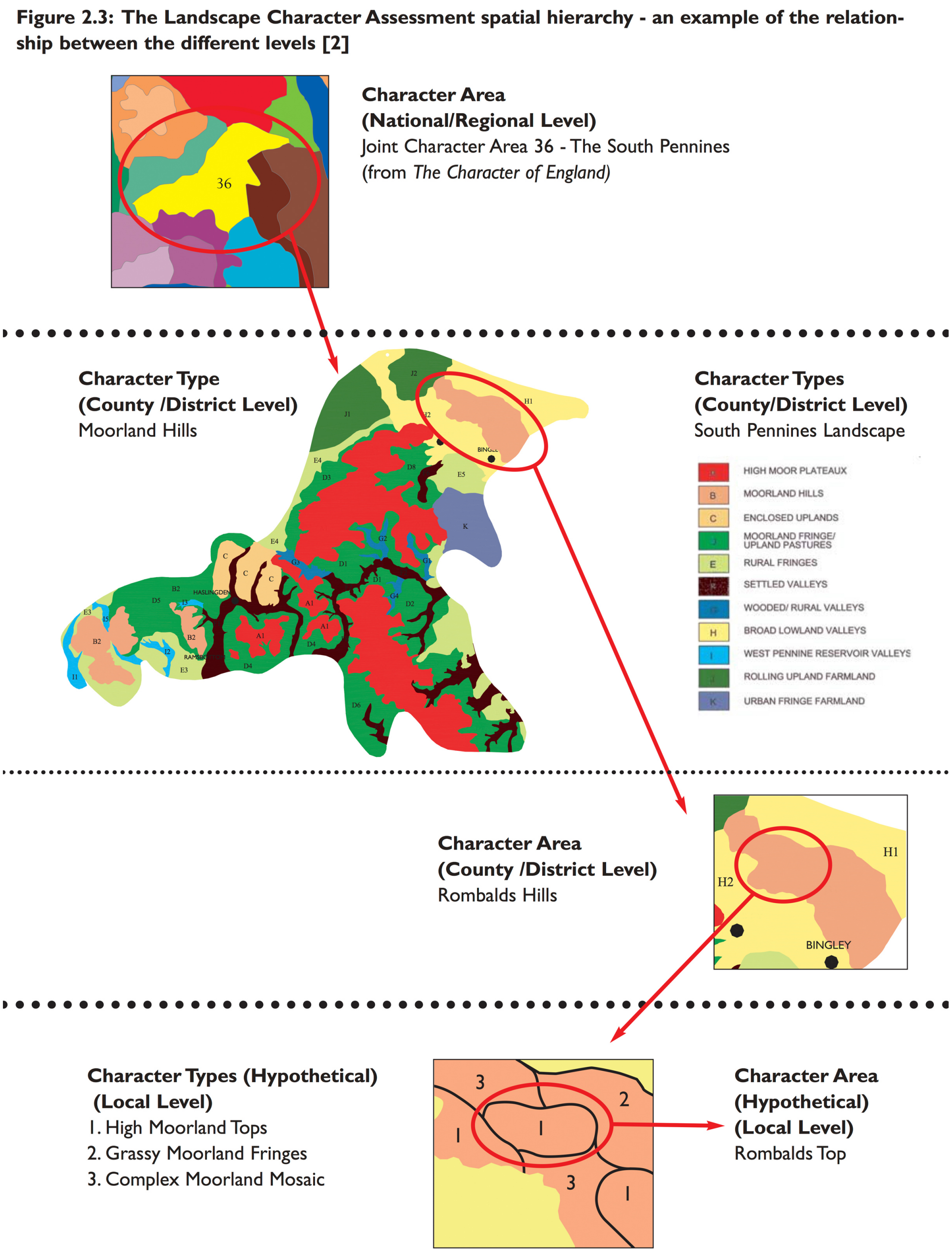


Figure 3.5 Landscape Character Types and Areas at Different Levels of Landscape Character Assessment

Source: Retrieved from Land Use Consultants (1999).

3.4.6 OUTPUTS OF LANDSCAPE CHARACTER ASSESSMENT AND ITS APPLICATION IN PRACTICE

The maps and attached descriptions of landscape character types and/or areas are the main outputs of LCA. These outputs could be utilized to inform judgments and decision making in *policy development*, *green infrastructure plans and strategies*, *waterways strategies*, *project design and master planning*, etc. (Tudor & Natural England, 2014, p. 10) (Figure 3.6).

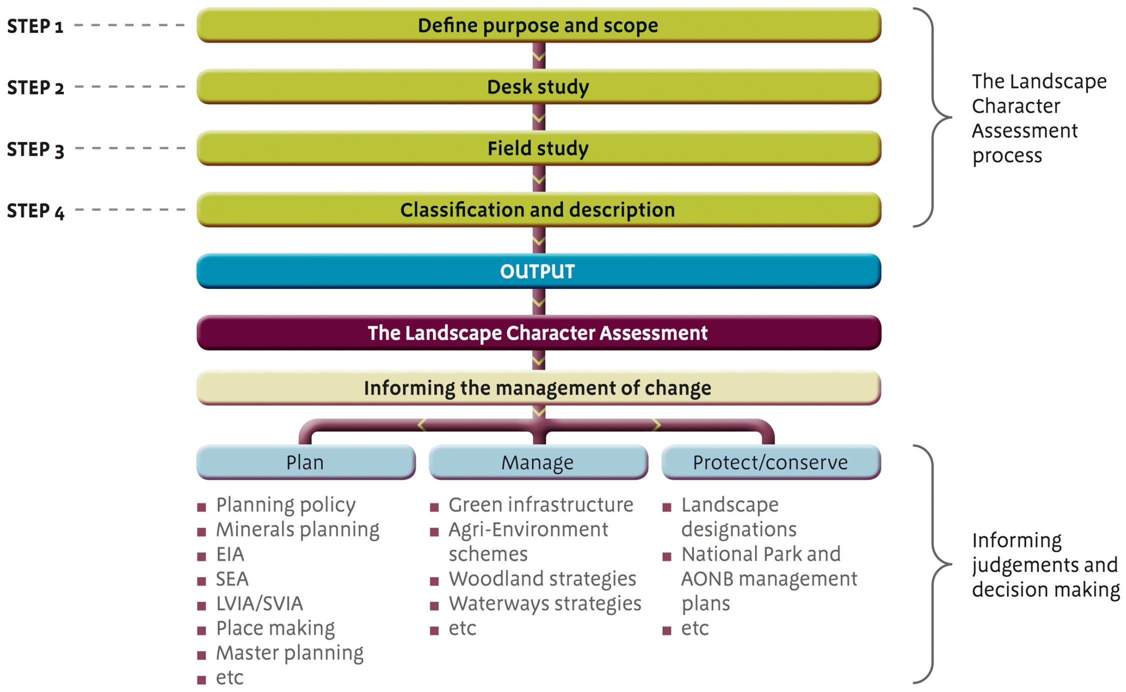


Figure 3.6 Landscape Character Assessment and Its Application in Practice

Source: Retrieved from Tudor and Natural England (2014, p. 17).

3.4.7 APPLICABILITY OF LANDSCAPE CHARACTER ASSESSMENT IN CHINA

Compared to the mature practice of LCA in the United Kingdom, there are limited tools available for landscape characterization and assessment in China. Studying the landscape character and types at various scales for future landscape development is still a new topic. Against this background, LCA was introduced to China in the past decade; until now there are only a handful of articles published in landscape journals to introduce the methodology of HLC and LCA and to illustrate their application in British case studies (Bao & Zhou, 2015; Li, Shan, & Feng, 2012; Swanwick, 2006; Wu & Yang, 2008). So far, there is no further exploration to test the applicability of LCA for a specific city or region of China, except the project of Landscape Value Mapping of Hong Kong.

Unlike most case studies in the UK, this project deals with the metropolitan landscape of Hong Kong at a scale of 1:50, 000: besides the conventional *countryside landscape* and *coastal waters landscape*, specific landscape types of *rural fringe landscape*, *urban fringe landscape*, *urban landscape* are also studied (Planning Department of HKSAR Government, 2005) (Figure 3.7). The preliminary landscape character areas are drafted using the data layers, such as *geomorphology and topography, hydrological features, vegetation types, road and street patterns, land use building footprint/height,* and *historical sites*, which were revised during the field surveys (ibid.). The identification of boundaries of landscape areas, especially the boundaries between urban, urban fringe, rural, or rural fringe landscapes, mainly depends on the details of obtained maps of land use and "built forms (usually road, footpath, stream or lot boundary)" (ibid.). Therefore, the Hong Kong case is an operational reference for landscape characterization of densely populated and urbanized metropolitan regions in Mainland China, while the data accessibility would be a limitation to carrying out a similar approach.

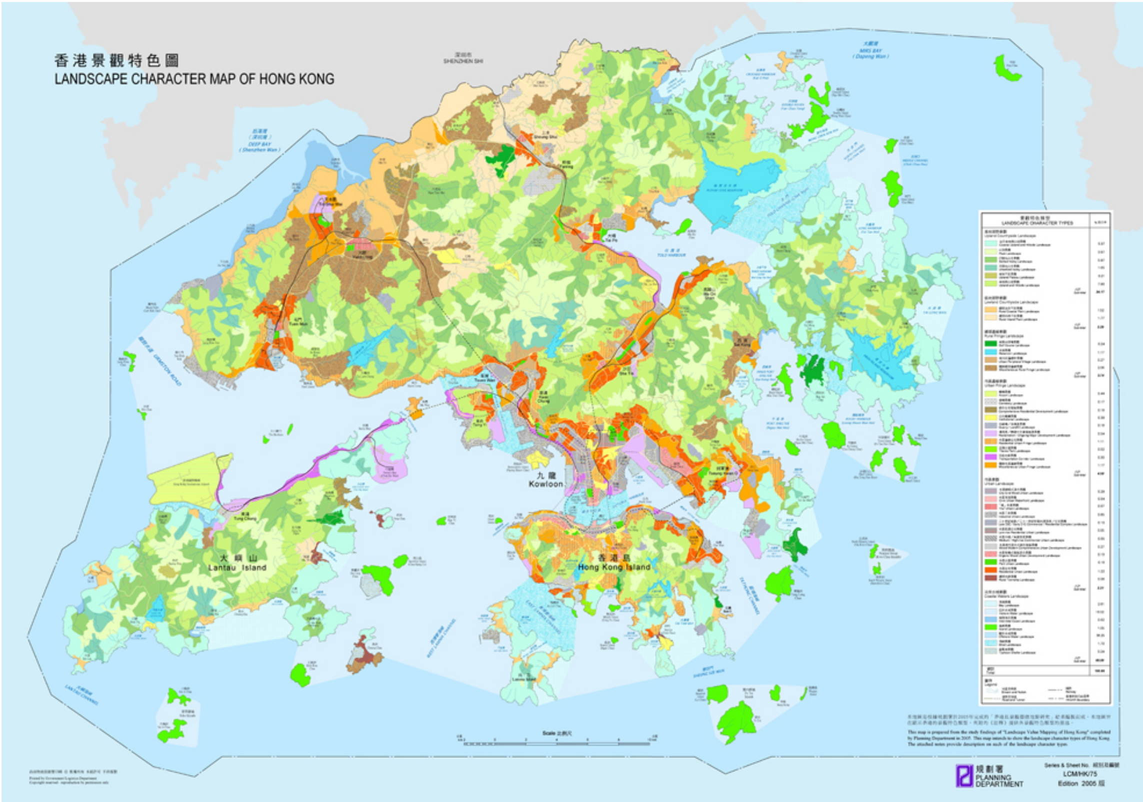


Figure 3.7 Landscape Character Map of Hong Kong

Source: Retrieved from Planning Department of HKSAR Government (2005); original scale 1:75,000.

3.5 HISTORIC CULTURAL LANDSCAPE ELEMENTS

Cultural landscape is a palimpsest with multi-layers, in which historic landscape elements and structures shaped in various periods are still visible and interact with each other within contemporary cultural landscapes. They demonstrate the historic development of the landscape and the coexisting landscape features of different periods (Bastian, Walz, & Decker, 2013).

It is generally accepted in Europe that historic cultural landscapes and their characteristic elements are valuable assets. They enrich the aesthetic, ecological and spatial qualities of land and provide functions and services for everyday life. However, these valuable cultural landscapes have declined and disappeared rapidly. Therefore, creating an inventory and sharing the information of these elements to inform future protection, management and planning is urgently required. New methods for classifying, documenting and evaluating historic cultural landscape elements (*Kulturhistorische Landschaftselemente*, KHLE) have been widely developed in Germany since the 1980s, especially in regional case studies of historic cultural landscapes such as in federal states of Bavaria, Brandenburg, Saxony, Thuringia, as well as the Rhine-Main region.

3.5.1 CLASSIFICATION

According to these case studies, two classification systems can be distinguished: by form or by function. For example, the classification system of elements in the Brandenburg case is based on three form types: spatially continuous elements, linear elements, and single elements (Hallmann & Pabst, 1993). While in the case studies of Saxony, Bavaria, Thuringia, and the Rhine-Main region, the elements are classified according to function types (Table 3.2). In the case of Saxony, 40 elements are classified into 11 categories (Table 3.3).

3.5.2 DOCUMENTATION AND CADASTRAL INVENTORY

Documentation sheets are applied to record and describe historic cultural landscape elements during surveys. The descriptive categories included in case studies of Brandenburg, Saxony, Bavaria, and Thuringia are listed in Table 3.4. Furthermore, these studies have mapped elements by GIS and have shared the information documented during surveys on online platforms such as the Cultural Landscape Cadaster of Rhine-Main and the geographic database "KLEKs – *KulturLandschaftsElementeKataster*" (Cultural Landscape Element Cadaster) of whole Germany ("KLEKs—Das Kulturlandschafts-Wiki," n.d.).

Table 3.2 Classification of Historic Cultural Landscape Elements by Functional Types in Regional Cultural Landscape Studies of Saxony, Bavaria, Thuringia, and the Rhine-Main Region (Germany)

Source: Based on Bastian et al. (2013); Bayerisches Landesamt für Umwelt, Bayerisches Landesamt für Denkmalpflege, and Bayerischer Landesverein für Heimatpflege e.V. (2013); Kopp (2012); Kulturlandschaftsportal Thüringen (2015). The names of functional types are translated by the author.

Functional Types	Saxony	Bavaria	Thuringia	Rhine-Main	Sum
Agriculture	×	×	×	×	××××
Forestry/wood and forestry industries	×	×	×	×	××××
Fishery	×		×		××
Hunting	×				×
Settlement (types)	×	×	×	×	××××
Building types	×				×
Traffic/transportation	×	×	×	×	××××
Mining	×			×	××
Industry		×		×	××
Raw materials production			×		×
Industry and energy production			×		×
Processing of food and materials	×				×
Military, safety, administration and representation	×		×		××
Sovereignty and representation			×		×
Defense			×	×	××
Religion	×		×		××
Community life		×			×
Recreation/leisure, recreation and health care		×	×		××
Education and culture			×		×
Trade and communication			×		×
Historical water use and hydraulic engineering			×		×
Others				×	×

Table 3.3 Categories and Types of Historic Landscape Elements of Saxony

Source: Retrieved from (Walz, Ueberfuhr, Schauer, & Halke, 2010).

Agriculture	***Mining***
vineyard	relics of old mining on ore
meadow with scattered fruit trees	relics of old mining on black coal
forest hide farmland	relics of old mining on brown coal
stone ridge	relics of peat cut
field-terrace	former stone quarry or excavation of chalk
hedge	
mountain meadow	***Processing of food and materials***
wet meadow	wind mill
damp meadow	water mill
heathland	other mill
old extensive agriculture	
	Military, safety, administration and representation
Forestry	battle field
old farm wood	rampart
pastural woodland	landwehr, linear earthwork
medium forest	fortress, castle
coppice	manor house
selection forest	park
Settlement types	***Building types***
one-street village	local architectural style
square village	farm house
dispersed settlement	
Hunting	***Fishery***
manorial hunting installation	pond
Traffic	***Religion***
narrow pass	monastery
alley	
old roads before 1900	
railway before 1900	
narrow gauge railway	
old dike	

Table 3.4 Description of Historic Cultural Landscape Elements in Regional Cultural Landscape Studies of Brandenburg, Saxony, Bavaria, and Thuringia (Germany)

Source: Produced based on Bastian et al. (2013); Bayerisches Landesamt für Umwelt et al. (2013); Hallmann and Pabst (1993); Kulturlandschaftsportal Thüringen (2015). The names of categories are translated by the author.

Categories for Description	Brandenburg	Saxony	Bavaria	Thuringia	Sum
Definition		×		×	××
Features/characteristics		×	×	×	×××
Size				×	×
Typology	×	×		×	×××
Classification as historical landscape elements		×			×
Origin	×	×	×	×	××××
Historical development		×		×	××
Occurrence and distribution		×	×	×	×××
Function	×		×		××
Meaning and appreciation (perception)	×	×			××
Present situation			×		×
State of protection		×		×	××
Threats/risks	×	×		×	×××
Objectives and measures	×				×
Restoration and renovation hints	×				×
Requirement of maintenance				×	×
Conservation and management		×			×
Significance		×	×		××
Sources of information, references		×		×	××
Image				×	×

3.5.3 CULTURAL LANDSCAPE UNITS BY CATEGORIES OR TYPES

The types, combinations and frequencies of historic landscape elements shape the varying character of landscape areas (Bastian et al., 2013). The Saxony Landscape Program adopts a quantitative approach to classifying landscape units by using two factors *diversity* and *frequency* of typical historic landscape elements (Bastian et al., 2013; Walz, Schauer, Ueberfuhr, & Halke, 2012). Individual maps that display both the locations and the levels of frequency of 40 historic landscape element types were overlaid, arriving at 17 Cultural Landscape Areas and 53 Sub-Units (ibid.) (Figure 3.8). In this way, a typology[12] of cultural landscape units is developed. This classification and its outcomes well illustrate the differences of landscape units in element types and frequency but overlook the qualitative landscape character, such as the inner spatial relations between elements rather than the locations of individual elements.

3.5.4 HISTORIC CULTURAL LANDSCAPE IN PRACTICE

The classification system and documentation sheets enable a comprehensive and holistic collection of cultural landscape elements for a particular region. These cultural landscape cadasters organized as open databases make the conservation and planning activities of historic cultural landscape accessible, visible, and transparent. In this way, local communities can become involved and sensitized to the influence of their everyday life and practices on these historic landscapes. Furthermore, the Cultural Landscape Areas/Units maps can be used as source material for landscape planning and regional planning, as well as for establishing a landscape development concept and regional policies in conservation and management.

---

[12] The Merriam-Webster dictionary defines *typology* as “study of or analysis or classification based on types or categories” ("Typology," 2017). In architecture, Aldo Rossi stated typology “presents itself as the study of types of elements that cannot be further reduced, elements of a city as well as of an architecture” (Rossi, 1984, p. 41). This research adopts the meaning of *typology* as a classification of types.

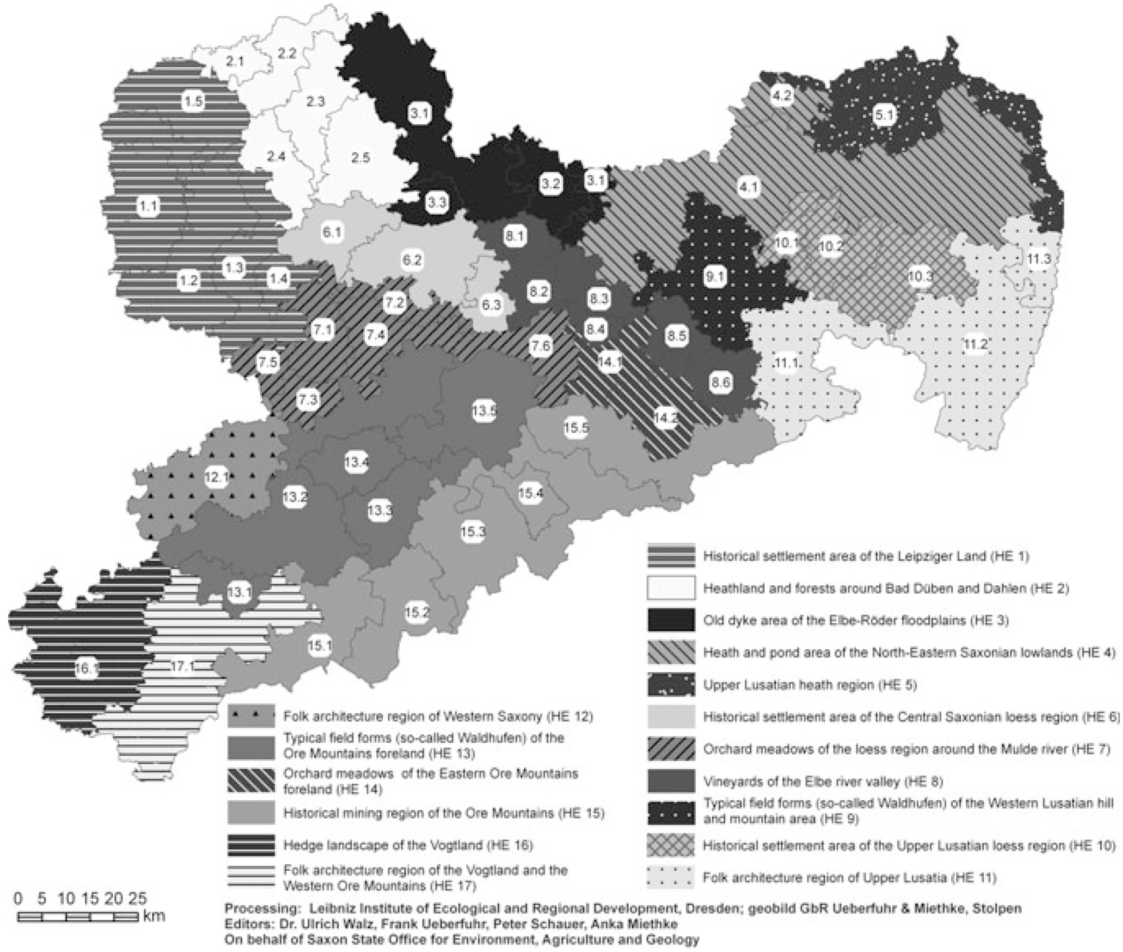


Figure 3.8 Cultural Landscape Areas in Saxony

Source: Retrieved from Bastian et al. (2013, p. 451).

PART III PERMANENT FORMS AND GREEN-BLUE INFRUSTUCTURE: THE ROLE OF LANDSCAPE ARCHITECTURE

This part reviews the current practices of postmodernism, regionalism, critical regionalism, critical reconstruction, green-blue infrastructure, and delta urbanism, all of which deal with the loss of regional identity, cultural landscape degradation, and water issues in urbanizing deltas. Most importantly, this part seeks to conclude with a critical assessment of the missing role of landscape architecture in all these discourses, especially the issue of cultural landscape degradation and urbanization in China.

3.6 LANDSCAPE ARCHITECTURE AND LANDSCAPE PLANNING

3.6.1 PROFESSION OF LANDSCAPE ARCHITECTURE AND LANDSCAPE PLANNING

The ASLA describes the profession of Landscape Architecture as one which “encompasses the analysis, planning, design, management, and stewardship of the natural and built environments” (American Society of Landscape Architects, n.d.-c) and lists the types of landscape architecture projects (Table 3.5). Landscape Planning in the US has developed as a branch of specialization within the profession of landscape architecture rather than within Regional Planning (Zube, 1986). Urban parks and greenway systems such as the Emerald Necklace in Boston planned by Frederick Law Olmsted and overlay landscape planning by Ian McHarg are most well-recognized landscape planning projects in the US.

Table 3.5 Types of Landscape Architecture Projects

Source: Adapted from American Society of Landscape Architects (n.d.-b).

• Academic campuses	• Monuments
• Conservation	• Parks and recreation
• Corporate and commercial	• Reclamation
• Gardens and arboreta	• Residential
• Green infrastructure	• Security design
• Historic preservation and restoration	• Stormwater management
• Hospitality and resorts	• Streetscapes and public spaces
• Institutions	• Therapeutic gardens
• Interior landscapes	• Transportation corridors
• Land planning	• Urban design
• Landscape art	

The European Council of Landscape Architecture Schools (ECLAS) describes landscape architecture as a discipline dealing with human activities shaping the built enviroment. The practice of landscape architecture involves "planning, design and management of the landscape to create, maintain, protect and enhance places so as to be both functional, beautiful and sustainable (in every sense of the word), and appropriate to diverse human and ecological needs" (European Council of Landscape Architecture Schools, n.d.). For Landscape Planning, the ELC defines it as "strong forward-looking action to enhance, restore or create landscapes" (Council of Europe, 2000).

3.6.2 LANDSCAPE PRACTICES IN CHINA

China has a long history of gardening (*Zaoyuan*) dating back to the 11th century BC (Zhou, 1990). In the modern profession and education of landscape architecture, the translated names for this discipline, such as *Yuanlin*, *Fengjing yuanlin*, *Jingguan jianzhu*, or *Jingguan sheji xue* are controversial and have given rise to much debate in academia (Liu, 2004; Sun, 2005; Wang, 1994; Yu, 2004). The Chinese Society of Landscape Architecture (CHSLA) has used the official name *Fengjing yuanlin* for landscape architecture since the 1990s and the profession covers:

> history & theory of LA, preservation of historical garden, natural and cultural heritage, planning and design of LA, garden-buildings, landscape engineering garden plants, zoos, urban green space system planning, planning of famous scenic sites and recreation area, natural conserves planning, urban and rural ecosystem, human habitat environment, economy and management, etc. (Chinese Society of Landscape Architecture, n.d.)

Landscape architecture (*Fengjing yuanlin*) was officially listed as a first-level discipline by the Ministry of Education in 2011 and parallels the disciplines of Architecture and Urban and Rural Planning. For the official name *Fengjing yuanlin*, the landscape architect Kongjian Yu (2004) argues that it shows the current understanding of landscape architecture in China is limited to Landscape Gardening when compared to the span of profession and education of landscape architecture in the US. While *Jingguan sheji xue*, including sub-disciplines of landscape design and landscape planning, expands the meaning and applied fields of our profession as landscape architects nowadays face the comprehensive challenges of dramatic landscape changes and environmental crises presented by the ongoing massive ubanization and industrialization in China (Yu, 2004; Yu & Li, 2004). The future of landscape architecture should expand to Land Design or Earthscape Planning to fulfill the demands of landscape and land design at this immense scale (Sun, 2002; Yu, 2004).

The descriptions of landscape architecture as a discipline and profession by the ALSA, ECLAS or CHSLA are more or less identical. However, the practices of landscape design in China still tend to focus primarily on urban green space and residential landscape. Landscape planning until today is mainly preoccupied with urban green space systems (as a special sector of planning within a master plan to be implemented by urban planners) at municipal and district (or town) levels and with the national parks and regional greenways at regional level. Landscape planning in China seldom addresses cultural landscape structures at any level, or develops plans for green infrastructure and regional open space systems at regional or provincial level. Thus, landscape architects seldom have the opportunity to play a role in new town and urban development or regional planning as in the US and Europe.

3.7 POSTMODERNISM, REGIONALISM, AND LANDSCAPE URBANISM

In architecture, the rethinking of regionality arose from concerns about architectural development under the impact of modernization and globalization. The *Postmodernist* movement beginning from the 1950s as a reaction to the reductionism and restraints of modernism reintroduced ornament and historic reference to architectural design. However, postmodern architecture has been criticized for copying the superficial forms of local context without any real function and thus creating derivative and inauthentic architecture (Dear, 1986; Lefaivre & Tzonis, 2003). There is no clearly defined *Postmodern Landscape Architecture* in the same sense as there is postmodern architecture even though landscape architects such as Lawrence Halprin, George Hargreaves, and Martha Schwartz have absorbed postmodernist design methods to explore a new design style (The Cultural Landscape Foundation, 2013)[13], which is characterized by rich references to the historic environment of a specific site or region (Lister, 1987).

Regionalism and *Critical Regionalism* are yet further approaches confronting the placelessness of modern architecture with a stronger consideration of the geographical context. In *The South in Architecture*, Mumford (1941) put forth his theory of regionalism in architecture. During the long lasting regionalist movement, Mumford's approach was almost the only one to reach a compromise in balancing local and global influences rather than simply rejecting globalization (Lefaivre & Tzonis, 2003). The term *critical regionalism* was first used by Mumford (1941) and was developed further by Frampton (1985). This new regionalism utilizes architecture as a resistance to the universalization of modernism and the superficial historic reference of postmodernism, and it continues the tradition of using regional design elements as well as referring to regional characteristics such as topography, climate, and light in architecture design (Frampton, 1985; Tzonis & Lefaivre, 1996). Furthermore, Frampton (1985) distinguishes his critical regionalism from the ignorant attempts to restore lost vernacular forms. Representative architects of critical regionalism like Alvar Aalto designed site-specific buildings in response to local climate and materials in Finland.

---

[13] "Postmodernist" is included as a landscape style in The Cultural Landscape Foundation's *What's Out There* database for historic designed landscapes in the US.

In the medium of landscape, Frampton (1999) went further in discussing the potential of the urban landscape as a *megaform* or *landform* that is capable of shaping the complex form of urban fabric and of effecting the megalopolitan landscape with its topographic character. Thus, Kelly Shannon (2006) stresses that Frampton's critical regionalism fosters the theoretic development of Landscape Urbanism, which subsequently has been extended to the world of landscape design to resist the homogenizing urban environment.

3.8 CRITICAL RECONSTRUCTION OF URBAN LANDSCAPE

Table 3.6 Elements and Structures in Cities and Cultural Landscapes that Offer Permanence to New Developments in Urban Landscapes

Source: Retrieved from Schöbel (2006, p. 225).

PERMANENCES	City	Cultural Landscape	Urban Landscape
ELEMENTS OR MODULES *that can serve for different functions over time*	• plot, block, quarter ... • courtyard, street, square, promenade ... • centers, areas, … • walls, ditches, canals, viaducts ...	• land lot, farmyard, type of village ... • markets, fairgrounds, public pathways, local connections, commons ... • shore, beach, edge ... • terraces, alleys, fruit gardens, fields with barns, monasteries ... • ditches, walls, dikes, channels …	Buildings, infrastructures and land uses to be restructured by a *critical reconstruction*: • suburban settlements • business parks • agricultural land • nature reserves • brownfields and wastelands • highways, railway lines • wind farms, solar fields • overhead power lines …
STRUCTURES OR FORMS *that can initiate coherency and sustainability (identity, difference, integration, hospitality ...)*	• 'translucency' of the landscape morphology • historical ground plan shapes • fabric of the public open space • building alignments, maximum eave lines, parcelling …	• massive morphologies of the natural landscape: relief, vastness … • fine structures of the cultural landscape: textures, grids, networks … • historical public rights and ownership structures … • meaningful places: visual axis, landmarks, panoramas …	

Critical Reconstruction (*Kritische Rekonstruktion*) is an approach developed from the urban reconstruction practice of post-war/wall Berlin. It is a guiding principle in the reconstruction and rehabilitation of the historic city center of Berlin as a place to live by referencing and reintroducing the historic city fabric in the International Building Exhibition Berlin (*Internationale Bauausstellung*—IBA) (Bodenschatz & Polinna, 2010). Schöbel (2016) interprets *critical reconstruction* as a cautious restoration of historic forms that could contribute to the permanent structures rather than its original functions or meanings. For the inner city, critical reconstruction does not intend to rehabilitate the whole historic urban structure, but a few key elements or textures; as for the featureless suburban areas, by transforming the elements or modules, or by restructuring the forms and patterns, historic cultural landscapes might give permanent structure to new developments of housing, infrastructures, and land use (ibid.) (Table 3.6).

3.9 GREEN-BLUE INFRASTRUCTURE

The expansion of impermeable surfaces in urban environments leads to increased risk of urban flooding, especially aggravated by climate change. Topics like stormwater management, resilient city, climate change adaptation, and green-blue infrastructure have generated growing interest worldwide during the past decade. Research projects and related practices such as the Low Impact Development (LID) in the US (e.g. Stormwater LID Practices Seattle and Portland), the Water Sensitive Urban Design and the Water Sensitive Cities in Australia (e.g. Sydney, Melbourne), Blue-Green Cities, the Green and Blue Infrastructure Strategy (e.g. Manchester, Maidstone Borough) in the UK, the Urban Green-Blue Grids in the Netherlands, and the Sponge City in China have explored measures tackling climatic challenges, and have contributed to more liveable, sustainable and resilient cities (Atelier Groenblauw, n.d.; Che, Xie, Chen, & Yu, 2015; Howe & Mitchell, 2012; Hoyer, Dickhaut, Kronawitter, & Weber, 2011; Manchester City Council, 2015; Prince George's County, 1999).

Traditional grey infrastructure drains the stormwater runoff in urban areas via a sewer system as quickly as possible, whereas green-blue infrastructure seeks to reintroduce the natural water cycle and to slow, retain, and purify stormwater flows as a resource for flood protection, balanced water supply, water pollution control, urban cooling, and so on. According to the Blue-Green Cities project, the blue-green approach integrates water management into urban green space. Thus blue-green infrastructure is more than just flood risk management strategy as it provides ecological, social-cultural, and economic benefits when the urban system is in both flood or non- flood status (Lawson et al., 2014). Furthermore, the Blue-Green Cities team gives examples of blue-green infrastructure (Table 3.7).

The theoretic development and practices of green-blue infrastructure and sponge city have been greatly promoted in China because of increasingly frequent and severe urban floods in metropolitan cities. The Ministry of Housing and Urban-Rural Development (2014) published technical guidelines for the construction of sponge city, and the central government released a pilot list of 16 sponge cities[14] and provided funding for these cities in 2015 (The State Council of the P.R. China, 2015). In addition to the latest attempts at municipal level, projects

[14] Two cities, Jiaxing and Zhenjiang, in the YRD were selected as pilot sponge cities.

at community/district level, such as the Qunli Stormwater Park (2009–2011) and Yanweizhou Park (2010–2014) by Turenscape, as well as the stormwater management plan of the Guangming New District in Shenzhen (2008), have drawn public attention. New town and urban development projects in the YRD cities, such as the Nanhu New Country Village project in Jiaxing (2011) by the SWA Group, the South Taihu Lake Planning project in Huzhou (2014), the Zhangjiabang Park in Shanghai (2015) by Sasaki Associates, and the Kunshan Studio (2012) led by Monash University and the Cooperative Research Centre for Water Sensitive Cities in Suzhou, all seek to integrate existing water and agriculture systems into the new urban fabric, open space system, and stormwater management system (Energy Smart Communities Initiative, 2014; Kunshan Studio, n.d.; Sasaki Associates, 2014, 2015; SWA Group, n.d.; Turenscape, 2011, 2014). These projects can serve as reference points for the new town and urban development in other YRD delta cities.

Table 3.7 Blue-Green Infrastructure Defined by the Blue-Green Cities Research Project

Source: (Lawson, 2014).

• Bioretention systems • Bioretention swales • Swales and buffer strips • Storage ponds, lakes and reservoirs • Controlled storage areas, e.g. car parks, recreational areas, minor roads, playing fields, parkland and hard standing in school playgrounds and industrial areas • Sand filters and infiltration trenches • Permeable paving • Rain gardens • Stream and river restoration • De-canalisation of river corridors and re-introduction of meanders	• Constructed wetlands • Property level strategies to reduce surface water and manage runoff, such as water butts • Open green space • Parks and gardens • Street trees • Pocket parks • Vegetated ephemeral waterways • Planted drainage assets (green roofs and green walls) • Green outfalls • Restored, rehabilitated and enhanced urban watercourses offering green erosion protection (see river restoration)

3.10 DELTA URBANISM AND POLDER URBANIZATION

3.10.1 DELTA URBANISM

Delta areas throughout the world are the most densely settled owing to fertile alluvial soil for agriculture, rich water resources, and convenient combined water and road transportation. Meanwhile, these areas are most vulnerable to flooding, land subsidence, and natural disasters, and the security of this living space is continuously under threat. The frequent devastating floods because of climate change in metropolitan delta cities such as New Orleans 2005, Japan 2011, and Bangkok 2011 have driven worldwide concern and rethinking of current urban development modules and flood defense strategies in these deltas and coastal areas (Meyer & Nijhuis, 2013). Delta Urbanism research is one specialization developed under this stream of thought, aiming to develop new approaches to urban planning and design for climate resilient delta cities. Urban deltas should be considered and studied as complex layered systems, in which layers of natural morphologies, infrastructural networks, and human occupation (e.g. built-up lands and water use) are interconnected and conflicting (Bucx, Marchand, Makaske, & Van de Guchte, 2010; Meyer & Nijhuis, 2013).

The Netherlands is a very low-lying country, renowned for the wisdom of “living with water”. Dutch people have a rich tradition and experience of land reclamation, water management, and creating a safe and high quality living environment in delta areas. The Delta Urbanism Research Group in the Delft University of Technology led by Prof. Han Meyer has years of experience in studying urbanized deltas worldwide, including the Dutch Delta, the Pearl River Delta in China, the Mekong Delta in Vietnam, and the Mississippi River Delta in the US ("Delta Urbanism TU Delft," n.d.). This research group focuses on research and design projects addressing urban delta types, climate adaptive urban design, multifunctional flood defenses, the transformation of landscape and urban patterns in urban deltas etc. The Delta Interventions Studio projects aim to combine safer water mangement systems with spatial identity and quality, and new cohesions of cities and delta landscapes in innovative designs ("Delta Interventions Studio," n.d.).

Besides the Dutch context, the Delta Urbanism practice in the US is also noteworthy. The Dutch Dialogues project led by the American Planning Association is a cooperation project between American and Dutch professionals to rebuild New Orleans after Hurricane Katrina by learning from the Dutch experiences of integrating water management infrastructures into urban fabrics (Meyer, Morris, & Waggonner, 2009; Meyer & Nijhuis, 2013). The Greater New Orleans Urban Water Plan has proposed a comprehensive water management plan to stabilize the soil and groundwater levels, and to link urban districts and waterfront public spaces (Waggonner et al., 2014). This plan will not only contribute to flood protection but also new spatial qualities and the future socio-economic growth of New Orleans.

In China, research into urbanization and climate change of the Pearl River Delta and the YRD has brought much-needed attention to the issues (Gu, Hu, Zhang, Wang, & Guo, 2011; Yang, Scheffran, Qin, & You, 2015). So far there are very few research projects on climate adaptive planning and design (especially at municipal and regional levels), urban forms of polder cities, metropolitan delta landscapes, etc. The Yangtze River Delta Project led by Princeton University provides a research-based low-tech but large-scale development plan for coastal climate adaptation at municipal and regional levels (Seavitt, 2014). This group seeks to build a soft infrastructure inspired by China’s ancient floodwater management techniques instead of single hard-engineered infrastructure like dikes and seawalls. The group develops design proposals to build semi-enclosed open polders with temporary water reservoirs in fields to collect, retain, and release flood water as well as to construct linear berm ridges on and off shore to reduce storm surge damage to Shanghai's four coastal districts (Seavitt, 2013, 2014) (Figure 3.9).

Figure 3.9 Open Polder Water Tank Study Model

Source: Retrieved from Seavitt (2013).

3.10.2 POLDER TYPOLOGY AND URBANIZATION

Polders are drained lowlands reclaimed from the sea, river plains, shallow lakes, lagoons, or swamps by dikes. The water level in polders can be separated and controlled independently from adjacent water body by sluices or pumping (Luijendijk, Schultz, & Segeren, 1988). Polders exist all over the world, normally below sea level but—under special circumstances—above. These polders have different forms and character, which are shaped based on their physical conditions, as well as by the various technologies of reclamation and poldering, planning, and socio-economic demands (Hooimeijer, Meyer, & Nienhuis, 2005). In general, Luijendijk et al. (1988) distinguish three polder types by the regional drainage base (the water level in polders is permanently or temporarily lower than the outer water level): *impoldered low-lying lands*, *lands reclaimed from the sea*, and *drained lakes* (pp. 180-181). In the Dutch case, similarly, Hooimeijer et al. (2005) identify three polder types based on their *natural types of ground* and the polder technologies that shape them: *peat polders*, *drained lakes* and *diked areas* (p. 156) (Figure 3.10); whereas De Wit (2009) classifies three polder types by their *basic form*s, relating to the forms of natural landscapes and the patterns of drainage and parceling systems[15]: *the holm polder* (*oval form*), *the accretion polder* (*peel-shaped form*), and *the mud flat polder* (*shoal-shaped form*) (p. 35) (Figure 3.11).

Furthermore, in the Netherlands, there are systemic studies about the Dutch tradition of creating polder towns and cities as well as typical urban and landscape practices based on the analysis of urban development and interrelated water management. In the book *Atlas of Dutch Water Cities*, Hooimeijer et al. (2005) describe the Dutch polder landscape as a

[15] In the Dutch context, De Wit (2009) states the basic form is "the form of reclamation" and "the form of the landscape is based on the basic form, the rationalisation of the topography, in which the interaction between reclamation and natural landscape is expressed" (p. 9).

“hydraulic system” and the polder city as a “hydraulic structure construction” (p. 13). This book also links the urban forms of polder cities with the three types of polders: *peat polder city* (e.g. Amsterdam and Rotterdam); *diked city* (e.g. Almere); *drained lake city* (Haarlemmermeer and Hoofddorp). Hooimeijer et al. further summarize the morphogenesis and spatial patterns of cities and their surrounding polder landscapes in three modules (Figure 3.12). The patterns and characteristics of polders composed of drainage systems (e.g. sluices, mills, pumping stations, dikes, and canals), farms, buildings, road networks, determine the spatial qualities of their cities. The functional forms and structures of the polders can be recognized in current urban design, such as the geometric polder grid used as a basis for urban allotment (Meyer & Nijhuis, 2013). De Wit (2009) studies the successive transformation of these three basic forms of polders in six case studies of polder landscapes all over the Netherlands and arrived at the conclusion that knowledge of the constructive principles underlying these livable and unique cultural landscapes is helpful in the design of future metropolitan delta landscapes.

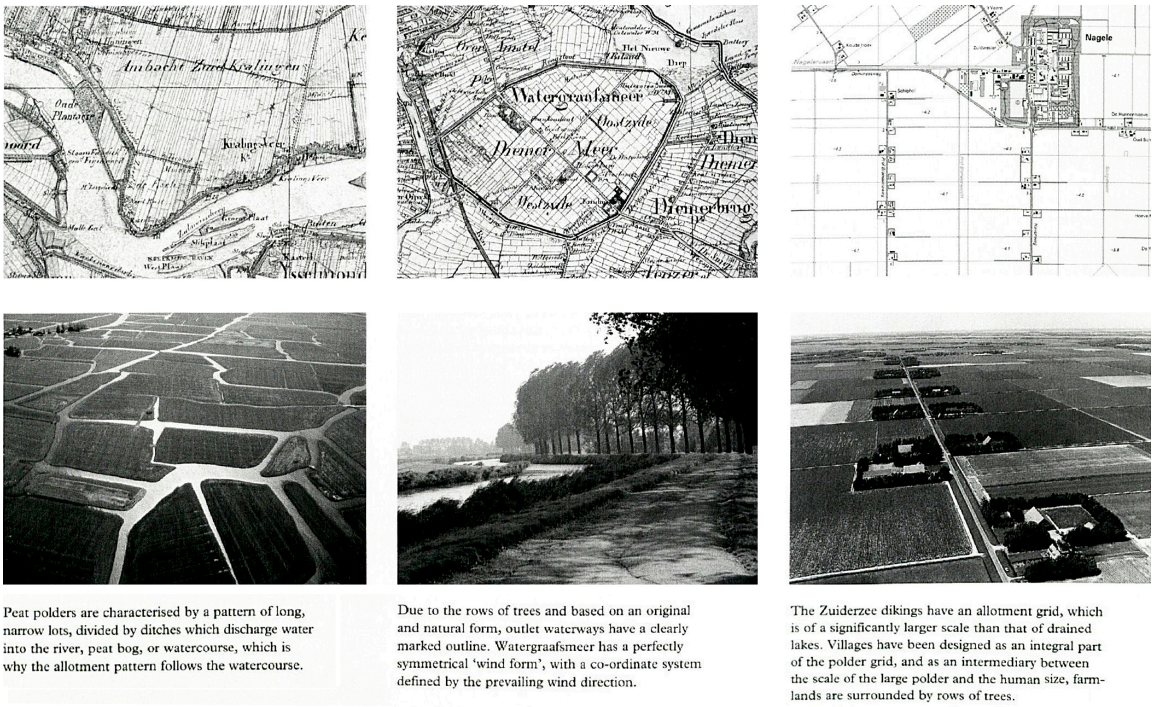


Figure 3.10 Three Dutch Polder Types and Their Characteristics

Source: Retrieved from Hooimeijer et al. (2005, pp. 158-159).

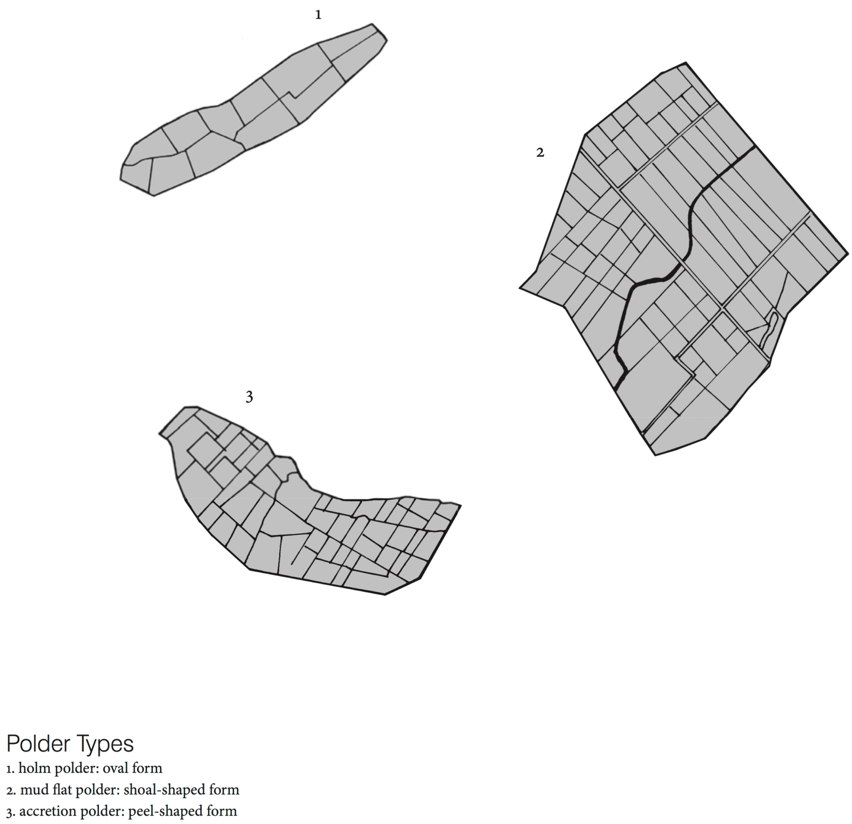


Figure 3.11 Three Dutch Polder Types and Their Basic Forms

Source: Retrieved from De Wit (2009, p. 34).

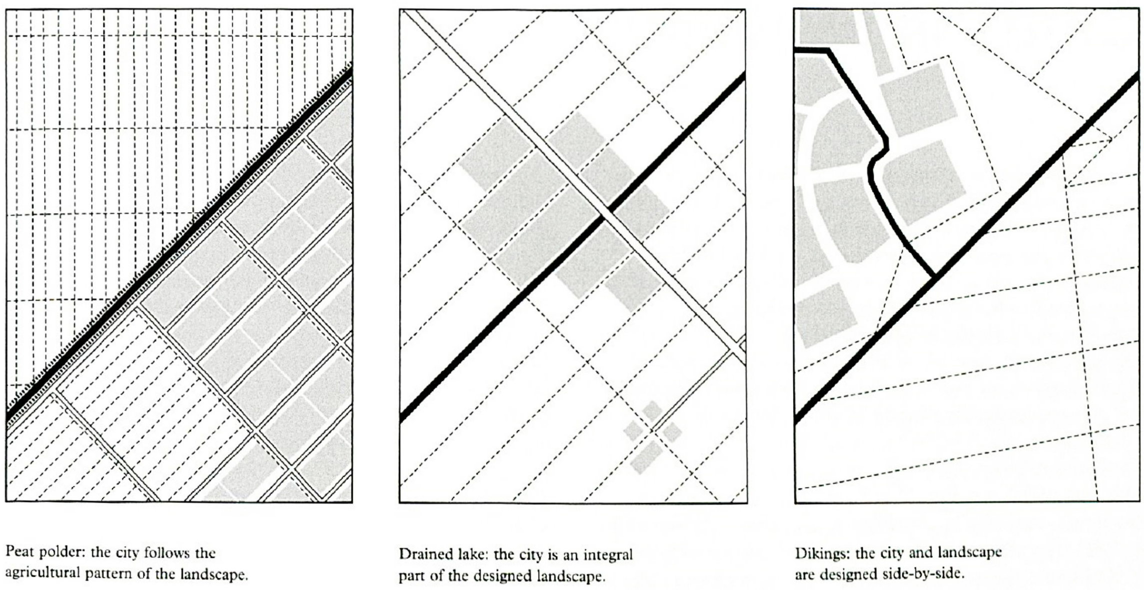


Figure 3.12 Spatial Patterns of Polder Cities and Landscapes

Source: Retrieved from Hooimeijer et al. (2005, pp. 158-159).

PART IV CONCLUSION

3.11 LANDSCAPE FORMS AND REGIONAL IDENTITY

The loss of diversity and identity of landscape character through urbanization and industrialization is a common issue all over the world. The fragmentation and disappearance of historic cultural landscapes and the emergence of new but generic cultural landscape elements and structures have resulted in the decline of regional identities.

In recent architectural history, we are confronted with a recall of regionality in architectural design to tackle the placelessness of modern architecture by referring to the geographical context, from postmodernism, regionalism to critical regionalism. Postmodern landscape architecture and landscape urbanism are two schools that resist the homogenizing impacts on urban environments by reference to the historic environment of a specific site or region, and by shaping urban fabrics. Utilizing vernacular materials, forms, or elements with respect to regional characteristics such as topography, climate, and light in the design process has been prevalent both in architecture and landscape practices. On the other hand, critics have pointed out that the newly built vernacular forms inevitably tend to be meaningless when designers reframe and transform them in “High Style” projects (Treib, 2002, p. 95).

When we consider regionality beyond the design of single buildings or isolated landscape projects, at urban or regional scales, there are limited discourses and tools for retaining regional identity in landscape and regional planning. The perception of the cultural landscape as a palimpsest is widely accepted: a multi-layered structure showing the ceaseless accumulation of created and superimposed new elements on the historic structure through everyday life. Interpreting the temporal process of making cultural landscapes and integrating the historic forms and structures of these multi-layered cultural landscapes into present landscape design and planning might be helpful in retaining regional identity within new urban and regional developments.

3.12 GAPS OF CULTURAL LANDSCAPE STUDY IN CHINA

The study of cultural landscape in China is still in its infancy. There is limited understanding of cultural landscape as a category of world cultural heritages or as a dynamically shaped ordinary everyday landscape. In China, the most significant element in the cultural landscape is people, who have intensive interaction with their physical environment almost everywhere. In this context, every landscape is culturally formed. This makes it more difficult for the researchers and public to understand the concept, meanings, and components of the cultural landscape. Thus, this research has provided an overview of and will refer to systematic cultural landscape studies in Europe and the US.

Landscape changes in China seem to be essentially similar to those in Europe. All over the world, besides the general driving forces like industrialization and urbanization, the most influential impacts have been socio-economic and technological developments, but always supported by political decisions as well as resulting policies and events. Industrialization is the common division between traditional and modern cultural landscapes, while this period in China is almost one century behind the European. Beginning in late 19th century, industrialization in China gained momentum from 1949 onwards and culminated in a revolutionary change with the initiation of economic reforms from 1978 onwards. Thus, the start of communist era in 1949 and the Economic Reform after 1978 are two significant divisions for the nation-wide transformation of landscapes in China. In conclusion, three eras can be distinguished to analyze recent significant changes in cultural landscapes in China:

- The pre-industrial historic landscapes (pre-1949), in which traces of historic landscape elements and structures still remain and are visible;
- the landscapes of collective agriculture during the early communist era (1949–1978/82[16]), designed for the achievement of local, regional and national subsistence in food production while at the same time providing the foundations for large scale industrialization; landscapes altered mainly due to political decisions and policies in this stagnant industrialization and urbanization period;
- the contemporary landscapes of the reform era (post-1978), resulting from accelerated urbanization and industrialization with extreme fragmentation of land, often irreversibly transformed or heavily degraded natural landscapes, vanishing historic landscapes, monofunctional industrial landscapes, and multifunctional urban landscapes. Modern types of land use have overlapped and replaced historic landscape structures completely in an “industrial logic”.

So far, the research into landscape changes has been understood as the application of quantitative research methods either in remote sensing or in landscape ecology. To date, the qualitative and aesthetic changes in landscape character have been largely overlooked. Qualitative changes in landscape elements and structures should also be considered and documented by mapping and descriptions as in the LCA and KHLE programs in the UK and Germany.

---

[16] The rural landscape was imprinted by the collective agriculture until the early 1980s when the People’s Communes was formally abolished in 1982.

3.13 RESTRUCTING CULTURAL LANDSCAPES IN METROPOLITAN AREAS

3.13.1 LINK BETWEEN CULTURAL LANDSCAPE AND URBANIZATION IN LANDSCAPE ARCHITECTURE

Cultural landscape is not a prevalent concept or topic in spatial planning, heritage protection policies, or landscape architecture theory and practice in China. So far, the study of cultural landscape has been restricted to cultural heritage sites or national parks. Little attention has been paid to traditional cultural landscapes such as rural settlement patterns, let alone contemporary everyday landscapes. Landscape architects in China seldom have the opportunity to play a role in new town and urban development or regional planning as in the US and Europe. Their work is currently limited to the design of urban green spaces and residential quarters. Apart from national parks and world heritage cultural landscapes, landscape planning projects such as urban green space systems and regional greenways are dominated and implemented by urban planners from municipal and regional planning institutes. The link between historic cultural landscapes and urbanization in current landscape architecture practice in China is missing.

3.13.2 CULTURAL LANDSCAPE AS GREEN-BLUE INFRASTRUCTURE IN DELTA URBANIZATION

The research into urbanization and climate change in China's Pearl River Delta and the YRD has brought mounting concerns. So far there are very few research studies on the polder types, urban forms of delta cities, metropolitan delta landscapes, climate adaptive planning and design (especially at municipal and regional levels), etc. Moreover, landscape architects have not yet paid much attention to the issue of the metropolitan (or urban) delta landscape. More emphasis should be given to the possibilities of combining delta (polder) landscapes with urban fabrics as spatial qualities and identities, and to integrating flood defense systems into open space systems as in the Netherlands. The growing conceptual development of green-blue infrastructure, sponge cities and their implementation in China might contribute to meeting the challenges. The stormwater management projects at community and district levels, especially the new town and urban development projects in the YRD cities are useful references. A review of the literature shows that polder landscapes in the Netherlands have been studied more under constructive and functional aspects as hydraulic or flood defense systems than as historic cultural landscapes or heritage sites. The case study of the YRD region in this dissertation will focus on both technical and cultural/historic dimensions of the contemporary metropolitan delta landscape. Furthermore, this research will explore the possibilities for re-activating components of historic cultural landscapes as green-blue infrastructure and the potential for transforming the YRD delta cities into sponge cities.

3.13.3 CULTURAL LANDSCAPE AS A DESIGN ISSUE IN METROPOLITAN AREAS

To conclude, consideration of the cultural landscape as a design issue in landscape architecture when confronted with the on-going degradation of the cultural landscape, frequent urban flood disasters, and the mass expansion of urban-industrial land use in China is urgently required. Even if this professional understanding of the role and task of landscape architecture has as yet only partly been recognized by the public, politicians, and planning authorities, in the West more than in China, worldwide there is an increasing awareness of the issues, especially in the face of the enormous problems in rapidly expanding metropolitan regions. The exisiting types of landscape practice dealing with cultural landscapes worldwide, the missing role of landscape architecture in China, as well as the potential offered by cultural landscape in metropolitan areas were summarzied in Table 3.8.

3.14 LANDSCAPE ANALYSIS INSTRUMENTS FOR METROPOLITAN AREAS

In Europe, there are well-established instruments of systematic landscape analysis for landscape characterization or assessment, such as HLC and LCA originating in the UK, and KHLE from Germany. These projects primarily deal with rural landscapes, and some extend to townscapes or urban landscapes, which still have boundaries and character distinguishable from their neighboring rural landscapes.

In contrast to mature practice in Europe, there is no commonly recognized approach to landscape characterization in China. At the same time, the rapid urbanization in China shifts the performance requirements of this tool. Given the particularities of China’s urban systems, especially in rapidly expanding metropolitan areas, the blurred urban, suburban and rural landscapes should be studied as a sequence on an urban-suburban-rural continuum, rather than discrete rural or urban landscapes considered as static or aesthetic entities. Another challenge in applying existing European tools to a specific region or city in China lies in the fact that population density, land use patterns, pace of development, planning and land ownership systems, and especially data availability are not comparable to Europe.

Thus new instruments are required for landscape analysis in the study of landscape characteristics and changes in metropolitan areas in China. How to readjust and bridge the shortfalls of existing European methods to fit the YRD region is at the core of the present investigation. The modified instruments of analysis will be described in Chapter 5. Given the usefulness and practicability of a modified LCA or KHLE for a representative segment of the YRD, transfer to the other metropolitan regions of China would also be feasible.

Table 3.8 Cultural Landscape as a Design Issue in Metropolitan Areas in Landscape Architecture

Source: Italicized items are adapted from American Society of Landscape Architects (n.d.-b); Chinese Society of Landscape Architecture (n.d.); Lawson (2014) and are categorized by the author.

Cultural Landscape as a Design Issue	Regional Scale	Municipal Scale	Local/District Scale
In Landscape Architecture Worldwide	• *historic preservation and restoration* (asla), e.g. *natural and cultural heritage* (CHSLA) • *natural conserves planning* (CHSLA), national parks • *hospitality and resorts* (ASLA) • *planning of famous scenic sites and recreation area* (CHSLA) • *land planning* (ASLA) • regional open space planning • new town development • green infrastructure, e.g. regional greenways • *transportation corridors* (ASLA) • *reclamation* (ASLA) …	• preservation of historic urban districts, towns and villages • *urban green space system planning* (CHSLA), e.g. *parks and gardens* (Lawson, 2014), urban greenways • *urban and rural ecosystem* (CHSLA) • *urban design* (ASLA) • *stormwater management* (ASLA) • brownfields and wastelands …	• *residential* (ASLA) • *streetscapes and public spaces* (ASLA) • *monuments* (ASLA), landmarks • *preservation of historical garden* (CHSLA) …
Missing Role of Landscape Architecture in China	• *land planning* (ASLA) • regional open space planning • new town development • green infrastructure, e.g. regional greenways • *transportation corridors* (ASLA) • *reclamation* (ASLA) …	• preservation of historic urban districts, towns and villages • *urban green space system planning* (CHSLA) • *urban design* (ASLA) • *stormwater management* (ASLA) • brownfields and wastelands …	• *residential* (ASLA) • *streetscapes and public spaces* (ASLA) …
Highlights in Metropolitan Areas	• green and blue infrastructure • grey infrastructure, e.g. power lines; *transportation corridors* (ASLA), e.g. highways, railway lines • new town and urban development • agricultural landscape structures • *stormwater management* (ASLA), e.g. *river corridors*, *storage ponds, lakes and reservoirs* (Lawson, 2014) • renewable energy landscape, e.g. wind farms, solar parks …	• urban landscape structures, e.g. urban/suburban housings, urban road systems • rural landscape structures, e.g. rural settlements, field parcels, canal system, vegetation cover • industrial areas, industrial parks • business parks • brownfields and wastelands • *stormwater management* (ASLA), e.g. urban rivers, canals, *storage ponds, lakes and reservoirs* (Lawson, 2014) • renewable energy landscape, e.g. wind farms, solar parks …	• urban settlements, e.g. residential blocks, gated communities • rural settlements, e.g. farmstead, vernacular dwellings • *stormwater management* (ASLA), e.g. *rain gardens*, bioretention swales (Lawson, 2014) • renewable energy landscape, e.g. wind turbines, solar panels …

CHAPTER 4 TIME, SPACE AND CULTURAL LANDSCAPE: MORPHOGENESIS OF A METROPOLITAN DELTA LANDSCAPE

> “The form of a landscape is no accidental or random phenomenon, but the result of a transformational process that can also be called a formal process when seen in terms of form. All morphogenetic, technical, functional, cultural and architectural aspects are expressed in the form; the form of the landscape incorporates all other aspects and is the expression of their organisation. The explanation of the form of the landscape is the description of the logic of this organization and of the transformation, the development of a new form from the existing one. Seen from this perspective, the landscape can be viewed as an organization of interrelated spatial phenomena.” (De Wit, 2009)

The YRD has had a long tradition of human settlement, land reclamation and intensive agriculture dating back to ancient times, which turned the former marshes and peatlands into a highly productive region for rice, fish and silk (China's Agricultural Heritage Research, 1990; Miao, 1982; Zheng, 1987). These local agricultural and hydraulic activities have altered and shaped the forms and characteristics of the historic cultural landscapes. This process of shaping landscapes was accompanied by adapting to the regional physical and morphological conditions and by the agricultural and hydraulic techniques evolving in parallel with the land use system. The continuous land reclamation, poldering, and paddy-fish-silk farming in the delta lowlands have created the permanent structures and character of polder landscapes for thousands of years, which today can be acknowledged as typical.

Since the implementation of Economic Reforms since 1978, this formerly highly productive agricultural region has been transformed into the fastest-growing megalopolitan region in China because of booming urbanization and industrialization. Consequently, historic site-specific cultural landscape elements and structures have gradually been swallowed by reckless urban development, while new cultural but generic, mixed urban and industrial landscape elements have become prevalent.

This chapter seeks to demonstrate the temporal-spatial morphogenesis of cultural landscapes in the YRD region, from the historic polder landscape to the contemporary metropolitan delta landscape. By a historic study and mapping, this chapter explains how developments of land reclamation and poldering techniques, water conservancy, land use systems, and urbanization and industrialization have been driving the morphological, technical, functional and architectural changes of cultural landscapes that are expressed in forms and structures. Five historic polder types were discovered as the logic behind the spatial organization of the polder landscapes in the YRD region.

4.1 YANGTZE RIVER DELTA

4.1.1 TAIHU BASIN AS THE RESEARCH AREA

The Taihu Basin is a typical physical and cultural geographical zone of the YRD. This area is bordered by the Yangtze River in the north, the Qiantang River and Hangzhou Bay in the south, Mountain Tianmu and Mao in the west, and the East China Sea in the east. It covers 36,985 km^2 and has a population of 59.7 million (2013), accounting for 0.4% of the national territory but accommodating 4.4% of the population of China. This region is mainly situated in a low-lying alluvial plain (about 2–7 m above sea level[17]), of which 60% are polder areas[18] (Wang, 2006). These polders are normally reclaimed paddy fields from a body of water, such as the sea, a river, or a lake, and they are enclosed and separated from the outside water by dikes. Water surface accounts for one sixth of the whole region, including numerous lakes and crisscrossing rivers and canals. Lake Taihu is the largest lake, which is situated in the middle of the delta with an average water depth of 1.9 m, a lakeshore of 393.8 km and a surface area of 2,338 km^2.

Because of the nearly flat topography and sub-tropical monsoon climate, the basin is annually under threat of flooding, waterlogging and typhoons. Floods in rainy seasons from May to September have caused disastrous damage and economic loss in the flood plains of the Yangtze River, such as the floods of 1931, 1954 and 1998 (ibid.). Thus, the hydrological issues have always been central to a range of human concerns, for instance, agriculture and drainage, urbanization and flood control, as well as for amenities and burdens of everyday life.

During the past three decades, the Taihu Basin has undergone significant land use and land cover changes, leading to the deterioration of ecosystem and frequent occurrence of flooding (Gao, 2004; Pan, Yang, Su, & Wang, 2015). For instance, from 1985 to 2010, the amount of cultivated land has decreased from 68.4% to 43.6%, whereas the built-up areas have dramatically increased from 5.1% to 25.6%; the water area, however, has undergone no

---

[17] Wusong Altitude System, same as following

[18] *Polder* is “a piece of low-lying land reclaimed from the sea or a river and protected by dykes, especially in the Netherlands” ("Polder," 2015). In Chinese, we call a polder a *Weitian* or *Weizi*, which is a unique agriculture system developed from the farming and flood management practices in the riverside, lakeside, or coastal low-lying areas in South China (Zhao & Liu, 2003). In the middle and lower reaches of the Yangtze River, there are various types of polders, whose names differ according to their sizes and natural ground, regions, or reclamation techniques (ibid.). The different types of polders are collectively referred to as *Weitian* by the similarity of “reclaimed fields enclosed by dikes” (ibid., p. 58).

significant change during this period (Pan et al., 2015).

4.1.2 FORMATION OF THE YANGTZE RIVER DELTA

The Yangtze River (*Chang Jiang*, means long river), at 6,300 km long, is the third-longest river in the world. It drains one-fifth of China's territory, and its drainage basin accommodates one-third of the country's population (Wikipedia) (Figure 4.1). The Yangtze River carries a huge volume of sediment when it flows into the East China Sea. This sediment formed a large tidal delta at the river month. The current delta, which was a gulf area in ancient times, has been gradually surrounded and enclosed by sandy ridges under the forces of sedimentary movement and tides (Tan, 1973). These sand ridges formed the first coast that gradually extended seaward and shaped a relatively higher chenier (shelly sand ridge, called *Gangshen*) in the coastal zone (Xie, 2010). During this process, Lake Taihu transformed from a lagoon into a lake completely isolated from the ocean. All this developed the gulf area into the present-day delta (Miao, 1982). Thereafter, the coastline continued to grow seaward starting from the east side of the chenier ridge (Figure 4.2). The strand plain is now still growing towards the sea at the speed of approximately two kilometers per century (Van Slyke, 1988). Two thirds of Shanghai's municipal area has been formed by the sediment deposition during the last two to three thousand years. All these processes have shaped the geomorphology of the Taihu Basin.

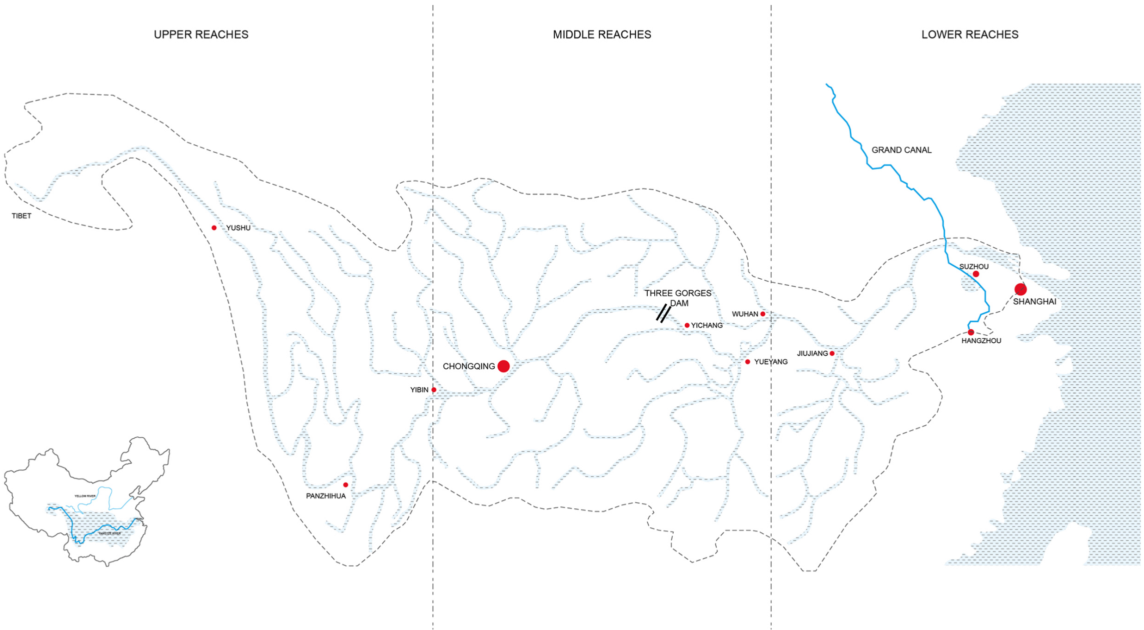


Figure 4.1 The Drainage Basin of the Yangtze River

Source: Author's drawing adapted from Kunshan Studio (n.d.).

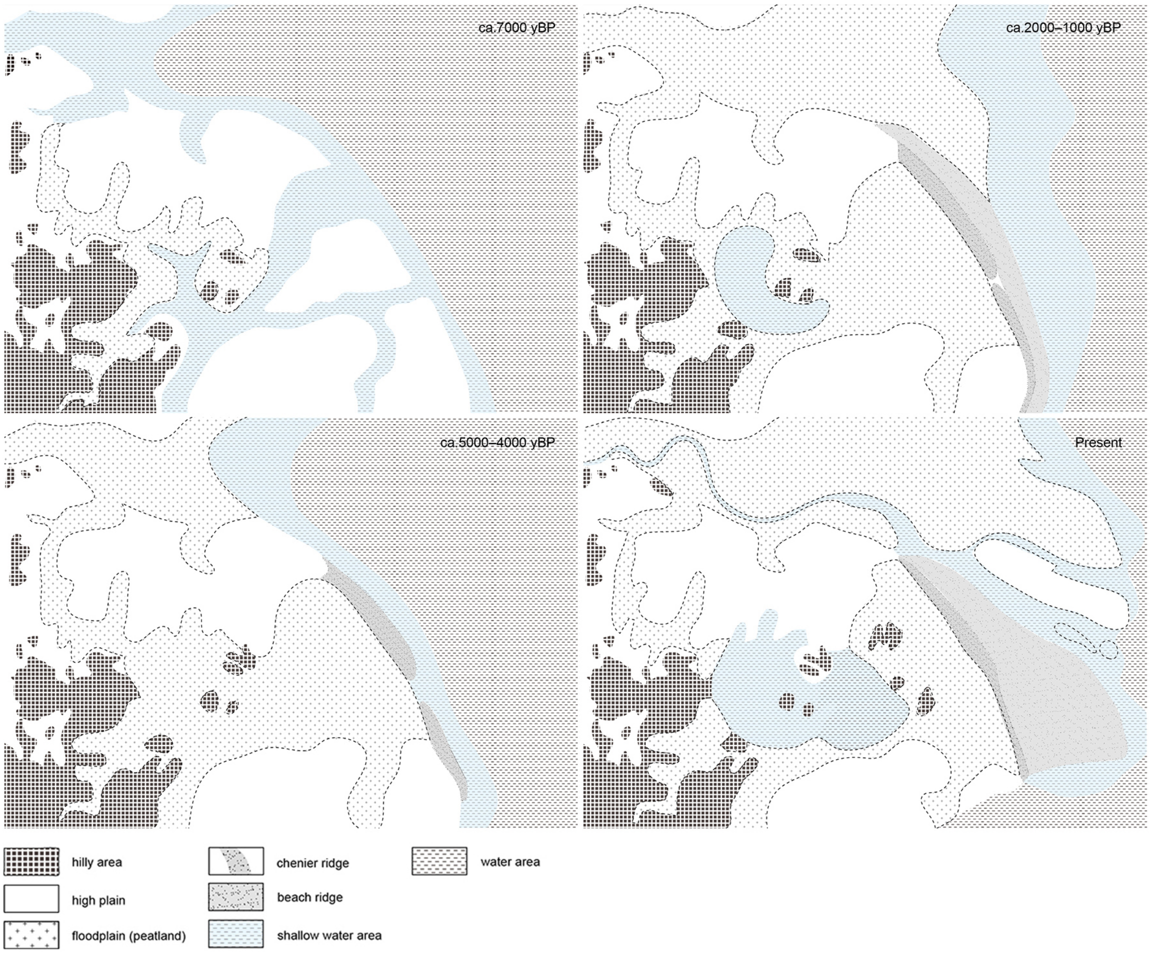


Figure 4.2 Landform Evolution of the Yangtze River Delta

Source: Author's drawing adapted from Umitsu (1990, p. 243).

The topography of the Taihu Basin decreases from the west to the east, from the peripheral area to the center, like a plate. The hilly area composed of mountains of 200 to 500 m and low hills of about 10 to 30 m is situated in the west of the basin and the rest is a vast plain: the central part of this plain is the most low-lying area, and is about 2.5 to 3.5 m in elevation; the northwest part, the Wu-Cheng-Xi-Yu plain area, is situated in a relatively high upland, which is about 5.5 to 8 m in elevation; the northeast riverside and coastal area, is at 4.5 to 6 m; the south part along the Qiantang River and the Hang-Jia-Hu Plain is at 4 to 5 m (Gao, 2004) (Fig. 4.3). This special topography makes it difficult to discharge the runoff water from the hilly area to the sea. The flooding issue has been fundamental to agricultural production and security in the delta region. Especially after the 1980s, floods have been occurring ever more frequently as the impermeable surface of urbanized areas proliferates.

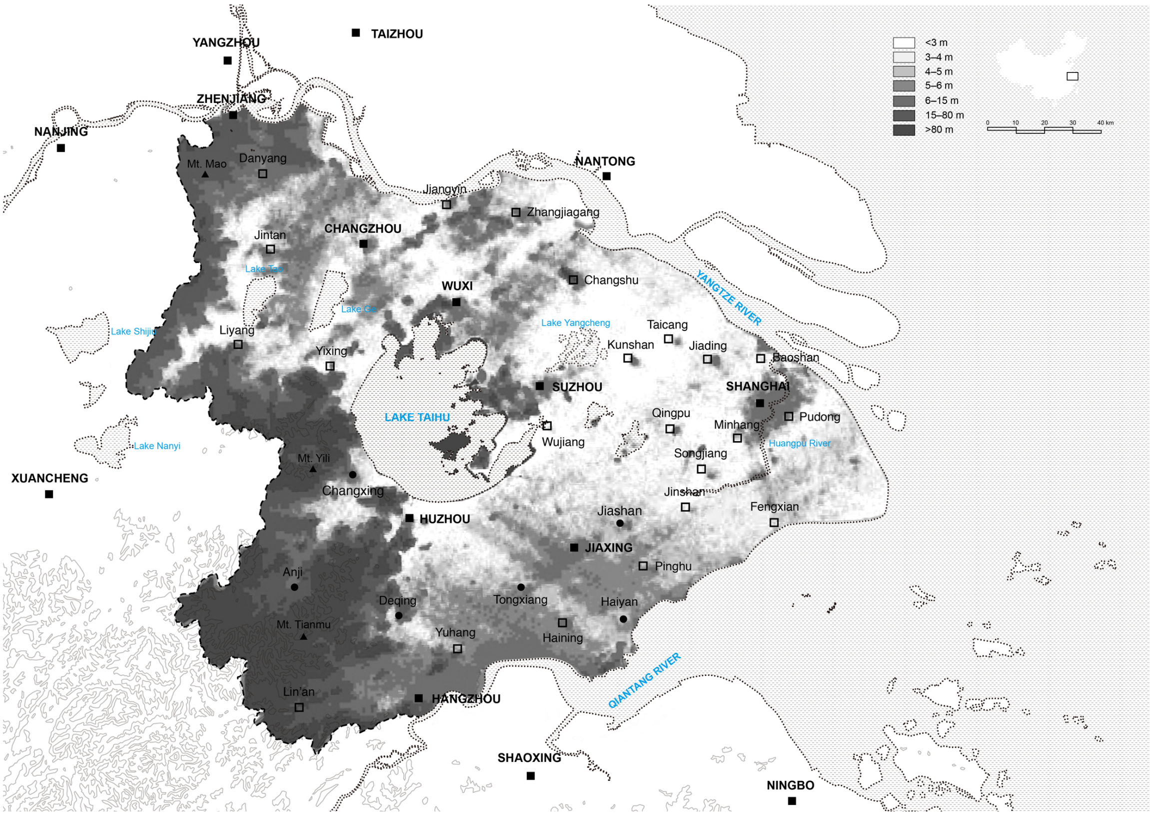


Figure 4.3 Topographic Map of the Taihu Basin

Source: Author's drawing adapted from Pei (2014, p. 16).

4.1.3 EVOLUTION OF NAMES AND BOUNDARIES

In regional studies, identifying the controversial names and boundaries of a research region is a fundamental issue.

There are numerous names for the research region, the metropolitan delta region centered on Shanghai, across the timeline and conforming to different research topics and criteria. Various terms for the *Jiangnan Region* (means the south of the Yangtze River), *Jiang Zhe Region*, *Jiang Zhe Hu* (the abbreviation for Jiangsu, Zhejiang Province and Shanghai), *Yangtze River Delta Region*, and *Lower Yangtze River Region* are all commonly used both in everyday life and academic publications. Among these terms, the *Jiangnan* and *YRD region* are the most frequently used in urban and regional planning, landscape architecture, and architecture publications. More specifically, the term *Jiangnan* is normally applied in historical studies on ancient towns, vernacular dwellings, traditional gardens, etc., whereas the term *YRD Region* is used as a modern concept when analyzing the formation and development of human settlements, environmental change, and regional planning in this megalopolitan or metropolitan region[19]. Moreover, the YRD megalopolis could be understood as the modern pattern of the Jiangnan region since the geographical context and cultural resources have been preserved (Liu, 2009). Therefore, this thesis adopts the term *YRD region* in studying the urban and cultural landscapes of the megalopolitan delta.

The boundaries of the YRD region are also diversely defined according to the different eras and criteria, such as the natural, cultural, administrative, or economic geographical factors (Li, 1991; Xu, 2002). The regional boundaries have experienced the evolution from west to east, large to small, and generic to specific through the timeline (Xu, 2002) (Figure 4.4). Nowadays, the YRD region is mostly used as a concept for the YRD Economic Zone or the YRD Urban Agglomeration that encompasses 26 cities, including the territory of Shanghai municipality, and parts of Jiangsu, Anhui and Zhejiang Province (The State Council of the P.R. China, 2016). Rather than administrative or economic factors, physical and cultural factors were in the foreground of this research as they have significantly shaped the landscape morphologies of this region. Therefore, the research area will be reduced to a typical physical and cultural geographical zone in the sense of a *drainage basin*[20], which we refer to as the Taihu Basin.

[19] The statistics are based on the results of searching Google Scholar with the keywords "the South of the Yangtze River" and "the YRD Region".

[20] Skinner and Baker (1977, p. 212) defined nine physiographic macroregions in nineteenth-century China by drainage basins: *Manchuria*, *North China*, *Northwest China*, *Upper Yangtze*, *Middle Yangtze*, *Lower Yangtze*, *Southeast Coast*, *Lingnan*, and *Yun-Kwei*.

Figure 4.4 The Evolution of Boundaries from the Tang Dynasty to Present

Source: Author's drawing, referring to the boundaries of the YRD region defined by Li (1991); Xu (2002); Tan (1982).

4.1.4 CULTURAL LANDSCAPE

The reclamation and impoldering in the YRD dates back to the 2nd century BC. The polder areas guarantee agricultural production, protect against floods, and promote the economic development and social stability of this region. The sizes and components of polders and the forms and patterns of the polder landscapes have undergone continuous transformation. The remaining historic polder landscape is characterized by diverse structures that consist of a sophisticated ensemble of landscape elements, such as canals, dikes, sluices, bridges, paddies, settlements, etc. It has high aesthetic value and promotes the regional identity with a poetic image of canal towns and a “land of fish and rice”.

Water, as the most dominant landscape element, has influenced the structures of cultural landscapes in the YRD region. The forms and patterns of water and polder systems are intimately related because the poldering activities, farming and hydraulic management have been mutually reinforcing. By means of a water morphology study of eight delta cities, we arrive at an overview of the diversity and density of water elements in the YRD (Figure 4.5).

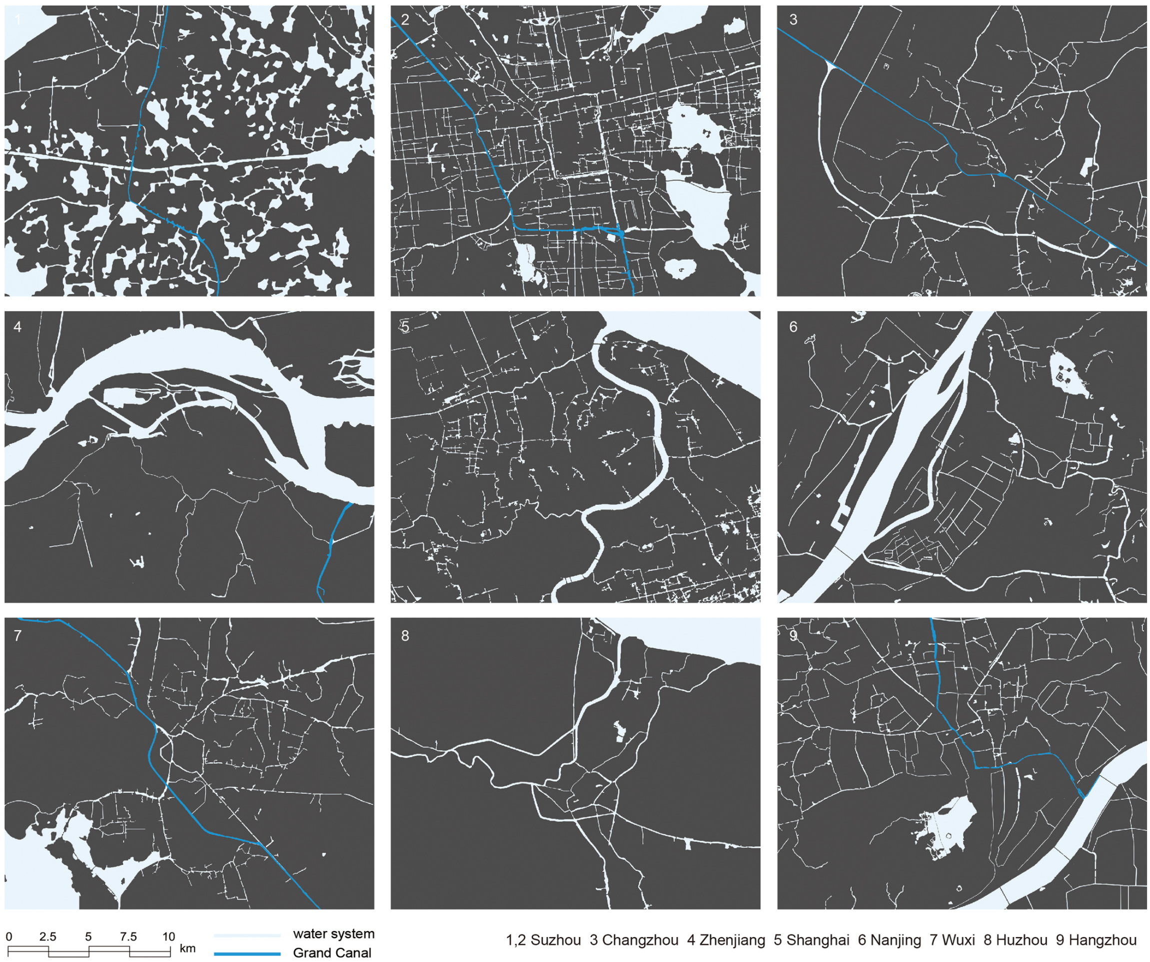


Figure 4.5 Water Morphology Study of Eight Delta Cities

Source: Author’s drawing. The water morphology study was conducted by mapping the water layer as captured by Google Maps 2013. The water layer of this region has low cartographic precision, and extracting the water layer using the image trace tool in Adobe Illustrator also causes a loss of detail.

The YRD has a unique hierarchical water system: a crisscrossed water network comprised of dense but short canals with low flow volumes and numerous lakes. There are many terms for rivers, canals, and lakes of different forms and sizes in this region (Table 4.1). Although the forms and locations of most water elements have been altered, the naming system of local villages, towns, and polders still reflects the names of these water elements.

Table 4.1 Hierarchical Water System in the Yangtze River Delta

Source: Adapted from Pei (2014, p. 35); Zheng (1987, pp. 269–274); ("Gang" 1999); Wu (2007). For the translation of Chinese terms see Appendix C.

Water System	Levels	Names	Description of Origins, Sizes and Forms
Lakes		*Hu*	Lake, such as Lake Taihu
		Dang	Shallow lake or marsh
		Dian	Shallow lake
		Yang	Small lake
Liner natural or artificial waterways including rivers, canals and creeks	I	*Jiang*	Natural major river, such as the *Wusong Jiang* and *Huangpu Jiang*
		He	Watercourse, both for natural and artificial; the artificial watercourses dug after the 1949 are called *He* (Pei, 2014, p. 35), such as the *Taipu He* and *Wangyu He*.
	II	*Tang*	A wide transverse canal with dikes on both sides, which is a combined system of water and road transportation (Tan, Song Dynasty), such as the *Di Tang* and *Shuanglin Tang*. In the Taihu Basin, *Tangs* are normally west-east transverse watercourses to join with the longitudinal ones. In the ancient *Tang-Pu* polder system, *Tangs* were about 60–100 m wide and distributed around every 3.5–5 km from each other (Zheng, 1987, pp. 269–274).
		Pu	A wide longitudinal canal that connects with major rivers, lakes and sea. In the ancient *Tang-Pu* polder system, *Pus* were about 60–100 m wide and distributed around every 2.5–3.5 km from each other (ibid.).
	III	*Gang*	A small canal that connects with larger rivers, lakes and sea ("Gang," 1999), such as the 72 *Gangs* in Zhenze, *36 Gangs* in Wujiang.
		Lou	Small canals that are densely distributed along the Taihu lakeshore as water inlets and outlets, such as the *38 Lous* in Wuxing.
	IV	*Jing*	Small creeks that were dug for boating and irrigation by breaking through the embankments of *Tang-Pu* polders; together with *Bangs* and *Lous*, form the branched water system of *Jing-Bang* polders.
		Bang	Like *Jings*, small creeks that are not mainly for navigation but intimately related to irrigation and everyday life (Wu, 2007).
		Lou	Small dead-end curving creeks, as the termini of the branched water system in the *Jing-Bang* polder system

4.1.5 URBAN SYSTEM

Among all metropolitan regions in China, the YRD region has the longest tradition of urbanization, the largest size, the most diversified economic base, and the highest population density. The historic urban system was characterized by a network of city and town cores connected by a sophisticated canal system (Figure 4.6). This urban system no longer exists as since the 1980s its urban cores have rapidly expanded to form a continuous stretch of urban clusters. Meanwhile, the past water-based urbanism has been replaced by the current road-based urbanism, and this leads to the deterioration of the historic canal system.

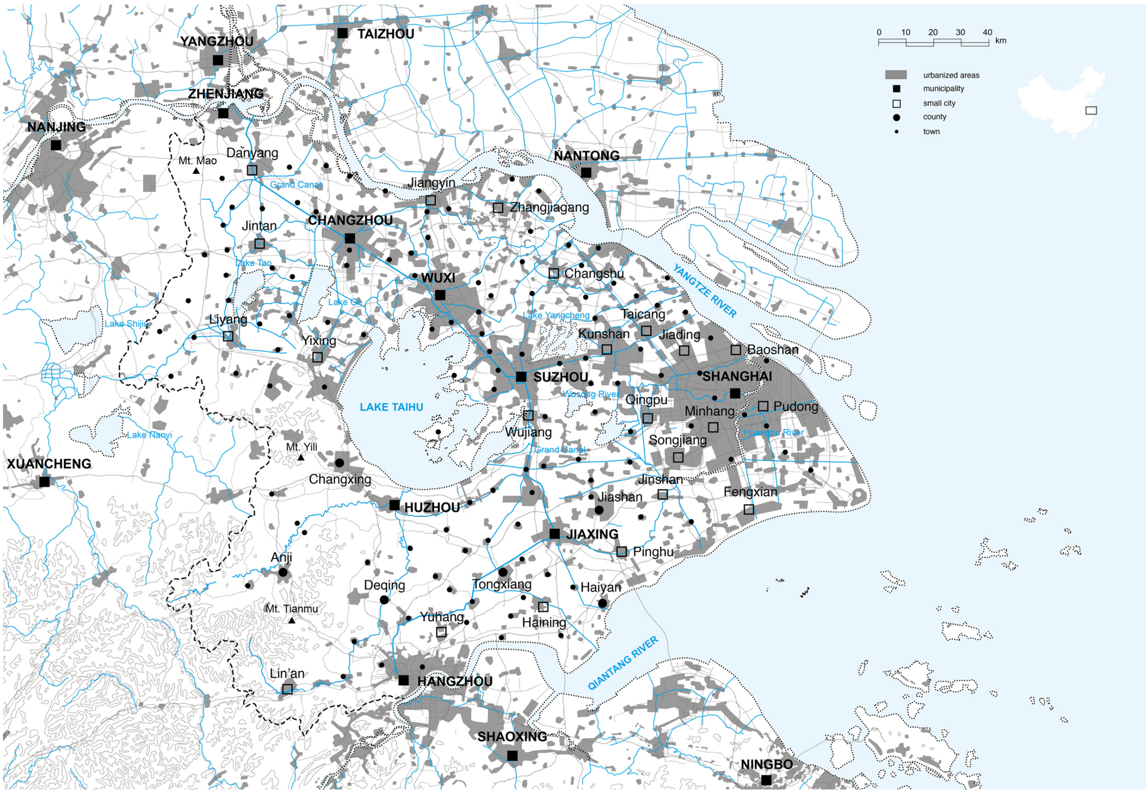


Figure 4.6 Distribution of Municipalities, Small Cities, Counties and Towns in the Yangtze River Delta Region

Source: Author's own map, 2015.[21] For enlarged version see Appendix A.

---

[21] The urbanized area, locations of cities, counties and towns were drawn according to Google Map 2015; the water system was drawn by mapping the water layer of maps from the *Changsanjiao dituwang* [Atlas of the Yangtze River Delta] 2015; the road network was obtained from Open Street Map 2015; the contour line layer was from the "DCW 1990 Countour Elevations" of the CHGIS dataset (Harvard Yenching Institute & Fudan Center for Historical Geography, 2007).

The contemporary urban system has Shanghai as the leading city, Nanjing, Hangzhou, Wuxi, Suzhou, and Changzhou as the other core cites, as well as the urban network of numerous small and middle-sized cities and towns. The advanced and efficient railway, highway and waterway systems, reaching all towns, market towns, and rural areas, maintain the intensive economic interaction between large cities and their peripheral areas (Zhou, 1991).

DELTA CITY SUZHOU

From the overview of the cultural landscapes in the delta region, we zoom in on a representative delta city, Suzhou, which used to be a major cultural and economic center, and has abundant cultural heritage and fascinating rural landscape.

Suzhou is located in the alluvial plain of the Taihu Basin, with an average elevation of 3–4 m, and is particularly vulnerable to flooding and waterlogging. It has a long tradition of land reclamation and intensive agriculture. Suzhou used to hold a prominent position in South China due to its highly productive rice and fish farming, prosperous silk industry, and especially its convenient location for water transport and trade along the Grand Canal (UNESCO World Heritage Site, 2014). However, Suzhou has lost its leading position because of the booming development of Shanghai since the early 20th century and the decline of inland water transport in the modern era (Gu, Hu, Zhang, Wang, & Guo, 2011).

Cultural heritage such as the old town with its classic gardens (UNESCO World Heritage Site, 1997) and canal towns constitute the historic urban landscape. The polder landscape, as the most typical rural landscape in this region, is a sophisticated ensemble of landscape elements such as (paddy) fields, roads, canals, dikes, trees, and settlements. Its visual appearance is determined by the morphologies of water systems, including natural rivers and lakes as well as artificial networks of canals, waterways and ditches. These water systems function as an irrigation system and are simultaneously used for flood control and water transport.

4.2 MORPHOGENESIS OF CULTURAL LANDSCAPES: FROM THE HISTORIC POLDER LANDSCAPE TO THE METROPOLITAN DELTA LANDSCAPE

In this section, the temporal-spatial morphogenesis of the cultural landscapes in the YRD region from the Neolithic Period to the contemporary era is illustrated in terms of land reclamation techniques, water conservancy, land use systems, and urbanization/industrialization. We describe how these factors have been driving the morphogenetic, functional as well as technical and cultural changes of polder systems that are expressed in forms and structures.

4.2.1 NEOLITHIC PERIOD TO SUI DYNASTY (–618 AD)

The discovery of Neolithic sites shows that people settled this region and started rice farming 6,000 years ago (Zheng, 1987). The reclamation of the lowlands dates back to the late Spring and Autumn Period (770–476 BC); during the Warring States period to the Han Dynasty (475 BC–220 AD), this region has seen a successive expansion of sparsely distributed polders of a primary form (Gao & Han, 1999; Miao, 1982) (Fig. 4.7-8). The construction of the Jiangnan Canal (the south section of the Grand Canal) for military use during the Wu, Qin and Han Dynasties created conditions conducive to reclaiming the area along the east Taihu lakeshore (Miao, 1982) (Fig. 4.9). During this period, the *Song* (current Wusong River), *Lou* and *Dong Jiang* were the three main rivers that drained runoff from Lake Taihu eastward to the sea (Zheng, 1987) (Fig. 4.10).

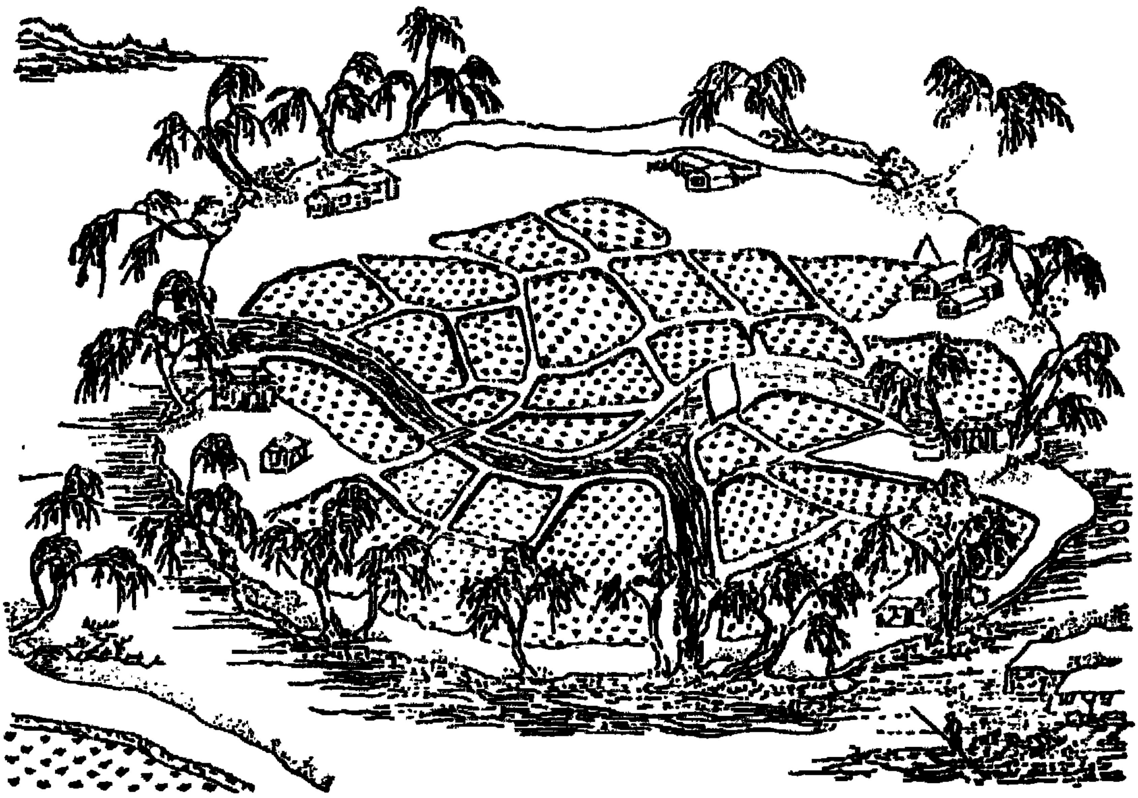


Figure 4.7 Primary Form of Reclaimed Fields

Source: Retrieved from E (Qing Dynasty).

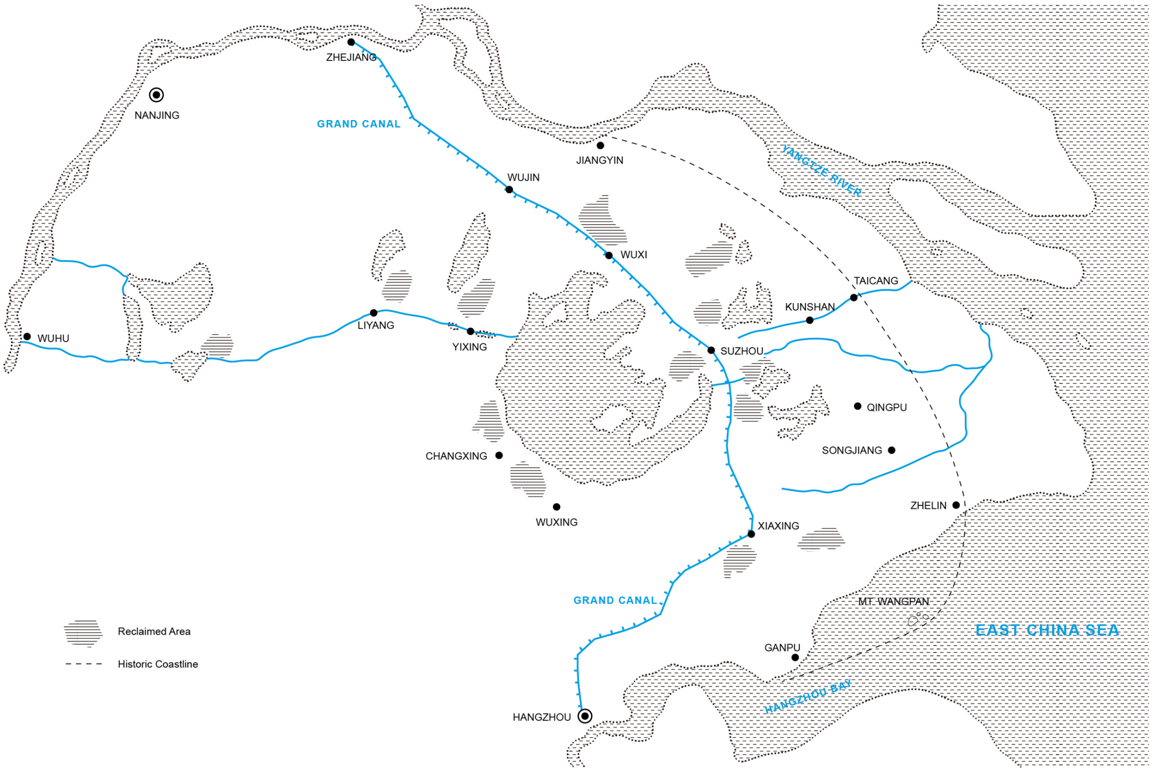


Figure 4.8 Distribution of Reclaimed Areas in the Han Dynasty

Source: Author's drawing adapted from Zheng (1987, p. 78).

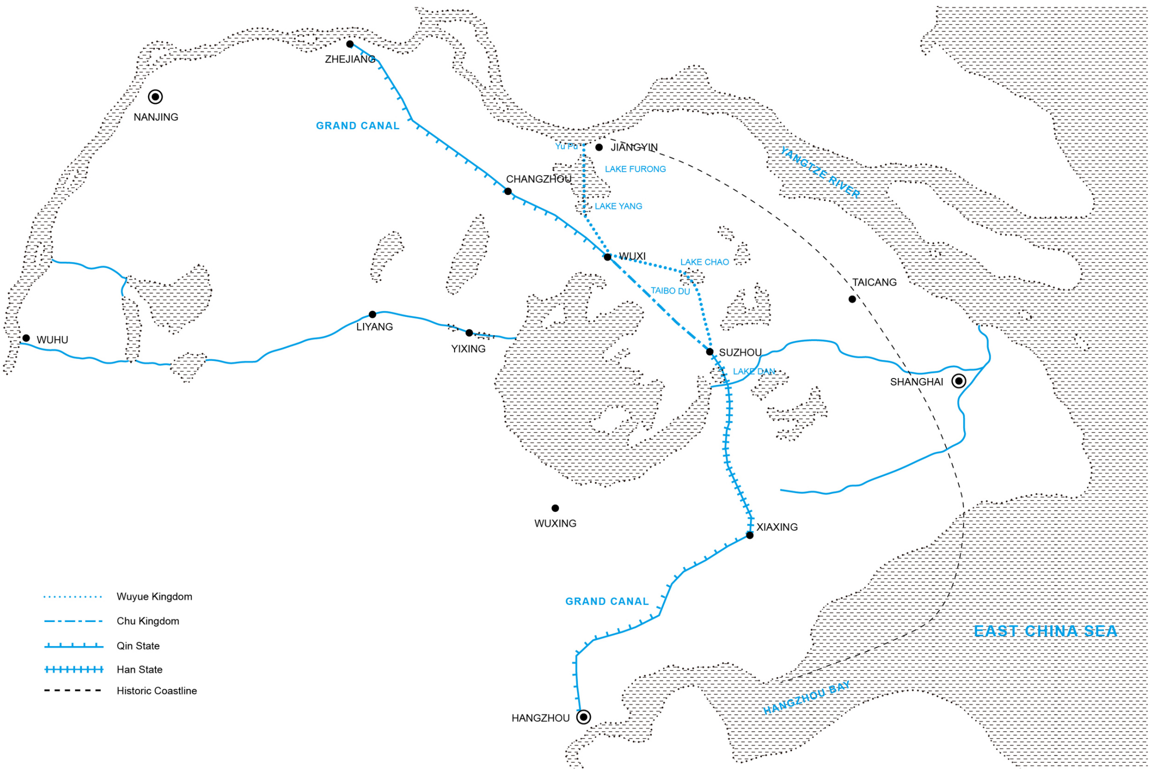


Figure 4.9 The Construction of the Jiangnan Canal during the Spring and Autumn Period to the Han Dynasty (770 BC-220 AD)

Source: Author's drawing adapted from Zheng (1987, p. 167).

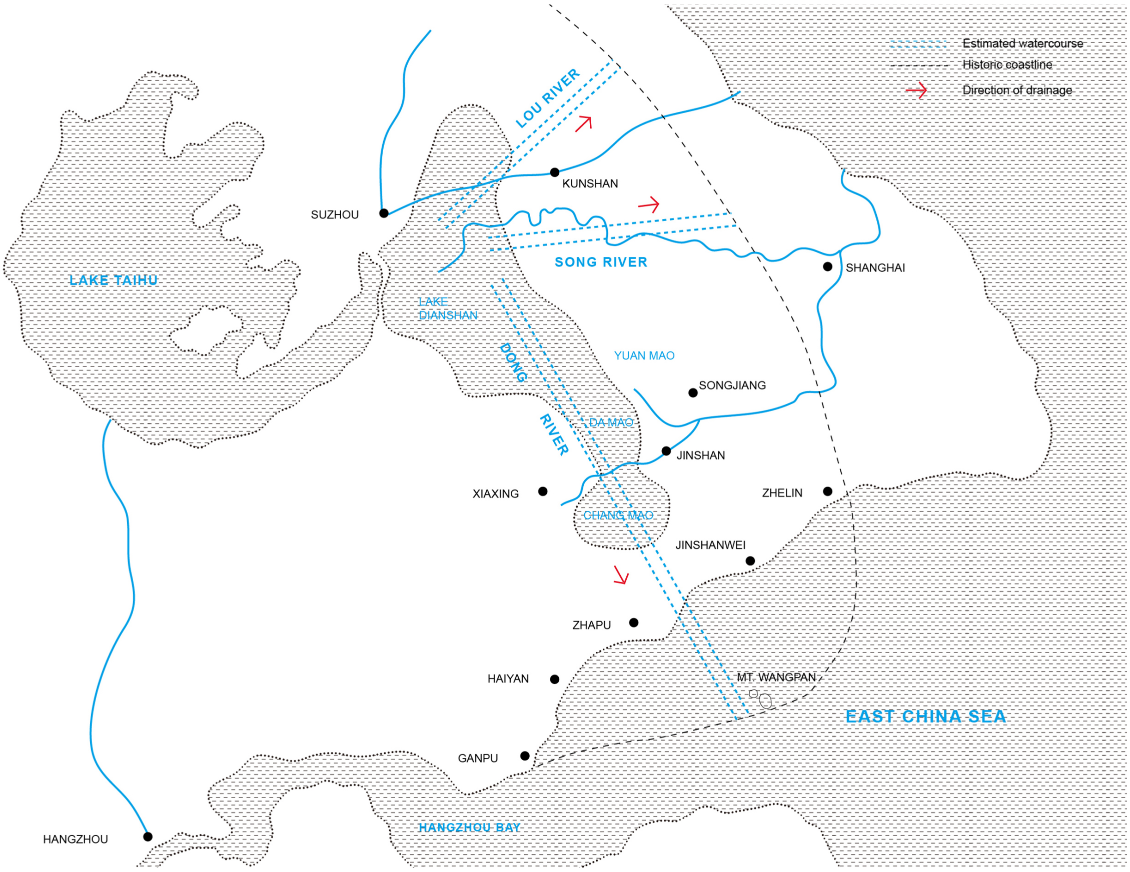


Figure 4.10 Distribution of the Song, Lou and Dong River

Source: Author's drawing adapted from Zheng (1987, p. 23).

4.2.2 TANG DYNASTY TO FIVE DYNASTIES AND TEN KINGDOMS (618–960)

Since the Tang Dynasty (618–907), the reclaimed polder areas in the Taihu Basin had substantially expanded due to the increasing migration from North China and the consequent booming development of agriculture and water conservancy. Also, the Taihu Basin has been the largest silk weaving center in China since this period. All these regional developments led to a shift of the economic center from North to South China.

HYDRAULIC DEVELOPMENT

This period is often referred to as the golden age of hydraulic development in the Taihu Basin (Huang, 1990). The coastal and lakeshore dike systems boosted the development of the *Tang-Pu* polder system: The construction of a seawall system from Haining to the south bank of the Wusong River made an extensive reclamation from the sea possible; the diking along the south Taihu lakeshore shaped the canal-road system (*Tanglu*)[22] and allowed the reclamation from marsh, drainage, and secure water transportation (Zheng, 1987). For the water system, the main drainage river, the *Lou Jiang*, gradually silted up and disappeared altogether in the 8th century and instead the 36 *Pus* drained the runoff northeastward to the sea in a decentralized way; the Dong River also silted up in the 8th century and most of the *Pus* and *Gangs* that drained water southeastward to the sea were blocked up due to the construction of the coastal dike system (ibid.).

EMERGENCE OF THE TANG-PU POLDER SYSTEM

During the 2nd to 10th century, a well-planned polder system transformed from the primary enclosed fields under the ancient land use system "*Tuntian zhi*" (Miao, 1982; Wang, 1989). The *Tuntian* system was a state-promoted agricultural system, by which the local government planned and implemented the mass reclamation and water conservancy construction by assigning the intensive labor to the military and local peasants.

A "big polder" (*Dawei*) system, the *Tang-Pu polder* (*Tangpu weitian*) system, came into shape after the mid Tang Dynasty (ca. the 8th century) (Miao, 1982; Wang, 2013, p. 60; Zheng, 1987). During the 10th century, this polder system was further developed, completed and consolidated by the Wuyue Kingdom in a unified, combined water and polder management system (Miao, 1982) (Figure 4.11). The empire set up a specific hydraulic authority and assigned the military to dredge canals, to build and maintain dikes, sluices and bridges, and to plant trees in different hydraulic zones (ibid.). Land reclamation from lakes and rivers during this period was prohibited. All these attempts guaranteed the stability of water and polder systems and enabled long-term and sustainable flood management.

This *Tang-Pu* polder system was characterized by large polder size, a chessboard-like water network, high dikes, and wide canals of *Tangs* and *Pus* as the boundaries. One polder occupied approx. 800 to 1,800 ha: The wide transverse *Tangs* (*Hengtang*) were built every 3.5 to 5 km apart from each other, and the longitudinal *Pus* (*Zongpu*) were built every 2.5 to 3.5 km; *Tangs* and *Pus* were around 60 to 100 m in width; they were 6.7 to 10 m in depth and with dikes of around 3.3 to 6.7 m in height, which was 1 to 3.3 m higher than the flood water levels[23] (Miao, 1982; Zheng, 1987). These polders were as large as big cities, and had rivers and waterways within, and gates and sluices at the marginal dikes. The picturesque image of the agricultural landscape in the YRD region emerged during this period (Wang, 2010). It was

---

[22] The canal-road system of *Tanglu* was composed of a canal and dikes on both sides.

[23] The numbers of width, depth and height were recalculated by the author by transferring the traditional Chinese measurement unit, the *Zhang* to the metric scale. One *Zhang* is equivalent to 3.3 meters.

an open landscape with wide networked canals, high dikes planted with willows, paddy fields, and groups of settlements with white walls and black tiles. This landscape had high aesthetic value and was described and appreciated in literature, paintings, and poems.

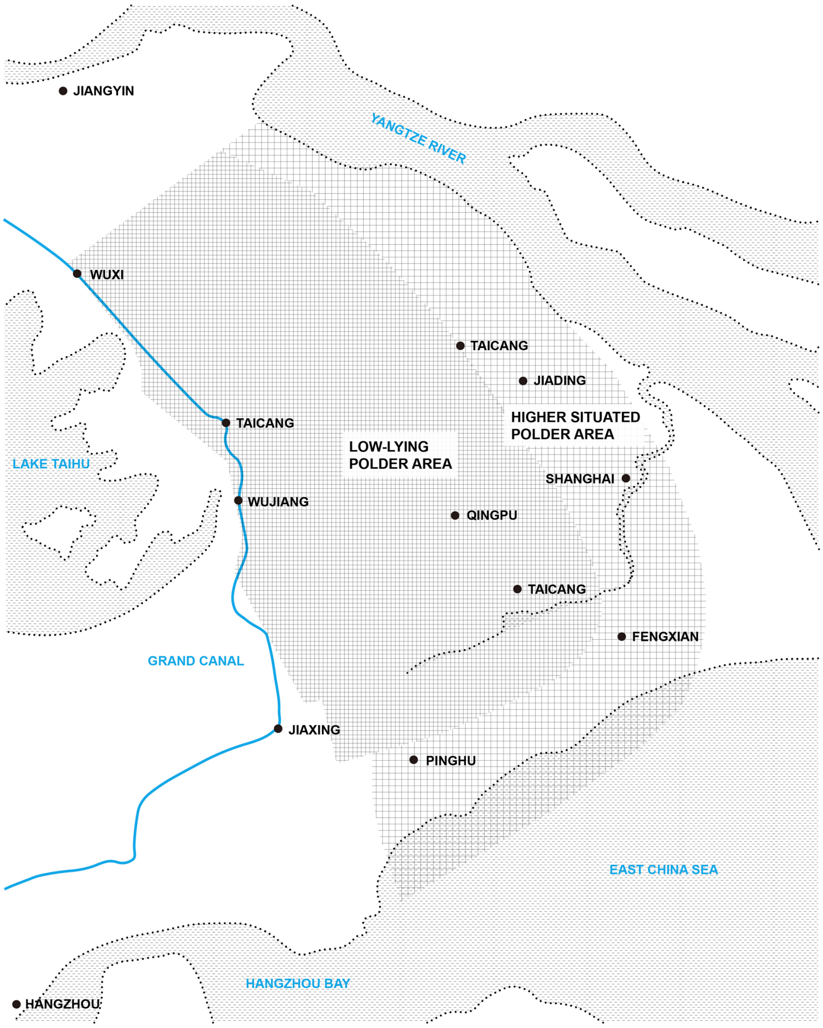


Figure 4.11 Distribution of the *Tang-Pu* Polders in the Wuyue Kingdom Period

Source: Author's own map adapted from Zheng (1987, p. 85). The *Tang-Pu* polder areas included the low-lying and higher elevated polder areas that were distributed in the longitudinal zone in-between current Shanghai and Suzhou.

EMERGENCE OF THE LOU-GANG POLDER SYSTEM

"*Lougang*" is a local term referring to the small densely distributed watercourses that discharge water into or out of Lake Taihu. The hydraulic projects of *Lougangs* and their related polders were mainly built along the west, south, and east lakeshore of Lake Taihu (Figure 4.12). The development of the *Lou-Gang polder* (*Lougang weitian*) system was accompanied by the embankment construction of Lake Taihu: The diking along the southeast lakeshore from Wuxing to Changxing during the 5th century BC to 3rd century AD and the construction and strengthening of the *Di Tang* from Changxing to Pingwang during the 3rd to 8th century shaped the south embankment of Lake Taihu; the southeast embankment from Wuxing to south Suzhou formed along with the construction of the *Wujiang Tanglu* since the 8th century (Deng et al., 2016; Miao, 1982) (Figure 4.13). The diking activities shaped the whole south embankment of Lake Taihu. Its continuous improvement greatly promoted the flood control, reclamation and agricultural production, water transportation, and living conditions in this region.

The reclamation from the mudflats along the Taihu lakeshore simultaneously shaped the *Lou-Gang* polder system around the 8th century (Deng et al., 2016). It was composed of polders and their irrigation and drainage systems, including *Lougangs*, *Tangs*, embankments, mulberry fields, fishponds, sluices, and crisscrossed ponds and lakes. The *Lougangs* were perpendicular to the lakeshore, and were built at intervals of several kilometers to connect the water flow from Lake Taihu with the wide *Tangs* for irrigation and water transportation in those newly reclaimed areas (China's Agricultural Heritage Research, 1990).

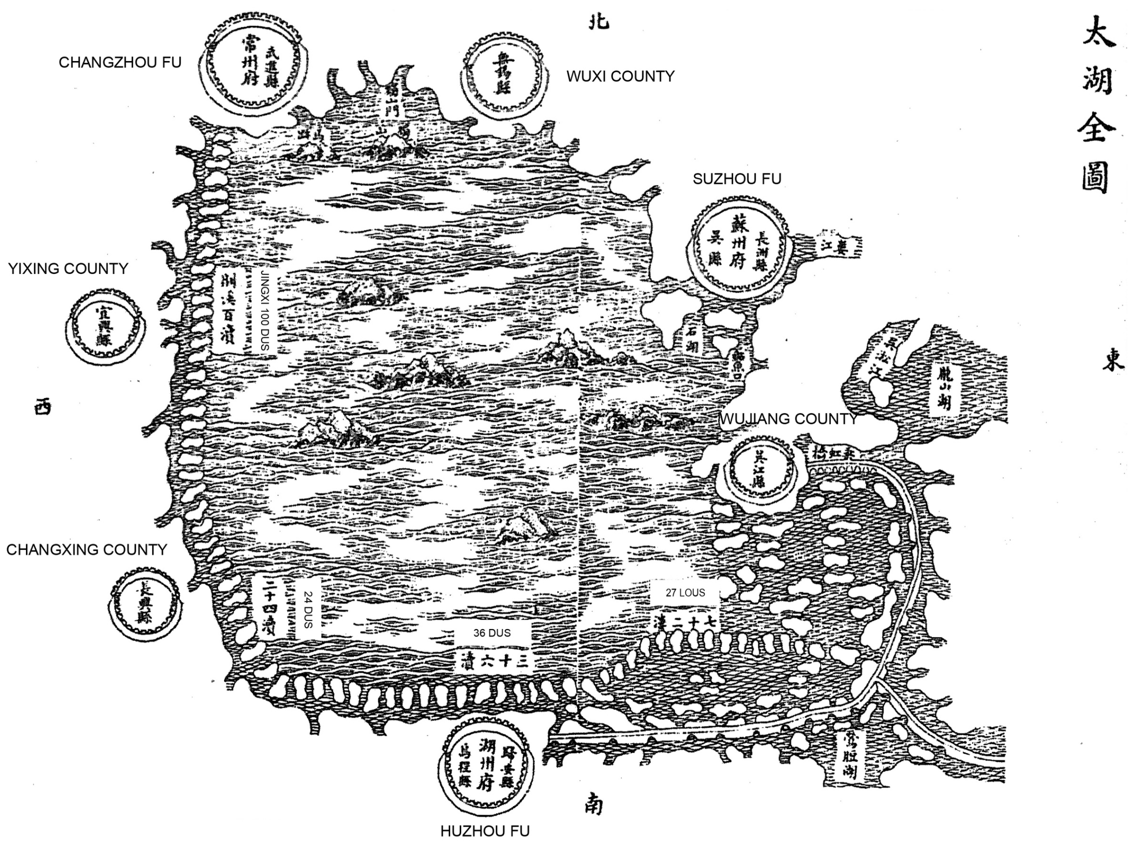


Figure 4.12 *Long-Gang* Polder System along the Taihu Lakeshore

Source: Diagram reproduced from Zhang (Ming Dynasty-a) and labels translated by the author.

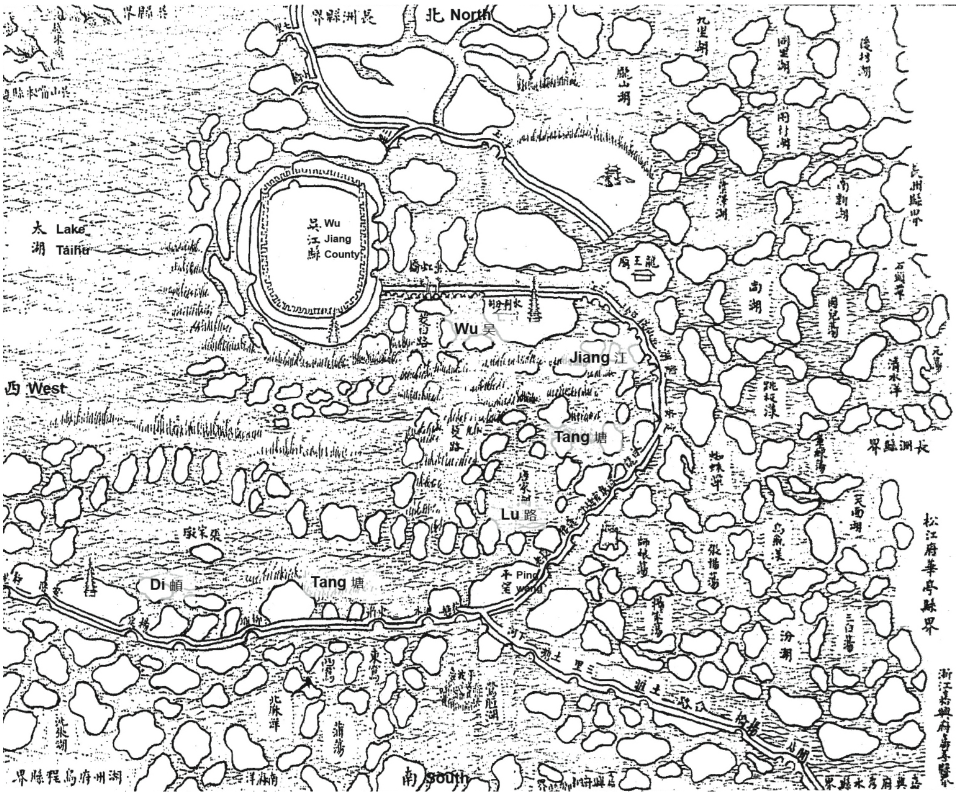


Figure 4.13 Hydrological Map of Wujiang County, *Wujiang Tanglu* and *Di Tang*

Source: *Wujiangxian quanjing shuilitu* [Hydrological Map of Wujiang County] reproduced from Zhang (Ming Dynasty-b, p. 18); translations added by the author.

4.2.3 NORTHERN SONG TO YUAN DYNASTY (960–1368)

WATER CONSERVANCY, AGRICULTURE, AND EARLY INDUSTRY AND TRADE

Since the Song Dynasty, the population had grown rapidly as the capital city moved southward from Kaifeng to Hangzhou because of domestic wars. From the late Song to Yuan Dynasty, the population of the Jiangnan region[24] had proliferated from 2.7 million to 10.5 million (Lu, 2006a). The population pressure of migrants intensified deforestation and mass reclamation from lakes and rivers, resulting in chaos and conflicts in maintaining water conservancy in this region (Huang, 1990).

The main drainage river, the Wusong River gradually silted up during the Song Dynasty because of uncontrolled reclamation and siltation of lakes and canals (Zheng, 1987).

[24] The Jiangnan region here includes the seven delta cities of Suzhou, Songjiang (current Shanghai), Changzhou, Zhenjiang, Hangzhou, Jiaxing and Huzhou.

Therefore, flooding, waterlogging and droughts occurred much more frequently during the 11th to 20th century than in the 10th century (Jiangsu Department of Water Resources, 1976). The hydraulic management of this period focused on dredging the Wusong River and the Dianmao lakes area as well as the *Pus* connected to the Wusong river to drain the floodwater of Suzhou, Songjiang (current Shanghai) and Jiaxing to the sea (Miao, 1982). New regulations for polder management were set, including the height, width, and gradient of polder embankments (Fang, Wang, & Xue, 1997; Zheng, 1987). All these attempts alleviated the decline of the *Tang-Pu* polder system. In the meantime, the agricultural development boosted early industry and trade, and since the Yuan dynasty, the Taihu Basin became the primary production region of grain and textile and the economic center of South China (Deng et al., 2016; Gu et al., 2011). New sections of the Grand Canal were constructed to connect the new capital Beijing with the Taihu Basin to transport grain, tea and silk (Figure 4.14).

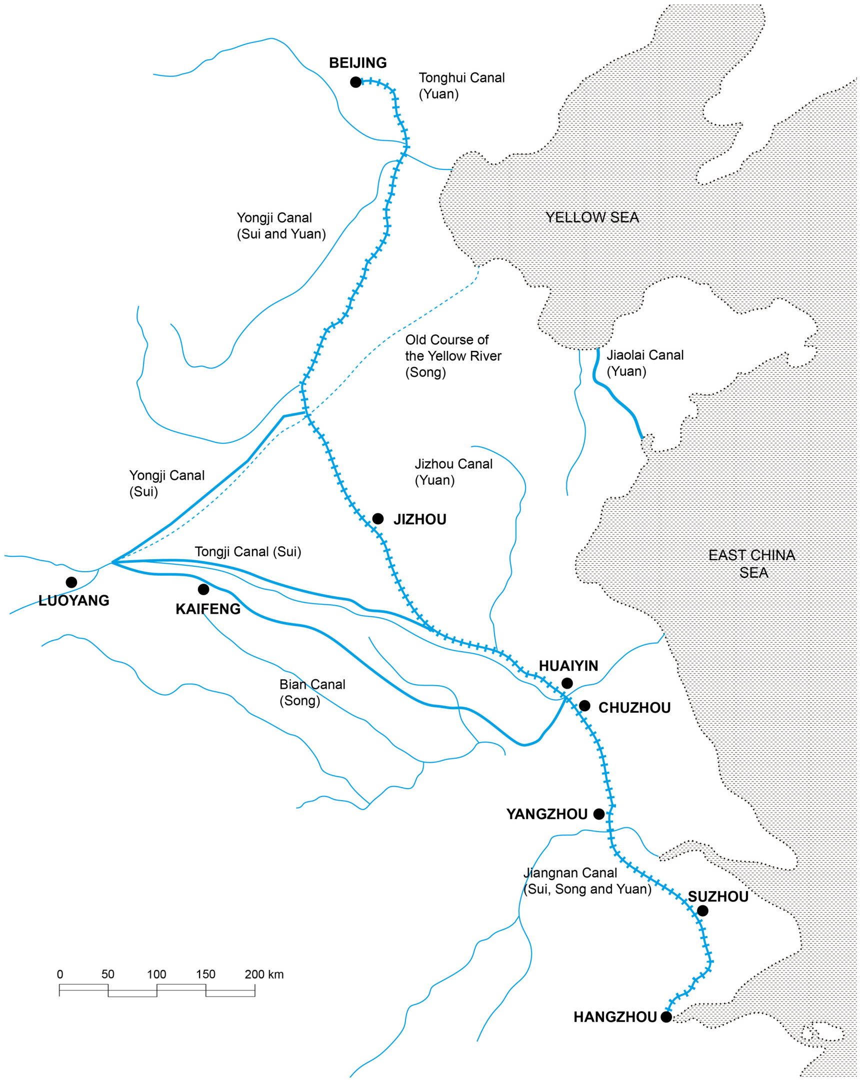


Figure 4.14 Route of the Grand Canal

Source: Author's map adapted from Yu, Li, Li, and Zhang (2012, pp. 5-6).

EMERGENCE OF THE JING-BANG POLDER SYSTEM

From the Song Dynasty onwards, the hydraulic management system of the Wuyue Kingdom was abolished (Zheng, 1987). The centralized land use system was replaced by a household based agriculture production system, in which tenant farmers rented state-owned land held under lease by landlords (Jiang, 1981). The change in land use system made the maintenance of the big polder system difficult with consequent conflicts between tenants. Large *Tang-Pu* polders were thus divided into smaller polders, and the dikes, sluices and canals were destroyed by chaotic reclamation and lack of maintenance (Zheng, 1987). These changes in population, land use, and hydraulic management led to the decline and collapse of the *Tang-Pu* polder system. Consequently, the big polder system transformed into a "small polder" (*Xiaowei*) system, namely the *Jing-Bang* polder (*Jingbang weitian*) system[25], which was characterized by small-sized polders and a fragmented water system in a branched canal structure constituted by *Jings* and *Bangs* as well as the curving cul-de-sac *Lous* (Wang, 2009).

4.2.4 MING TO QING DYNASTY (1368–1911)

DEVELOPMENT OF WATER CONSERVANCY

During the Ming and Qing Dynasties, the management of water conservancy focused on regularly dredging the Wusong River and other canals and on maintaining the weirs, sluices and dikes. However, the flooding and drought issues in the Taihu Basin were not effectively addressed. The main drainage watercourse for floodwater in the Taihu Basin changed from the Wusong River and Liu He to the Huangpu River, which, however, did not have sufficient capacity to drain a large amount of storm water (Miao, 1982). Flood control and polder management were separated. The polders were divided into smaller plots (around 200 to 500 ha in the Suzhou area, in 1432), and the canal system became disorganized, which lead to poor drainage and flood protection (Zheng, 1987). Furthermore, deforestation and soil erosion destroyed most lakes for water retention in the upper reaches of Lake Taihu, resulting in even more severe flooding in the plain area (ibid.).

DEVELOPMENT OF THE SMALL POLDER SYSTEM

The small polder system persisted throughout the Ming and Qing Dynasties. The size of

---

[25] Referring to the naming of the *Tang-Pu* polder system, the author named this small polder system as *Jing-Bang* polder system, adapting from the name of its canal system, *Jing-Bang system* (Wang, 2009).

small polders in the Ming Dynasty ranged from several hectares to 140 (Atsutoshi, 1982). The restoration and maintenance of the polder system were highly valued and implemented with more advanced hydraulic techniques in both flood protection and drainage.

For example, the new hydraulic technique of polder management was well applied in the case of the Furong Polder (Figure 4.15). The Furong Polder, whose altitude decreased from the border to the middle, was built in the mid-15th century in the territory of current Wuxi and was around 4,300 ha. This polder had a hierarchical dike and sluice system to divide fields into separated zones according to elevation, and to control the different water levels of the separated zones; it also included a water surface accounting for 25% of the total land surface composed of lakes, ponds, and canals to improve the water retention and drainage conditions (Zheng, 1987).

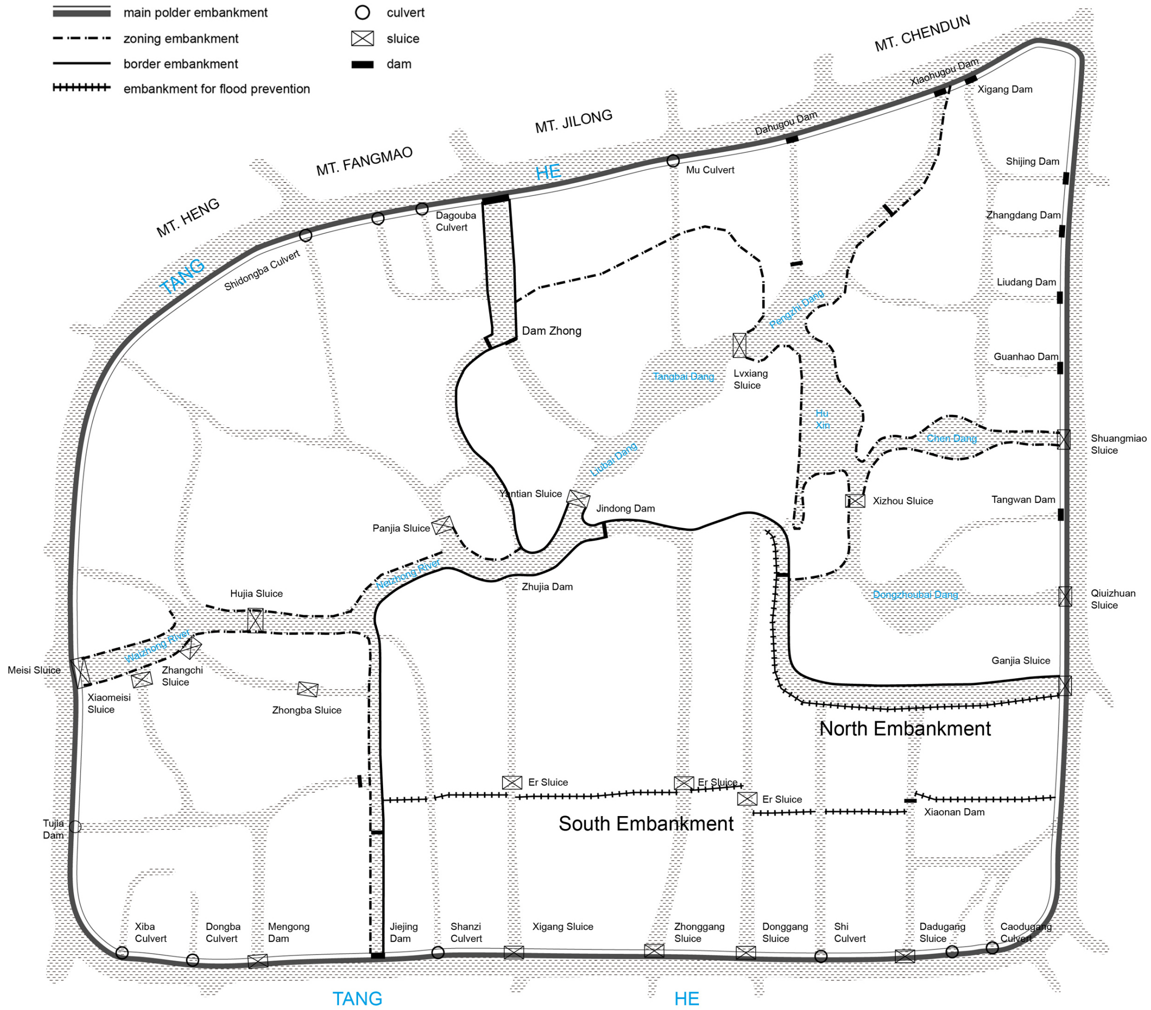


Figure 4.15 The Structure of the Furong Polder

Source: Author’s drawing adapted from Zheng (1987, p. 127).

The area situated in the west of the *Wujiang Tanglu* was progressively silted and transformed into dry land, while the eastern shore of Lake Taihu gradually formed (Miao, 1982). The *Lougangs* became denser and longer along with the continuous reclamation towards Lake Taihu over time. There the 100 *Dus* in Jinxi (water inlets) along the west lakeshore had existed since the North Song Dynasty, the 36 *Gangs* in Changxing and 38 *Lous* in Wuxing (both inlets and outlets) in the early Ming Dynasty, and the 18 *Gangs* in Wujiang (water outlets) and 72 *Gangs* in Zhenze (both inlets and outlets) formed after the Mid Ming Dynasty (Zheng, 1987) (Figure 4.16).

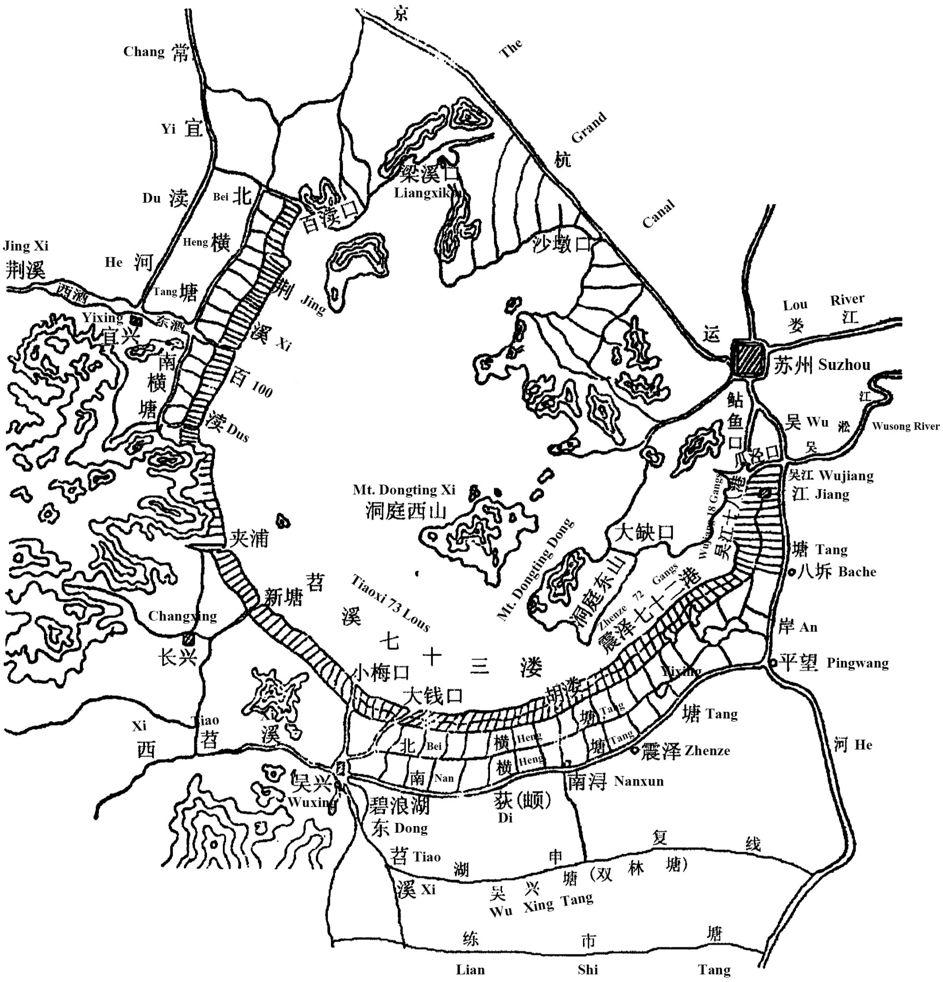


Figure 4.16 Distribution of *Lou-Gang* Polders along the Taihu Lakeshore

Source: Reproduced from Zheng (1987, p. 97), labels translated by the author.

EMERGENCE OF THE HU-DANG POLDER SYSTEM

During the 14th to early 20th century (Ming and Qing Dynasties), continuous reclamation in the very low-lying lake plain of the east Lake Taihu (the current south Suzhou, Huzhou and Jiaxing area) formed a new type of polder named *Hutian* or *Dangtian* (literally meaning “lake field") (Wang, 2012; 2013, p. 423). This *Hu-Dang* polder (*Hudang weitian*) system[26] is also one type of the small polder systems, which differs from the *Jing-Bang* polder system in the shape of water bodies, polder patterns and plant coverage.

These *Hu-Dang* polders, like islands, were separated land units surrounded by a large water surface and were vulnerable to floods. The elevation of these polders normally decreases from the border to middle. At the beginning of poldering, these areas were planted with reeds and other aquatic plants, which were further developed with rotation farming of rice and dry crops, and later on became highly productive paddy fields (Wang, 2013). The marginal dikes of these *Hu-Dang* polders were planted with mulberry trees to feed silkworms, which together with fishponds and paddies formed an integrated agriculture system. Rice, aquatic plants, mulberry, and typical dike trees (such as willows) along the canals and lakes formed a diverse vegetation landscape and ecosystem (Wang, 2012).

BOOMING URBANIZATION AND TRADE

The population of the Jiangnan region grew steadily during the Ming and Qing Dynasties, from 8.9 million in 1391 to 27.9 million in 1851 (Ge, 2000). The pressure of population growth, limited arable land, and heavy tax greatly promoted the production of cash crops, local textile industries, and trade, which in turn boosted urbanization. During this period, Suzhou and the other delta cities formed the most prosperous region in China, and became one of the birthplaces of China's commodity economy (Gu et al., 2011).

During the Ming Dynasty, the basic sizes and distribution patterns of cities, towns, and country markets (*Shi*) in the Taihu Basin had formed (Gu et al., 2011; Lu, 2006b). During the Qing Dynasty, the number of country markets increased, and some were upgraded to towns (Gu et al., 2011). A multi-level urban system including fortified cities, center towns, local towns, and country markets was developed around Suzhou and Hangzhou (ibid.) (Figure 4.17). This hierarchical urban system fits Christaller's central place model (Christaller, 1966), and had a hexagonal pattern according to the service radius of markets and commute time by water transport (Lu, 2006b; Lu & Dong, 2005; Skinner, 1964, 1965) (Figure 4.18). These major delta cities were fortified with moats and walls for military defense, water transport and flood control, and canals running through the city divided land into sections connected by bridges (Figure 4.19). The markets and towns were built with stores and residences in pivotal points of canal networks to have easy access to water transport and to trade. Thus, settlements distributed spatially related with canals, and three patterns of linear, cross (hash), and networked were discovered (Huang & Li, 2011) (Fig. 4.20).

[26] The name *Hu-Dang polder system* was created by the author by combining *Hu* and *Dang* fields and also by referring to the name of the lake plain area in east Lake Taihu, which is referred to as the *Hu-Dang* Zone.

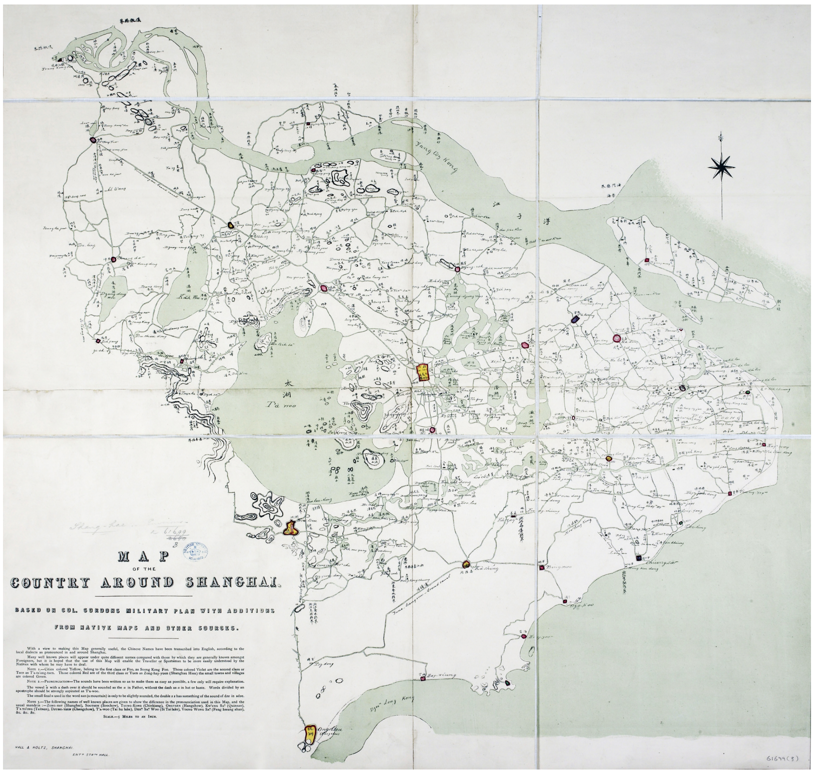


Figure 4.17 Fortified Cities, Towns and Country Markets in the Yangtze River Delta in 1864
Source: Retrieved from the open source collection of Virtual Shanghai ("Map of the country around Shanghai," 1864).

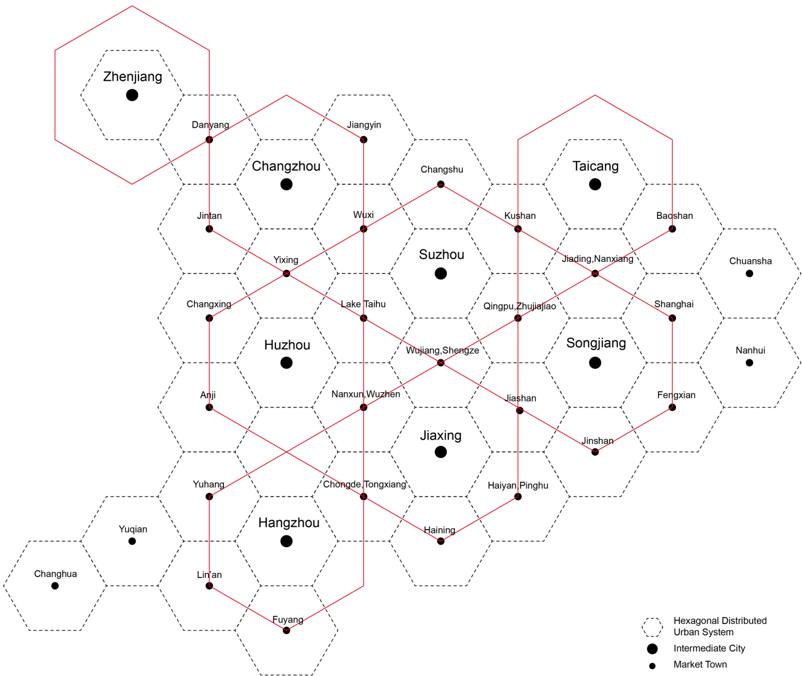


Figure 4.18 Hierarchically Hexagonal Pattern of the Urban System in the Yangtze River Delta Source: Author's drawing adapted from Lu (2006b, p. 32).

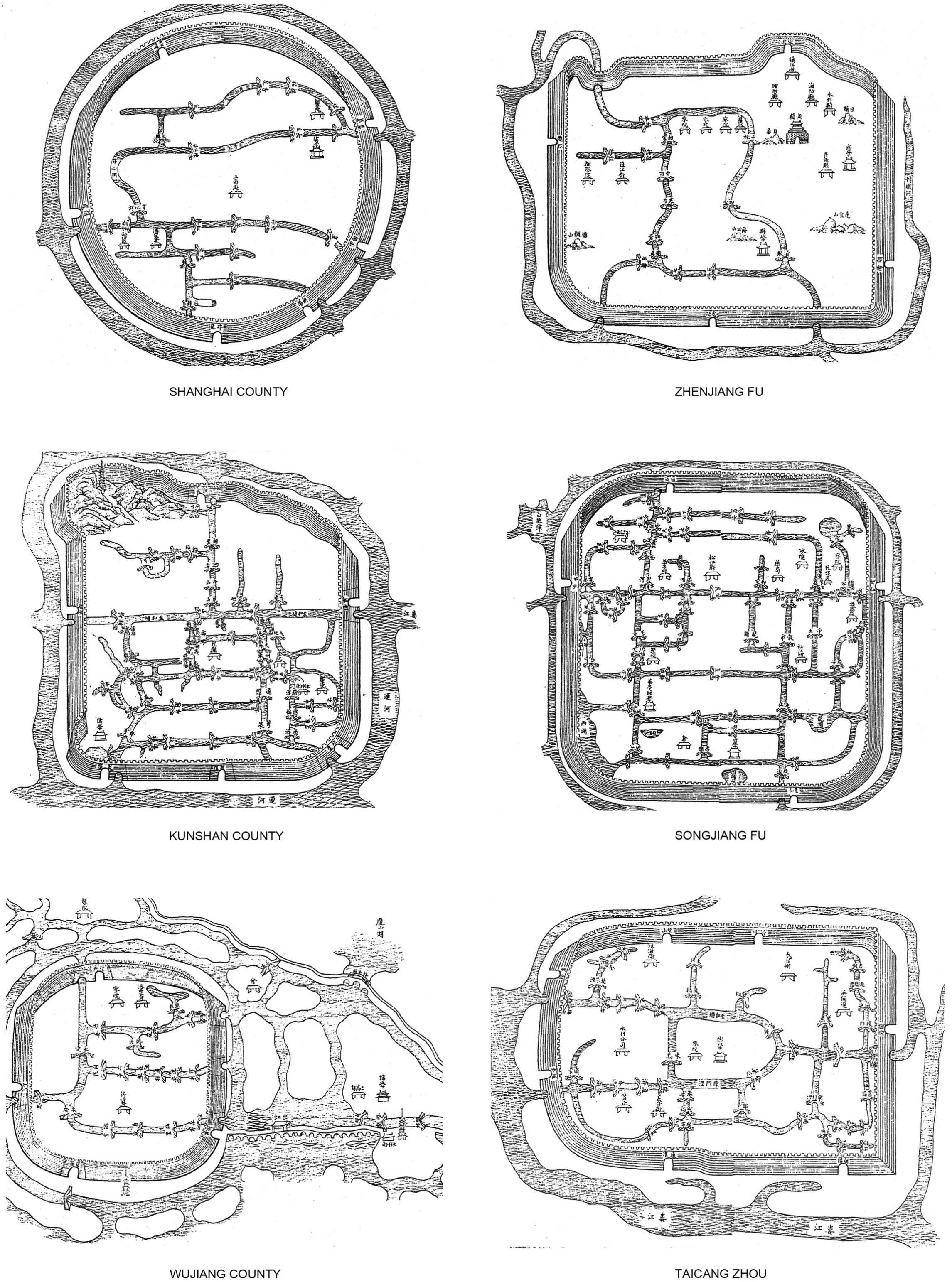


Figure 4.19 Water Systems of Six Delta Cities in the Yangtze River Delta in Qing Dynasty

Source: Adapted from Zhang (Ming Dynasty-b) with author's labels added.

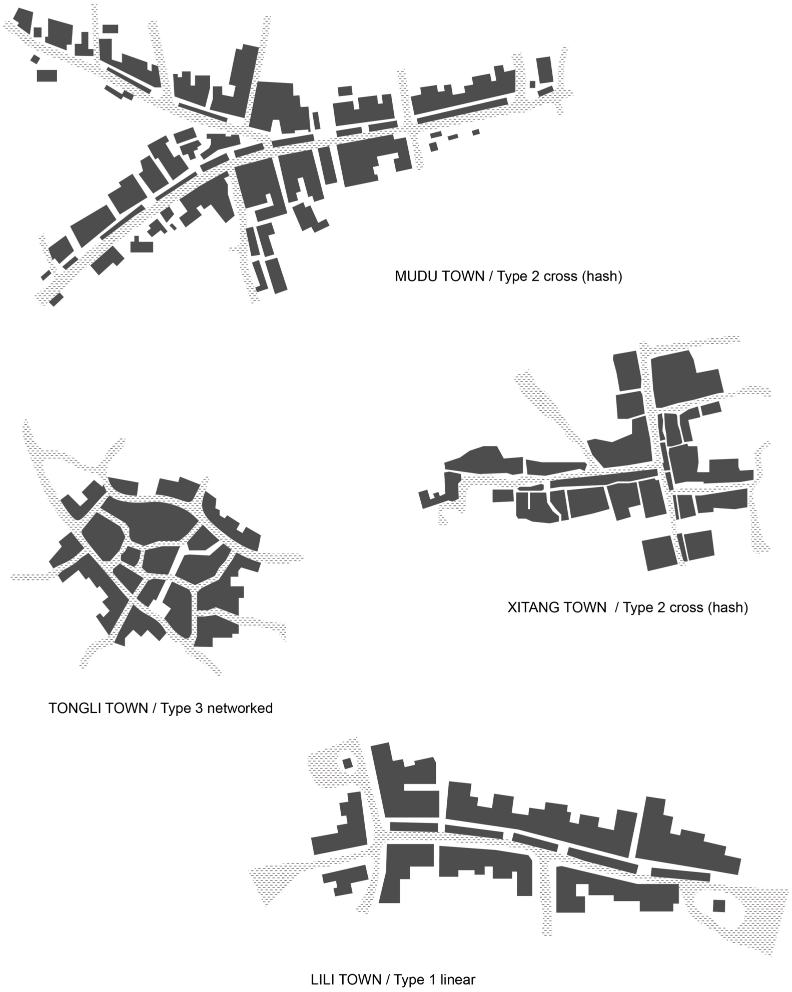


Figure 4.20 Three Water-related Settlement Patterns in the Yangtze River Delta

Source: Author's drawing referring to settlement patterns adapted from Duan, Ji, and Wang (2002, p. 193); Huang and Li (2011, p. 113).

4.2.5 REPUBLIC OF CHINA (1912–1949)

PATTERN OF THE HU-DANG POLDER SYSTEM

During this period, the remaining *Hu-Dang* polders in the lake plain area called *Yulin wei* (meaning "fish scale" shaped polder), were vulnerable to flooding. In Wujiang County of Suzhou, there were 2,948 fish scale polders in 1949, usually less than 70 ha (Wang, 2006; Zhang & Wu, 2012) (Figure 4. 21). Every individual polder has its own name. The sizes and forms of polders vary according to the distribution and patterns of the surrounding lakes and watercourses. The settlements are normally distributed on the embankments owing to their higher elevation and for convenient water transport. The patterns and structures of *Hu-Dang* polders can be illustrated by Fei Xiaotong's famous case study of the Kaihsienkung village (Fei, 1939). The territory of this village had an area of 204 ha and covered 11 polders (two shared with neighboring villages). It is situated at the junction of three streams, whose dwellings are on the embankments of four polders. The layout of the Xichang Polder of this village was mapped (Figure 4.22), illustrating the pattern and farming system of this kind of polder: The landform of this polder was lower in the middle and higher at the margin to allow water supply from the marginal areas to the middle; common irrigation ditches were dug to bring water from outside to inner fields and ran through each strip of the plots; dikes were constructed parallel to the margin, which had 10–30 m wide areas for mulberry planting, and the wider parts of embankments also provided space for settlements; pumps were built on the embankments to bring the water from the lower ditches to the higher elevated paddy fields; each small plot in the fields was divided by ridges and was level to allow even irrigation; most of the fields were planted with rice from June to December, and after harvest, fields with better drainage conditions might be planted with wheat or rapeseed (ibid.).

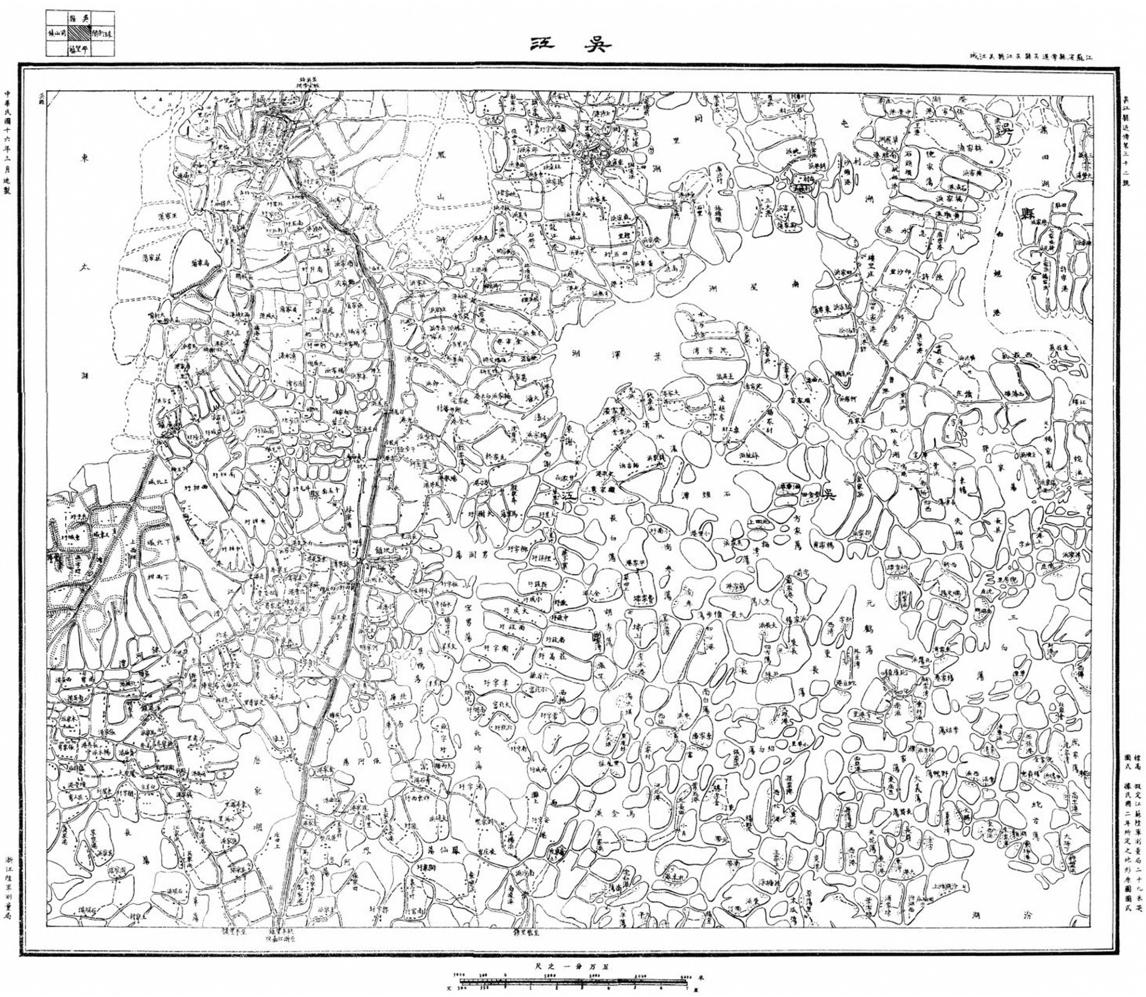


Figure 4.21 Fish Scale Polders in Wujiang County, 1927

Source: Retrieved from Sokuryobu (1986), published in the 1:50,000 Map Collection of Mainland China, Vol.1; original scale 1:50,000.

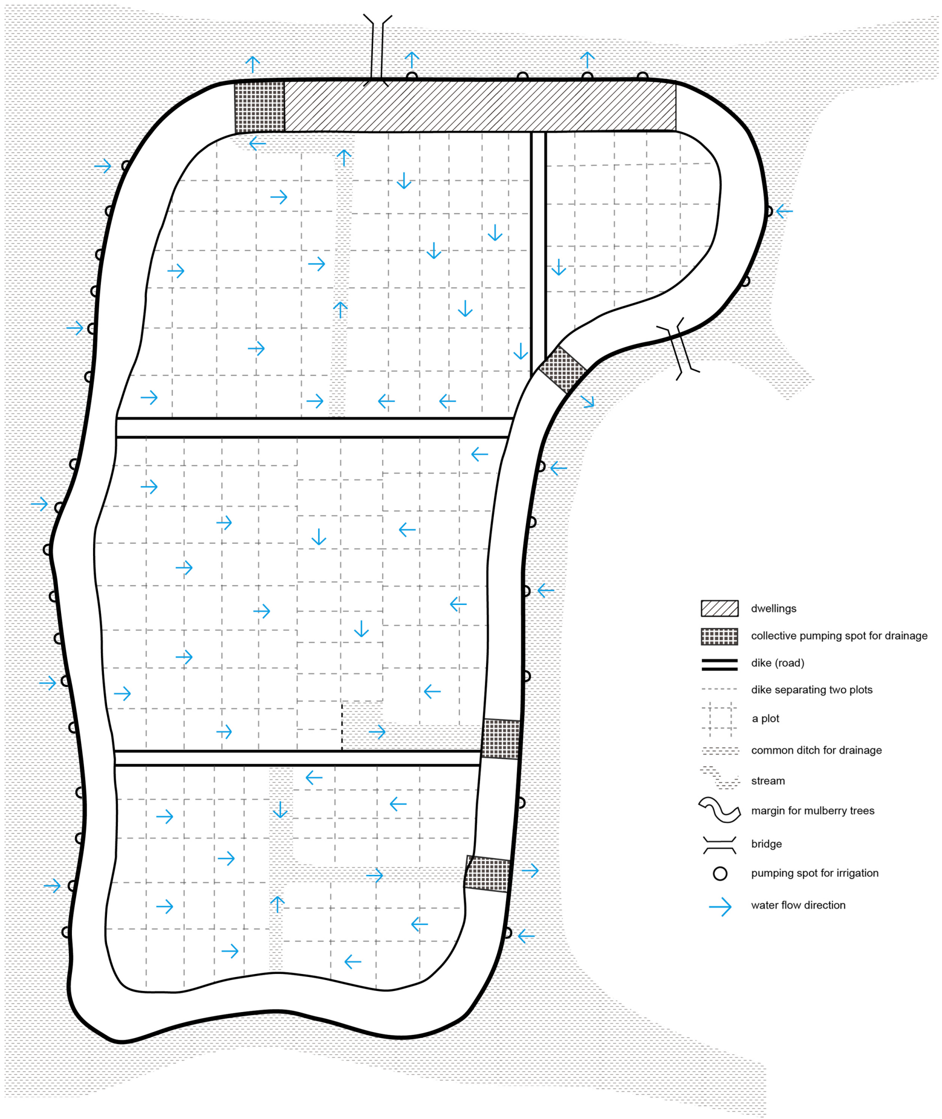


Figure 4.22 Structure of the Xichang Polder (66 ha), Wujiang County, 1932

Source: Author's drawing adapted from Fei (1939, p. 157).

URBANIZATION AND INDUSTRIALIZATION

After the Revolution of 1911, national industries were strongly encouraged by the new nationalist government. Water-based urbanism persisted during this period. The cities, towns and market towns were mostly distributed along the watercourses (Figure 4.23). Shanghai was formally established as a municipality in 1927, and has enforced its leading position as a port city in the YRD (Figure 4.24). Suzhou lost its leading position for trade in this region because of the decline of water transportation and the interior geographic location of trade. The construction of railway lines linking Tianjin and Nanjing (1908–1912) as well as one within the delta linking Nanjing and Hangzhou (1905–1909) weakened the transport role of the Grand Canal and the development of the cities along it.

Figure 4.23 Urban System of the Yangtze River Delta in 1927

Source: Produced by the Geographical Section and General Staff. (1927), original scale 1:250.000; retrieved from the open source collection of Virtual Shanghai.

Figure 4.24 City Plan of Shanghai 1927

Source: Produced by the U.S. Army Map Service (1927), original scale 1:50,000; retrieved from the China City Plans of the Perry-Castañeda Library Map Collection. We can see the newly planned urban landscape that was superimposed on the historic *Jing-Bang* polder system in Shanghai and its vicinity.

4.2.6 PEOPLE’S REPUBLIC OF CHINA (1950S–2010S)

Since the 1950s, the traditional agriculture along with the water system in the Taihu Basin has been declining (Wang, 2013). Since the abolition of collective agriculture in the early 1980s, especially during the following accelerated urbanization period, the water network has been mostly blocked, and the dike system of polders has deteriorated due to lack of maintenance and booming development of urban housing, infrastructure, and rural industries. All these functional and structural changes in water conservancy, canal and polder systems have consequently led to the loss of historic polder landscapes, and regional character and identity.

DEVELOPMENT OF WATER CONSERVANCY

From the 1950s to the 1990s, in the Taihu Basin, vast water conservancy construction, including building sluices and reservoirs, excavating and dredging watercourses, reinforcing dikes and levees, and maintaining and constructing polders to enhance the management of flood, waterlogging and drought have been carried out (Wang, 2006). The new hydraulic techniques for rapidly draining runoff through main watercourses has led to the destruction of the branched structure water system; the use of water pipes and mechanical water pumps has reduced the natural water flow and exchange (Wang, 2013). Presently, the Wangyu River and Taipu River have become the two main outflowing watercourses.

DECLINE OF THE LOU-GANG POLDER SYSTEM

A substantial decrease in number, and blockage and discontinuity of *Lougangs* reveal the decline of the *Lou-Gang* polder system during the urbanization of the lakeshore area. Presently, *Lougangs* are distributed at intervals of 0.5 to 1 km, and the size of the *Lou-Gang* polders generally ranges from ten to around 400 ha (Deng et al., 2016).

The water system of *Tangs* and *Lougangs* has long been neglected and was thus prone to severe silting. By the 1950s, almost half of the 100 *Dus* in Jingxi had disappeared, only 10 of 90 *Lougangs* along the southeast lakeshore were still connected to Lake Taihu; the 73 *Lougangs* along the south lakeshore were still intact until the 1990s but have been reduced to 47 in the past decades (Lu & Wang, 2005).

The landscape elements of the *Lou-Gang* polder system, such as the canals, sluices, stone bridges, and embankments and dikes are disappearing. The traditional integrated farming system of mulberry trees and fishponds has been vanishing as well, except in Huzhou, which nowadays has received renewed attention in the effort to protect and maintain this system as part of the area's hydraulic heritage. In 2016, the "Lougang Irrigation and Drainage System" in Huzhou was listed as a Heritage Irrigation Structure by the International Commission on Irrigation and Drainage (International Commission on Irrigation and Drainage, 2017).

POLDER MERGENCE AND STANDARDIZATION

In the early 1950s, there was a polder area of around 2,000 km^2 in Suzhou, divided into approximately 10,000 polders with an average size of 20 ha (Zheng, 1987). This pattern of small polders had endured since the 10^{th} century (Figure 4.25). After Land Reform (1950-1953), local farmers started to own land and were encouraged to involve in flood management and the polder system restoration. In 1954, a catastrophic flood hit this region, in which 80% of polder areas were breached (Wang, 2006). This flood exposed the vulnerability of the remaining small polder systems: the long perimeter of dikes for flood protection, low standards for flood protection, high water seepage, and high groundwater level (Fang et al., 1997). The movement of the Great Leap Forward and People's Commune promoted mass water conservancy development and *polder mergence* (*Lianwei* or *Bingwei*) in the late 1950s (ibid., p. 203) (Figure 4.26). The maintenance and restoration of polders, including strengthening dikes and constructing electromechanical pump stations as well as polder mergence had been consistently pursued during the 1950s–1990s (Wang, 2006).

The size of individual polders was a key issue for polder mergence. With the development of hydraulic techniques, the sizes of polders were no longer restricted to topography, the location of watercourses and embankments (ibid.). Thus, we observe the second substantial transformation since the big and the small polder system eras. In Suzhou area, during the 1950s and 1960s, the small polders were merged into large polders ranging from 60 ha to more than 600 ha (average 420 ha), which caused many conflicts between different drainage areas (Fang et al., 1997). During the 1970s, some improperly planned and excessively large polders were rescaled and reduced to around 300 ha (ibid.).

During the 1990s, polder standardization was triggered by the catastrophic flood in 1991. Polder standardization regulated the branched *Jingbangs* and *Lous* of the *Jing-Bang* polders into regular networks; the elevation of land surface was leveled to the same height, and the fields were parceled into a grid pattern; new drainage systems were built, equipped with pumping stations, sluices, dikes, and channeled canals and ditches; field paths and roads were widened and strengthened to allow access for vehicles and machines; the new canals and roads were framed by linear tree belts (ibid.) (Figure 4.27).

The sizes and patterns of polder systems were fundamentally changed during this process of polder mergence and standardization. As a result, the diverse historic polder landscape was replaced by a new geometric and standardized polder landscape. Merging small polders resulted in enhanced flood protection by reducing the defense perimeter of dikes and a substantial increase in crop yields (Zhang & Wu, 2012). But it also caused severe problems. The larger polders blocked the water flow, reduced water retention capacity, and increased flood threat to the areas beyond the merged polders.

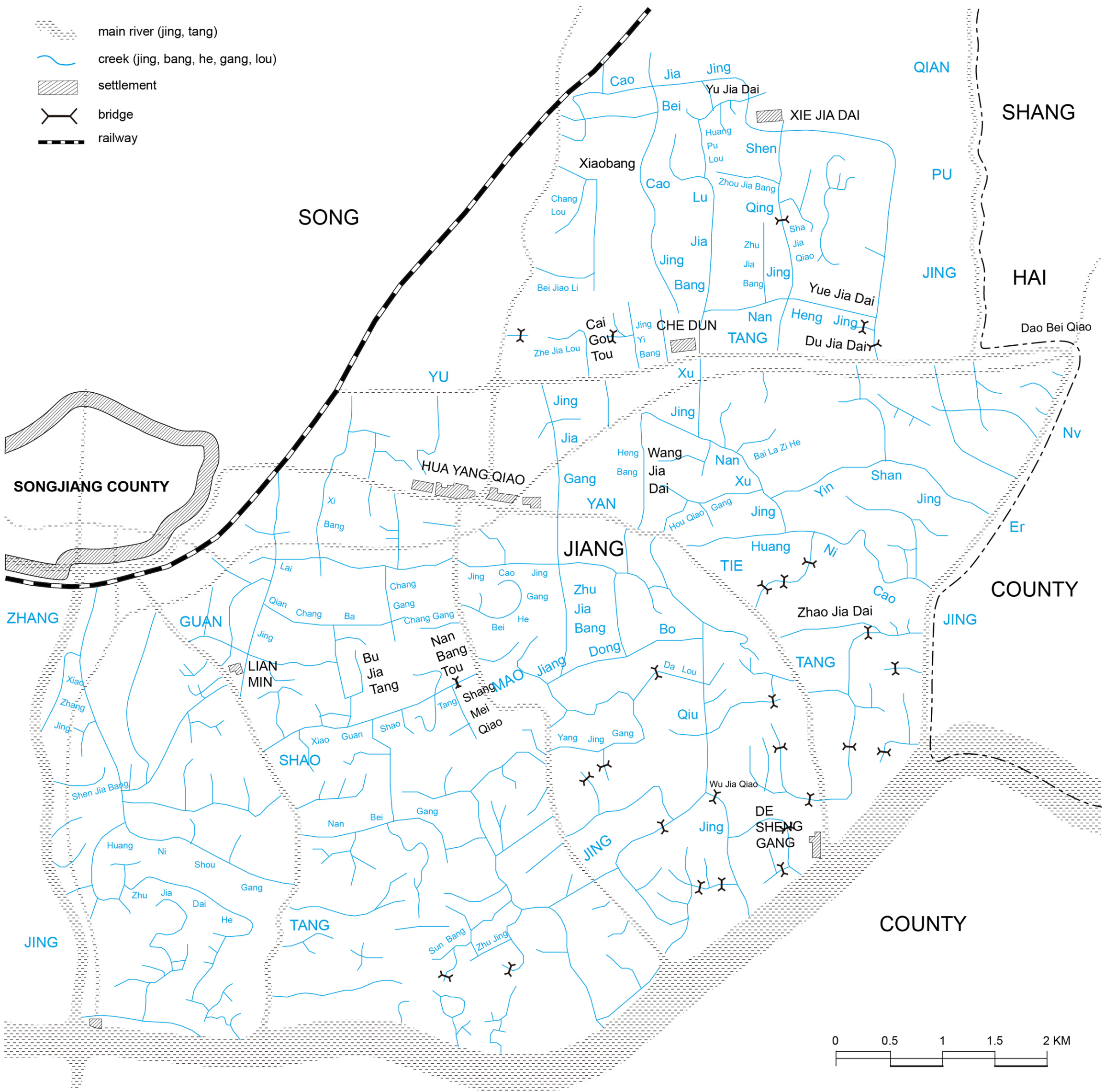


Figure 4.25 *Jing-Bang* Polder System in 1958, Songjiang County, Shanghai

Source: Author's drawing, adapted from *Shanghaishi ziyuan puchadui songjiangdui* [Songjiang resources census team of Shanghai] (1958); labels translated by the author.

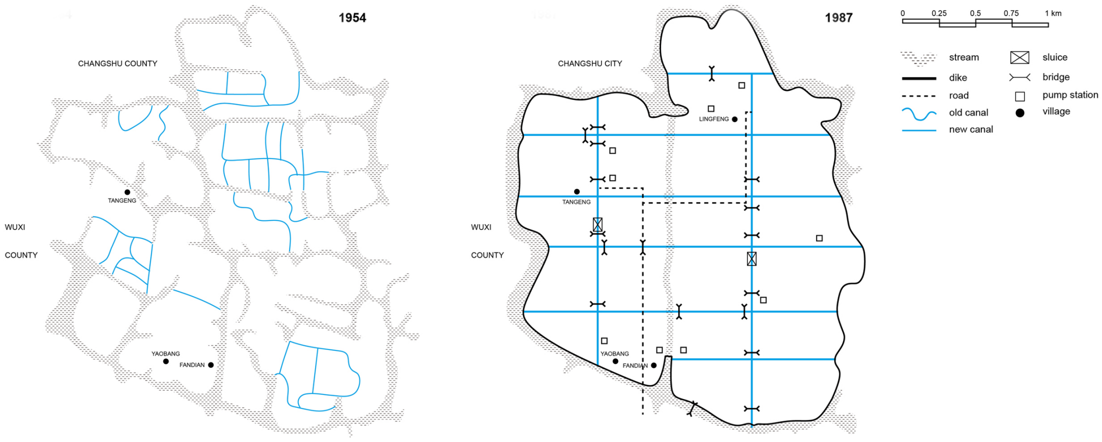


Figure 4.26 Mergence of the Fandian Polder in Beiqiao Township, Suzhou, 1954 to 1987

Source: Author's drawing adapted from Zhan, Li, Zhang, Chen, and Yu (1994, p. 400); labels translated by the author. The Fandian polder had an area of 493 ha including around 360 ha of paddy fields and was less than 4 m in elevation. Four villages were situated within this polder. Since 1958, individual small polders were merged into a large single polder, which was diked and equipped with sluices, pump stations, bridges, and new drainage ditches and channels.

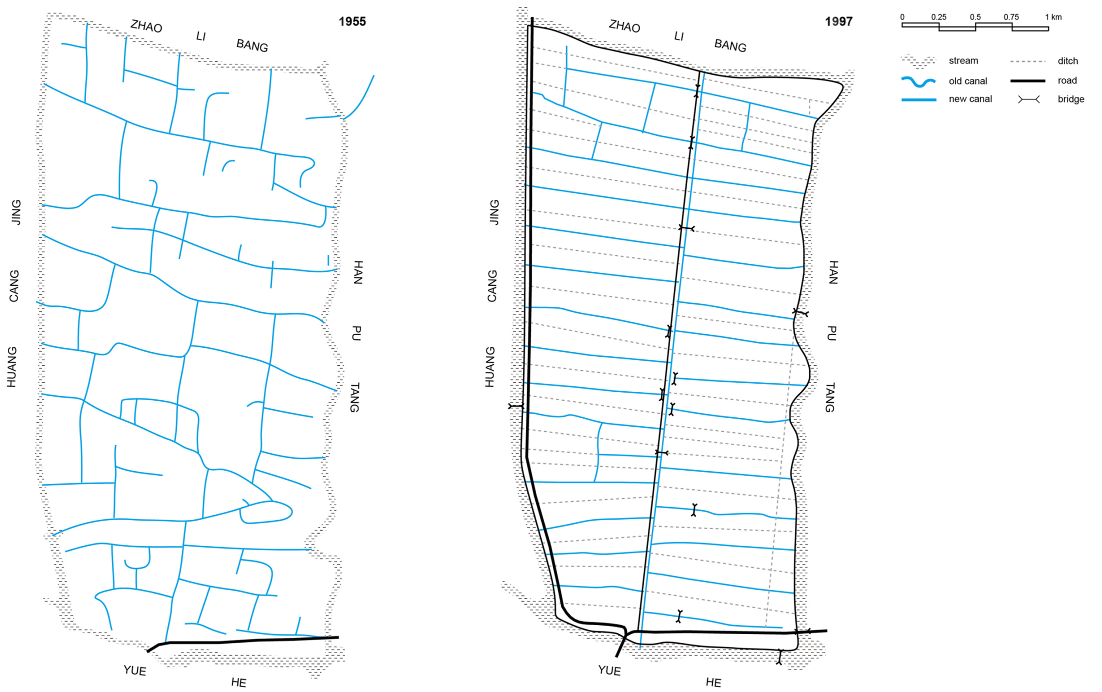


Figure 4.27 Standardization of the Tongxin Polder, Kunshan County, 1955 to 1997

Source: Author's drawing, adapted from Fang et al. (1997, pp. 209–210); Wang (1995); labels translated by the author. The Tongxin Polder had an area of 660 ha and was 2.3 to 3.5 m in elevation. Around 30 small polders were joined and standardized into one large polder during the 1950s to 1970s. The typically branched *Jing-Bang* canal system and paddy fields were leveled and reorganized into a grid with new roads and field paths, bridges, canals and ditches, dikes, and sluices.

RECLAMATION FROM LAKES

Simultaneously, the Great Leap Forward accelerated the land reclamation from lakes and the construction of polders in the Taihu Basin. These mass reclamation activities were implemented during the 1950s to 1970s, reaching a peak in the 1970s and were prohibited after the 1980s (Wang, 2006). By the end of the 1980s, the water surface of the Taihu Basin had decreased by 800 km^2, half of which was from lake reclamation; in the 1990s, all arable land below 5 m in elevation had been enclosed by dikes; 7,600 polders were built with an area of 11,000 km^2, and the polder area accounted for 30.9% of the whole Taihu Basin and half of the plain area (Gao & Han, 1999; Gao & Jiang, 1997).

This expansion of polder areas had considerably changed the overall hydrological conditions by increasing the risks of flooding and waterlogging in the Taihu Basin. The enclosed polder areas changed runoff discharge and redistributed the water flow in the whole region; the decreased water surface reduced the potential for water retention; the construction of dikes and pump stations occupied lakes and blocked the canals, which reduced flood control capacity (Gao & Han, 1999). Thus, the improved water management within the polders was achieved at the expense of the deterioration of the general drainage system.

URBANIZATION AND INDUSTRIALIZATION

From the 1950s to the early 1980s, the YRD region just like other coastal regions witnessed a retarded urbanization and industrialization mainly due to considerations of defense. In the 1950s, this region implemented a separated urban and rural development, and industry in rural areas was forbidden (Gu et al., 2011). The Centrally Planned Economy and the communalization of administrative units transformed the historic urban and market town system into a communes-based small town network (ibid.). The town networks in South Jiangsu Province, in cities like Suzhou, Wuxi and Changzhou, were enforced by the large-scale development of small rural industries and Township and Village Enterprises from the 1970s onwards. The reform era since the 1980s has seen a revitalization of the traditional urban centers and accelerated expansion of the urban agglomerations due to rapid industrial and commercial development (Figure 4.28).

All these changes led to the fundamental changes in the urban and landscape structures of polder areas of the YRD. The rural polders have been transformed into mixed agricultural, urban and industrial areas, including not only fields and settlements within polders, but also growing new infrastructure, urban housing and industries. For example, in Suzhou until 2010, among all polder areas, there were 10% urban polders, 25% economic zones, 35% mixed agricultural and industrial polder areas, and 30% remained as rural polders (Luo, Gu, & Gong, 2011). The rising impermeable surface of built-up areas increased the risks of flood and waterlogging and land subsidence in polder areas, which switched the target of water conservancy work from agricultural production to urban flood management.

The current metropolitan delta landscape is a highly dynamic and fragmented complex of all kinds of landscape elements and structures: degraded natural, vanishing historic rural, and mixed industrial and urban. Contemporary urban-industrial land use has superimposed on and replaced historic landscape structures. Like most coastal regions of China, the YRD is undergoing a period where land use has been modernized according to a generic and homogeneous industrial logic (Lefèbvre, 2003). The evolving metropolitan delta is characterized by its chaotic and unplanned rapid changes. The result is a mixture of fragmented fields, degraded canals, new gated residential areas, rural factories, and large transport infrastructure with limited accessible open spaces and public service facilities (Figure 4.29a, b).

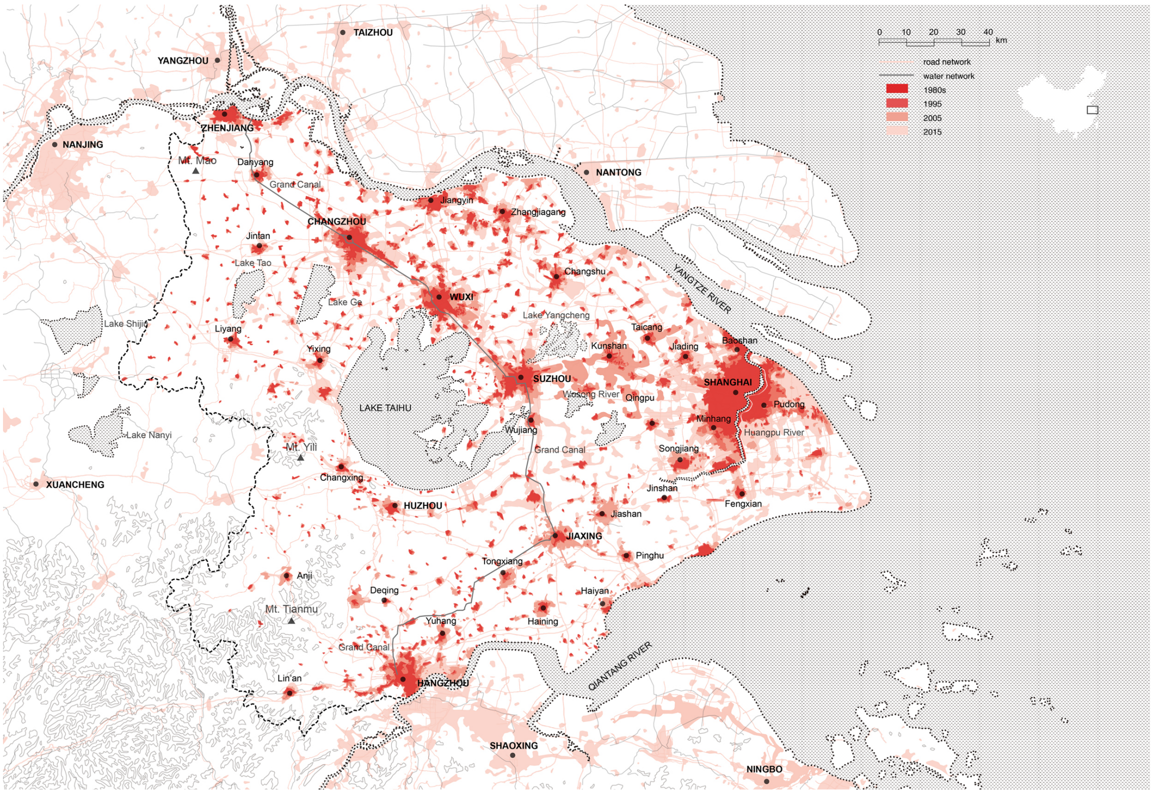


Figure 4.28 Urbanization of the Yangtze River Delta Region from the 1980s to 2015

Source: Author's drawing. The layers of urbanized areas in 1980s, 1995, 2005 were obtained from the Dataset of Land Use in the Taihu Basin (1980s, 1995, 2000, 2005), released by National Earth System Science Data Sharing Infrastructure (2012); the urbanized area of 2015 was extracted from the urban layer of Google Maps 2015. For enlarged version see Appendix A.

Figure 4.29a,b Dynamic and Fragmented Metropolitan Delta Landscape

Source: Photos taken by the author from the fast speed train from Hangzhou to Shanghai, 2014.

4.29a: The elevated highway and railway as boundaries show the contrast between the relics of the historic agricultural landscape and the new dense and homogenous suburban residential quarters.

4.29b: Various types of infrastructure cutting through canals and separating industrial estates.

4.3 CONCLUSION

In the YRD region, local people have shaped the polder systems during a long-term struggle with water to fulfill the demands of farming and inhabitation. The developments in hydraulic techniques, land use and farming systems, and urbanization and industrialization have driven the co-evolution of water, polder and urban systems. The historic study and mapping of the evolved polder systems and types, and the contemporary metropolitan delta landscape demonstrate the morphogenesis of typical cultural landscapes in the YRD region.

4.3.1 DEVELOPMENT OF WATER SYSTEM

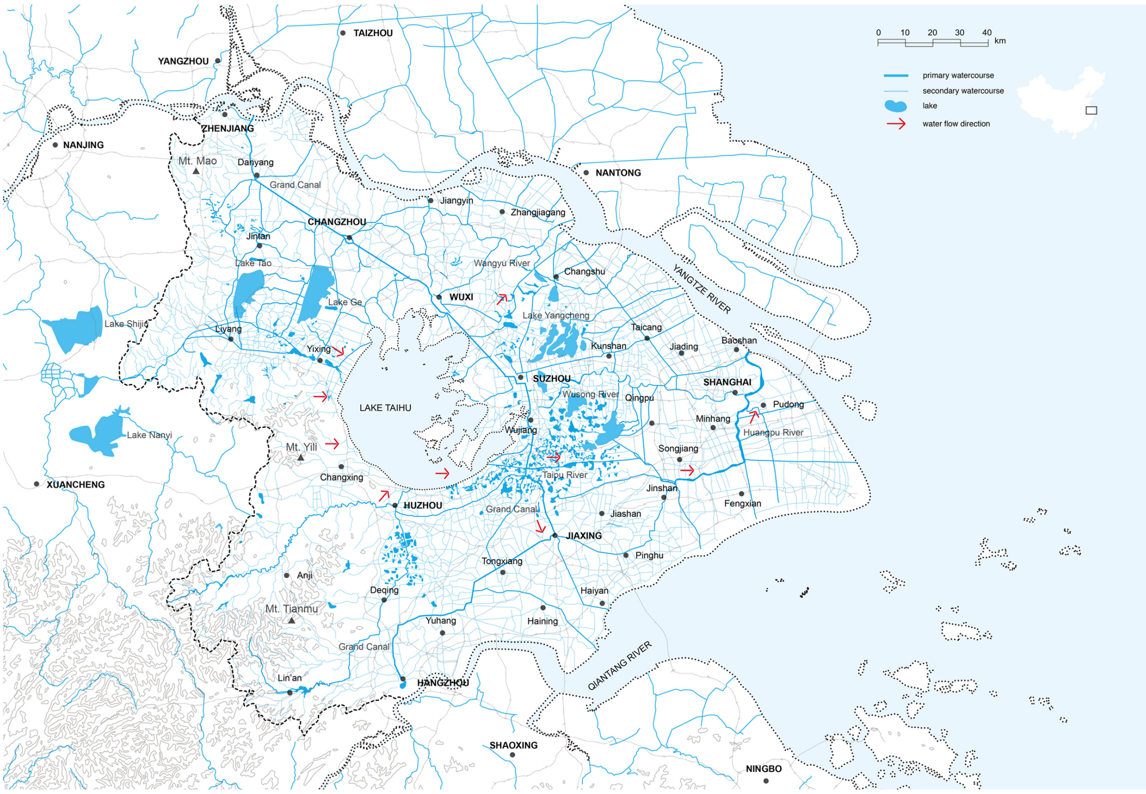


Figure 4.30 Today's Water System of the Yangtze River Delta Region

Source: Author's drawing by mapping the water layer from the *Changsanjiao dituwang* [Atlas of the Yangtze River Delta], 2015. For enlarged version see Appendix A.

The YRD has a unique hierarchical water system, comprised of dense but short canals (Figure 4.30), the beginning of which is date back to the 8th century BC. A crisscrossed network across the whole delta had taken form by the mid 3rd century. It shaped, and continues to shape the forms and patterns of and co-evolved with polder systems, and ensured agricultural production, water transportation, trade, and the formation of urban settlements.

This water system has been under maintenance and management continuously along with the polder systems throughout its hydraulic engineering history. The construction of the Grand Canal dating back to the 8th century BC created conditions conducive to land reclamation and trade of rice and silk with North China. The main drainage watercourses changed from the three rivers, the Song (current Wusong River), Lou and Dong before the Tang Dynasty, to decentralized networked canals after the 8th century, and back to the present two main outflowing watercourses of the Wangyu and Taipu River. Rapid draining runoff through the main watercourses has destroyed the branched structure of water system and typical polder landscape.

4.3.2 DEVELOPMENT OF POLDER TYPES

The reclamation of the lowlands in the Taihu Basin dates back to the 8th century BC, leading to the successive growth of sparsely distributed polders of primary forms. After the 8th century, the well-planned *Tang-Pu* polder system of big polders, took shape due to a state-promoted farming system and systematic reclamation. The *Lou-Gang* polder system along the Taihu lakeshore also took form around the 8th century, which could be considered as another type of big polder system. From the 10th century, these big polder systems collapsed into small polder systems because of population pressure, a household-based farming system, and lack of systematic planning and management. Three small polder systems including the *Lou-Gang*, *Jing-Bang* and *Hu-Dang* polder systems individually developed and functioned stably for almost a thousand years, and their overall patterns were retained until the mid 20th century. From the 1950s onwards until the 1990s, most of these surviving polder systems underwent mergence and standardization. The joint and standardized polders were rapidly urbanized and industrialized since the 1980s.

In conclusion, there are two substantial transformations of polder systems during the history of the YRD, from big to small, and again back to big polder systems (Figure 4.31). The trends of the two transformations, in general, are from fragmented to more rational systems, which were intended to improve the resilience of the polders systems: Small polder systems are more vulnerable to flooding than big polder systems. However, at the same time, the activities of polder standardization homogenized the characteristics of historic polder landscapes. The urbanization of polders since the 1980s can be understood as the third fundamental transformation, in which urban and industrial landscapes have superimposed on polder landscapes rather than changing the polder systems themselves. The on-going urbanization of polders results in structural and functional changes of the former rural polders, which increases the vulnerability of these urbanizing polders to flooding.

Based on the results of the historical study, a typology of polders was developed by adapting the Dutch polder classifications (Hooimeijer et al., 2005; De Wit, 2009, see Sect. 3.10.2), using the criteria of *basic forms* (water system and parcellation patterns) and the *polder technologies*, which shaped them. Five polder types in the YRD can be distinguished: the *Tang-Pu*, *Lou-Gang*, *Jing-Bang*, *Hu-Dang* and modern standardized polders. The basic forms of the five polder types were mapped (Figure 4.31). The *Tang-Pu* polder system no longer exists, and presently, the other three polder types, namely *Jing-Bang*, *Lou-Gang* and *Hu-Dang*, function as *palimpsests* (Corboz, 1983, see Sect. 3.2), still bearing their ancient characteristics while at the same time having been partly to fully transformed into standardized polders since the 1950s.

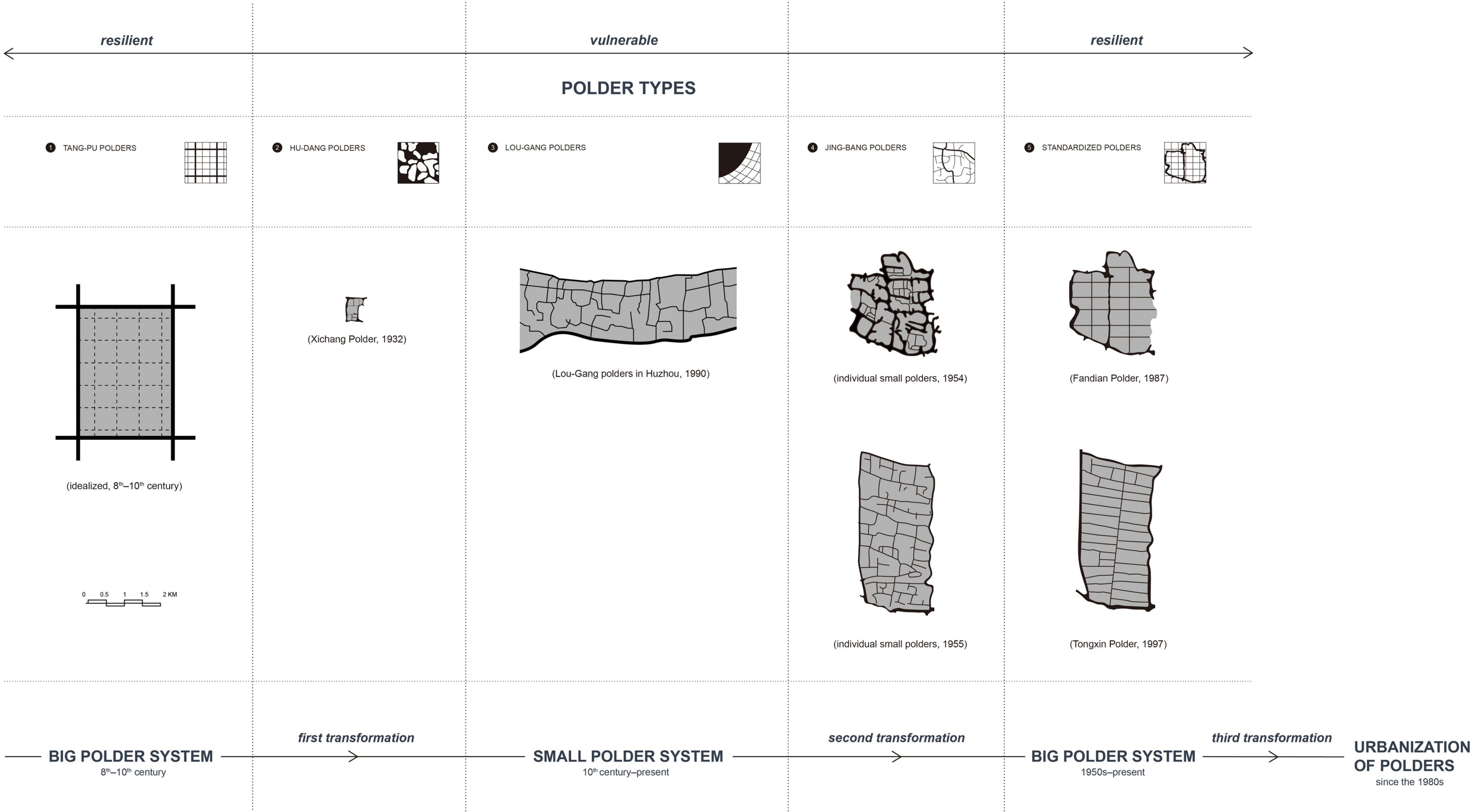


Figure 4.31 Polder Types in the Yangtze River Delta Region

Source: Author's diagram. The case of the *Lou-Gang* polders was adapted from Lu and Wang (2005). All these polders were laid out at the same scale and were grouped according to types.

4.3.3 MORPHOGENESIS OF CULTURAL LANDSCAPES

Regional physical conditions and culturally specific techniques, both hydraulic and industrial, together have continuously shaped the character and structure of the historic and the contemporary delta landscape. The current metropolitan delta landscape is a highly dynamic and fragmented complex of all kinds of landscape elements and structures with a chaotic and unplanned character. This new contemporary landscape has overlapped with and replaced historic landscape structures almost completely during the on-going, accelerated industrialization and urbanization. In the face of this irreversible trend, there is an urgent need to study and document the structural and functional changes of those remaining or restorable polder landscapes.

The historic polder structures, as *permanent forms*, can serve as "structure-giver"[27] for landscape conservation and management as well as for future urban development, in order to maintain and redevelop regional identity. Historic water-related elements and structures should be rediscovered and reactivated for generating permanent forms and as green-blue infrastructure to improve urban spatial qualities in terms of identity and resilience. This is not just an aesthetic question, because there is an increasing risk of urban flooding in polder areas, especially aggravated by the occupation of water surface and farmland for urbanization and in some instances by climate change. Thus, the reconsideration of the historic hydraulic heritage will support spatial planning, which may contribute to tackling the storm water issue in rapidly urbanizing polder areas.

---

[27] Schöbel-Rutschmann (2012) used this term "structure-giver" (translated from the German word "*Strukturgeber*") in the teaching and research of the LAREG Professorship. By using this term, he intended to conceptualize the role of open spaces and landscape, which is not only to compensate for urban growth and density, but also to provide a permanent structure for new urban developments, including the revitalization of the historic urban landscape, the qualification of suburban districts, as well as the integration of the historic cultural landscape with new land uses and infrastructure.

CHAPTER 5 A TYPOLOGICAL APPROACH TO PERMANENT FORMS AND GREEN-BLUE INFRASTRUCTURE

This chapter aims to develop a typological approach for mapping, describing and classifying landscape character areas and types in the YRD region as a theoretical foundation for generating type-specific measures to ensure the permanence and resilience of historic cultural landscapes to new urban development in landscape architecture practice. The methods and outcomes of this approach are displayed according to the five stages of research, which are: *define purpose and scope*, *desk study, field survey*, *mapping, description and classification*, and *practice*. In the concluding part, ways of using the research outcomes will be discussed at three different levels that are deduced in this chapter: landscape conservation, transformation and critical reconstruction.

The typological approach of the YRD region is developed at multiple scales and structured in five stages (Figure 5.1). The first three stages adapt the basic framework of Landscape Character Assessment (LCA). The second stage, *desk study*, adopts the same quantitative overlay method as in LCA. The fourth stage, *classification, mapping, and description*, investigates a combined qualitative and quantitative approach by adapting the additional methods of Historic Cultural Landscape Elements (KHLE) and Dutch polder classification for the metropolitan areas of Suzhou. The fifth stage deals with the implications for professional practice, drawn from the results of a Research by Design Project (which will be described below) on a specific landscape type, called the *Networked Polder Landscape*. The final results of the typological approach are documented in individual landscape profiles, in which the potential ways of restructuring cultural landscapes are discussed at the three levels of conservation, transformation, and critical reconstruction.

5.1 DEFINE PURPOSE AND SCOPE

5.1.1 PURPOSE AND AIMS

The main objective of this research is to provide guidelines for managing landscape changes and new urban developments in order to protect, transform, or restructure historic cultural landscapes. To fulfill these aims, a site-specific typological approach is developed for the metropolitan areas in the YRD:

- to map and describe the physiographic and hydraulic characteristics of the delta landscape;
- to identify distinct landscape character areas and to draft landscape character maps at various scales;
- to develop a classification of historic cultural landscape elements as basic items for landscape analysis;
- to identify, map and describe the characteristics of a particular landscape character area, and to monitor and visualize their changes;
- to develop a classification of landscape types;
- to generate type-specific measures for landscape architecture practice.

5.1.2 SCALE AND LEVEL OF DETAIL

To systematically analyze the characteristics of the metropolitan delta landscape, a multi-scale approach was pursued. According to the research objectives, accessible map resources, and the concept of using three levels in LCA, the three scales of characterization and the main tasks of each scale are structured. This work adapts the three scales used in

LCA (Tudor & Natural England, 2014, p. 13), and specifies the levels of details according to the Chinese geographical (at which topographic maps are drafted) and urban planning (at which urban master plans and regulatory plans are drafted) scales (see Sect. 2.5.1):

- *Regional scale* (*Quyu chidu*), at approx. 1:2,500,000–1:250,000, identifying the broad patterns of the physiographic and hydraulic units of the YRD region;
- *Local authority scale* (*Difang dangju chidu*), applied at the municipal level, typically at 1:50,000 or 1:25,000, identifying and mapping the landscape character areas in Suzhou municipality and their structural and functional changes;
- *Local or site scale* (*Bendi* or *Changdi chidu*), typically at 1:5,000, describing the attributes of the identified landscape character areas and classifying landscape types.

5.1.3 MAP RESOURCES

Mapping is a key method in the characterization approach. Geographic Information System (GIS), Computer Aided Design (CAD) and Vector Graphics Editor (VGE) software were used to analyze and map landscape elements displayed in different layers of historic paper maps, satellite images, and digital maps.

The collected and applied map resources include (Table 5.1) paper maps from the literature, local chronicles (*Difangzhi*), water conservancy annals (*Shuilizhi*), and open map databases; survey map collections from the literature, the internet and databases; web-accessible digital and satellite maps, such as Google and Tianditu; remote sensing maps; the GIS database of basic geographical information and land use. These map resources are of different periods from ancient times up to the modern era and are in various resolutions and projection coordinate systems. They are drawn using varied mapping techniques. It is necessary to find a unified way to reinterpret and collate these maps. A standard was set when overlaying layers from different source maps from various projection coordinate systems. The WGS84 Web Mercator system was adopted in the mapping process as it is the most frequently used coordinate system in both satellite images and digital maps, such as in Google and Tianditu Map. The Spatial Adjustment and Georeference tools of GIS were used to adjust the projection coordinate systems of the vector data (GIS based ArcMaps) and raster data (paper maps and satellite images). Thereafter, all these ArcMaps, paper maps and satellite images were exported to VGE (Adobe Illustrator) and were drawn and laid out in a unified coordinate system, mapping technique, and style.

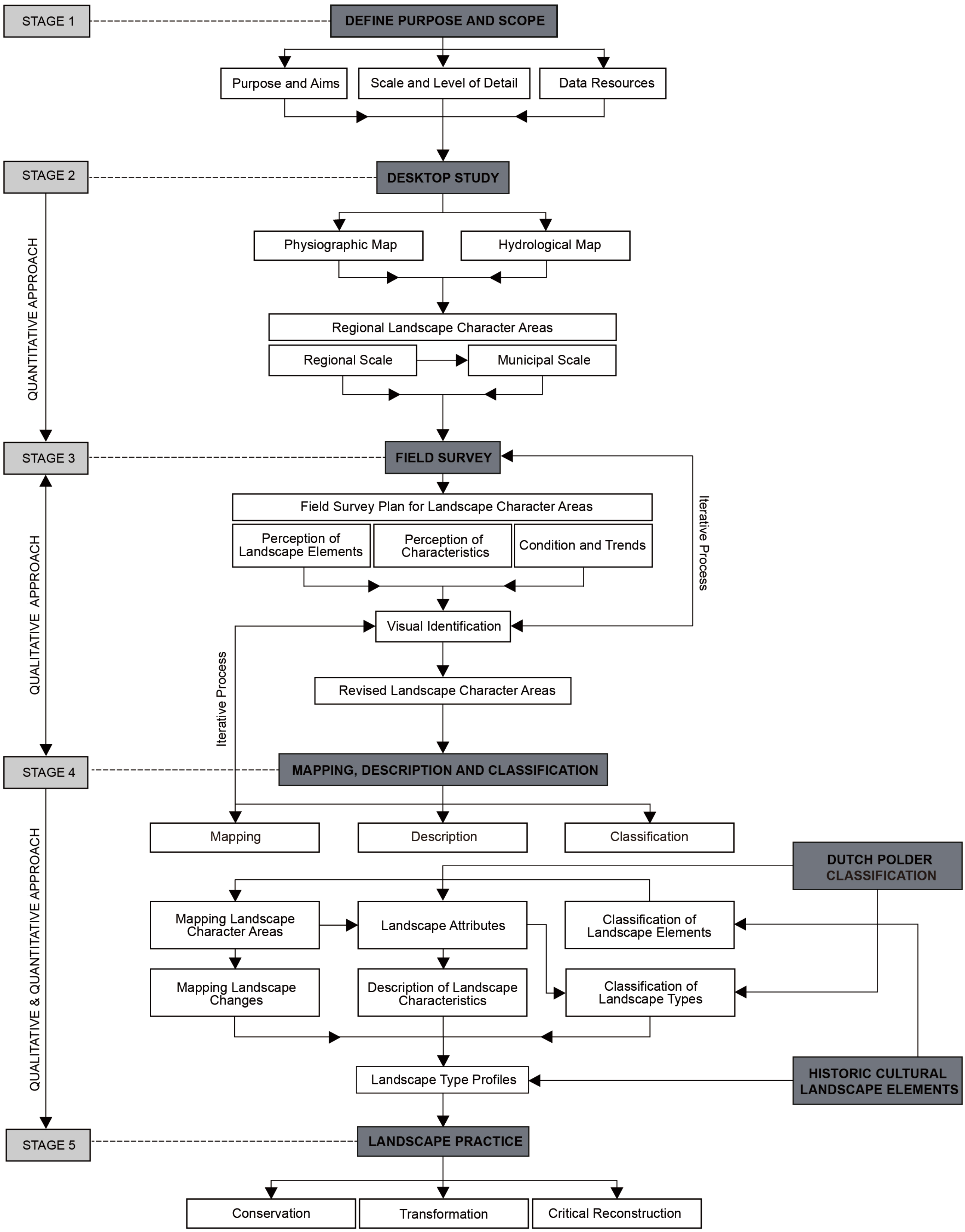


Figure 5.1 Framework of the Multi-scale Typological Approach

Source: Author's flowchart, adapted from Tudor and Natural England (2014, p. 15).

Table 5.1 Description of Collected Map Resources

Source: Author's summary.

Map Collections	Time	Scales	Projection Coordinate Systems	Sources	Description
GIS based ArcMaps					
Taihu Basin Database	1995–2000	1:250,000	GCS Krasovsky 1940	Released by the Lake-Watershed Science Data Center—National Earth System Science Data Sharing Infrastructure (2002)	This database covers the territory of the Taihu Basin. These GIS based ArcMaps include layers of locations of villages and towns, urbanized areas, water networks (at three hierarchical levels), water surface (lakes, rivers and sea), national roads, provincial roads, railways, contour lines, and administrative boundaries of provinces, cities and counties.
China Historical Geographic Information System Dataset	1990	1:1,000,000	GCS Xian 1980	Released by Harvard Yenching Institute and Fudan Center for Historical Geography (2007)	The contour layer from the "DCW 1990 Countour Elevations" covers the whole territory of China.
Paper Maps					
Comprehensive Physical Regionalization Map of the Taihu Basin	1988	at approx. 1:2,500,000	Unknown	Released by the Nanjing Institute of Geography and Limnology	This map identifies two general physiographic zones, including 11 sub-units, according to the combined factors of climate, geomorphology, hydrology, soils, land cover and vegetation, and agriculture.
Hydraulic Regionalization Map of the Taihu Basin	2006	at approx. 1:2,500,000	Unknown	Released by the Taihu Basin Authority of Ministry of Water Resources	This map identifies eight hydraulic zones, covering 20 sub-units, regarding the factors of topography, characteristics of water resources, canal and drainage systems, proportion of polder areas, and flood management measures.
Hydraulic Division Map of Suzhou	1997	1:550,000	Unknown	Published in *Suzhou Shuilizhi* [Water Conservancy Annals of Suzhou] (Fang, Wang, & Xue, 1997); drawn by Longfei Huang in 1997 and published by the Editorial Committee of Suzhou Water Conservancy History.	This map shows the six hydraulic divisions of Suzhou. This map includes the layers of hydraulic divisions, administrative boundaries, cities, towns, highways, national and provincial roads, rivers, lakes, marshland, canals and ditches, dikes, sluices, irrigation and drainage stations, and culverts.

Army Map Service Series L500 of China	ca. 1950	1:250,000	Transverse Mercator projection	Prepared by the Army Map Service (SNECO), Corps of Engineers, U.S. Army. It is included in the Harvard Map Collection, available online: http://hcl.harvard.edu/libraries/maps/collections/series_indices/China_Index.html	Compiled in 1954 from: China, 1:50, 000, Japanese General Staff, 1942; China, 1:500,000 AMS, Kiangsu, 1944-45; China 1:50,000, Central Land Survey, Chekiang, 1916. Planimetric detail was revised by photo-planimetric methods. Names were Romanized in accordance with the Modified Wade-Giles System. Road classification should be referred to with caution. These survey maps display the information of topography, water system patterns, land use, and vegetation cover.
Historical Topographic Map Collection	1983	1:50,000	Beijing Geodetic Coordinate System 1954	Prepared by the Surveying and Mapping Bureau of the People's Liberation Army General Staff Department in 1983.	This map collection covers the territory of Suzhou municipality. Each map includes layers of dwellings, blocks, railways, roads, country roads, canals, ditches, bridges, dams, sluices, dikes, woodland and so on.
Map Collection of Mainland China	1910s–1940s	1:50,000, 1:25,000	Unknown	These map collections were originally surveyed and produced by the Japanese Land Survey Department and were published by Sokuryobu (1986) . These maps were digitalized and shared by the Academia Sinica (Taiwan), available online: http://webgis.sinica.edu.tw/map_cm50k/	This map collection includes *Chugoku tairiku gomanbun no ichi chizu shusei* [Map Collection of Mainland China] at 1:50,000 and 1:25,000. These maps present the layers of water systems, settlements, and road networks.
Digital Street Maps and Satellite Images					
Google Map	2015	multiple scales, max 15 or 30 m resolution	WGS84 Web Mercator	Google Earth or desktop web	Google Map offers street maps and satellite images of regions and sites with detailed geographical information all over the world.
Tianditu	2015	multiple scales, max 15 m resolution	WGS84 Web Mercator	Tianditu is a national platform providing geospatial information services. It was established in 2011 by the National Administration of Surveying, Mapping and Geoinformation of China (NASG). Tianditu Suzhou provides survey maps at max 1:500, see http://map.suzhou.gov.cn/	Tianditu survey maps provide layers of water system (rivers, lakes, canals, fishponds, ditches), transportation, green space, and buildings (urban housing, rural dwellings, and factories). Comparing with Google Map, Survey Map of Tianditu has a higher resolution with more details of landscape elements, such as precise locations of buildings, canals, ditches, and fishponds; Google and Tianditu satellite images have the same source.

Atlas of the Yangtze River Delta	2015	multiple scales	Unknown	Prepared by the Shanghai Institute of Surveying and Mapping, Zhejiang Mapping and Geographic Information Bureau, Jiangsu Provincial Bureau of Surveying and Mapping, available on: www.csjmap.com	The *Changsanjiao dituwang* [Atlas of the Yangtze River Delta] provides survey maps that cover the territory of Shanghai, Zhejiang and Jiangsu Provinces. The atlas includes the layers of water system, hierarchical road network, locations of cities and towns, and scenic spots and parks.
Remote Sensing Images	1980s–2012	15 or 30 m resolution	Unknown	Produced by the National Earth System Science Data Sharing Infrastructure of China	The *Changsanjiao shijian xulie yaogan yingxiang shujuku* [Time Series Remote Sensing Image Database of the Yangtze River Delta, 1990–2012] includes the remote sensing images from 1990 to 2012; the *Changjiang zhongxiayou duo fenbianlv yaogan yingxiang shujuku* [Multi-Resolution Remote Sensing Image Database of the Middle and Lower Yangtze River Region, 1980, 1990, 2000] provides the TM, MSS and ETM images of the Middle and Lower Yangtze River Region of 1980, 1990 and 2000.

5.2 DESKTOP STUDY

5.2.1 REGIONALIZATION OF THE YANGTZE RIVER DELTA

At the regional scale, there are scarcely any accessible GIS based maps of the YRD region, such as division maps of climate, geology, landforms, and vegetation as utilized in the LCA case studies. In this case, existing paper maps of physiographic (e.g. comprehensive physical, topography, geomorphology) and cultural (e.g. hydraulics [28], land types) regionalization of the YRD region could work as the base maps for regional landscape characterization.

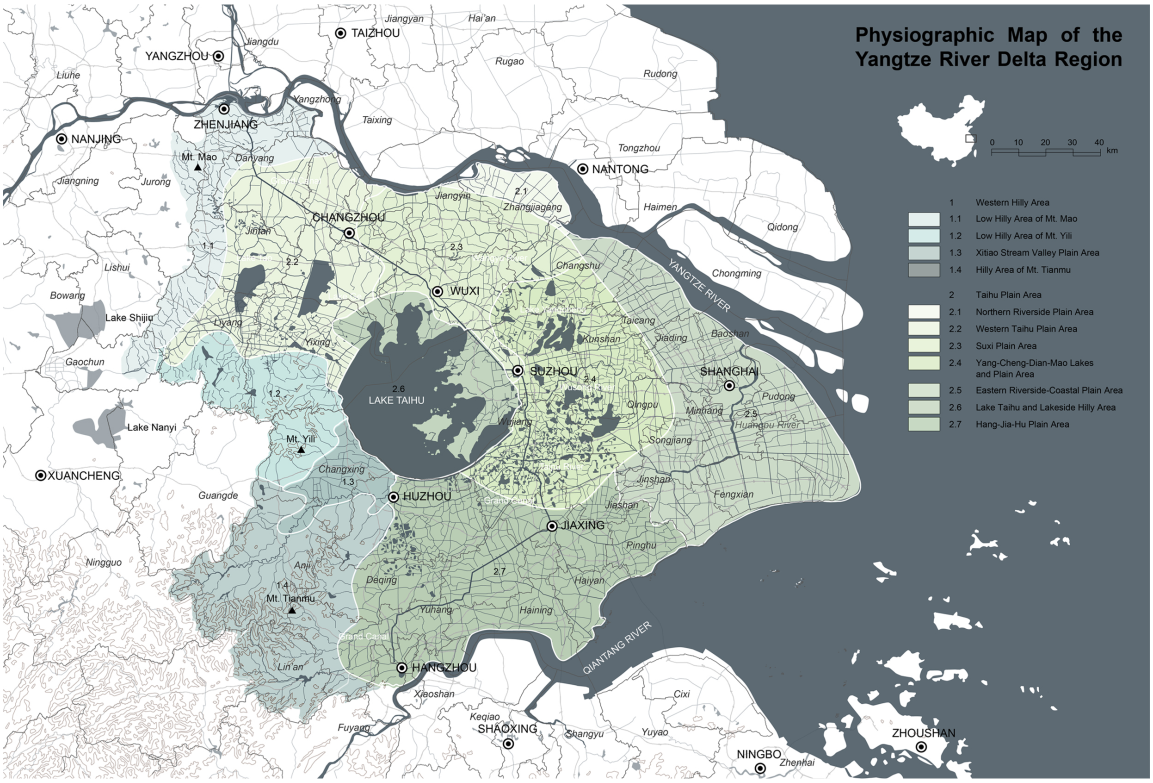


Figure 5.2 Physiographic Map of the Yangtze River Delta Region

Source: Author's map, adapted from Zhu et al. (1988, p. 20). New layers of water, roads, topography, city locations, and administrative boundary, as well as translated labels added by the author. For enlarged version see Appendix A.

---

[28] In this work, both natural and man-made (relating to hydraulics) characteristics of cultural landscapes are studied. For the physiographic units, the term *hydrological* (*Shuiwen de*) is used; when regarding man-made characteristics, following Wittfogel's concept of "hydraulic empire/civilization" (Wittfogel,1981), the term *hydraulic* (*Shuili de*) is used.

The *comprehensive physical regionalization map* (*Zonghe ziran quhua tu*), approx. at 1:2,500,000, identifies two general physiographic zones according to the combined factors of climate, geomorphology, hydrology, soils, land cover and vegetation, and agriculture (Zhu, Jiang, Ji, & Liang, 1988) (Figure 5.2). These two general zones are divided into 11 sub-units, four in the western hilly area and seven in the Taihu Plain area (Appendix B, Table 5.8).

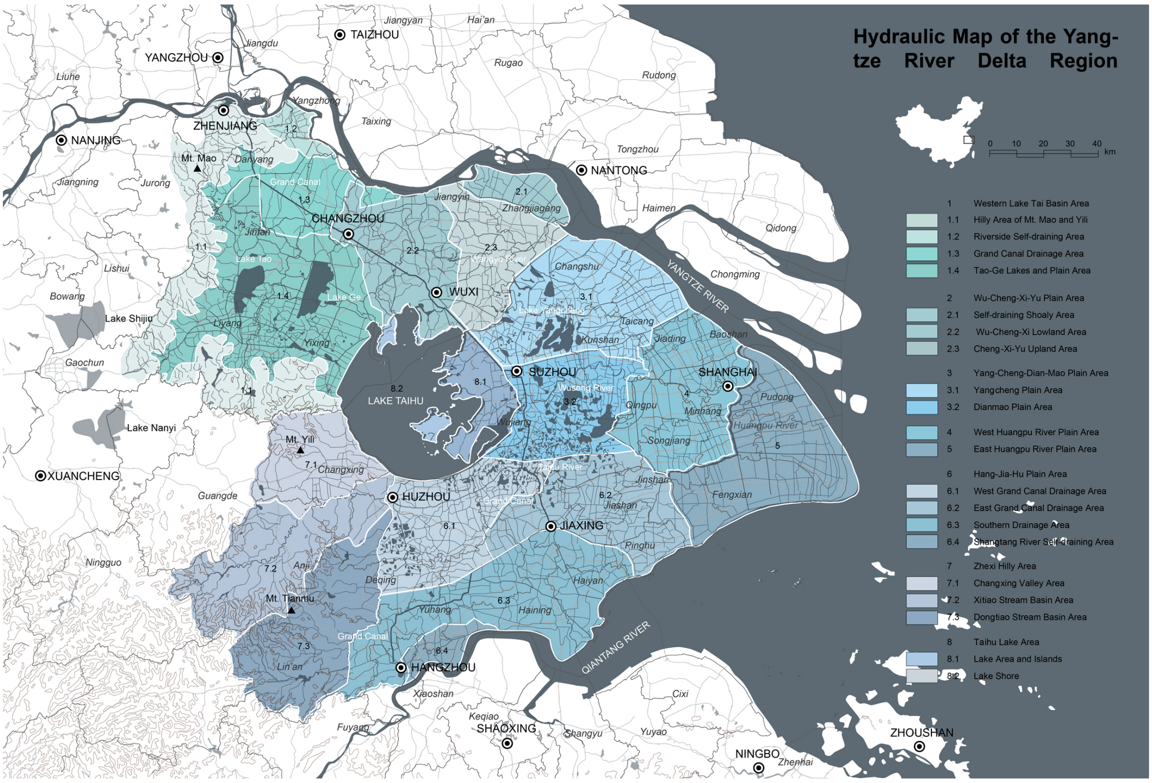


Figure 5.3 Hydraulic Map of the Yangtze River Delta Region

Source: Author’s map, adapted from Wang (2006, p. 39). New layers of water, roads, topography, city locations, administrative boundaries, as well as translated labels added by the author. For enlarged version see Appendix A.

For cultural factors, according to the morphogenesis of cultural landscapes studied in Chapter 4, the “hydraulic” factor is the one that has most significantly shaped the unique landscape characteristics of the delta region. Thus, the *hydraulic regionalization map* (*Shuili fenqu tu*), at approx. 1:2,500,000, was used as another base map for regional landscape characterization (Figure 5.3). Eight hydraulic zones covering 20 sub-units are classified and described by the factors of topography, characteristics of water resources, canal and drainage systems, proportion of polder areas, and flood management measures (Wang, 2006) (Appendix B, Table 5.9).

These two newly interpreted maps[29] as outcomes of this step demonstrate the diverse

[29] Both two paper maps were scanned and transformed to GIS to adjust the coordinate system to the

landscape characteristics of each unit. The other available regionalization maps such as the topography, geomorphology, land types, or agroclimate map are not used here as the divisions in these maps were classified according to the same (single or combined) physiographic or cultural factors as the two used.

5.2.2 REGIONAL LANDSCAPE CHARACTER MAP

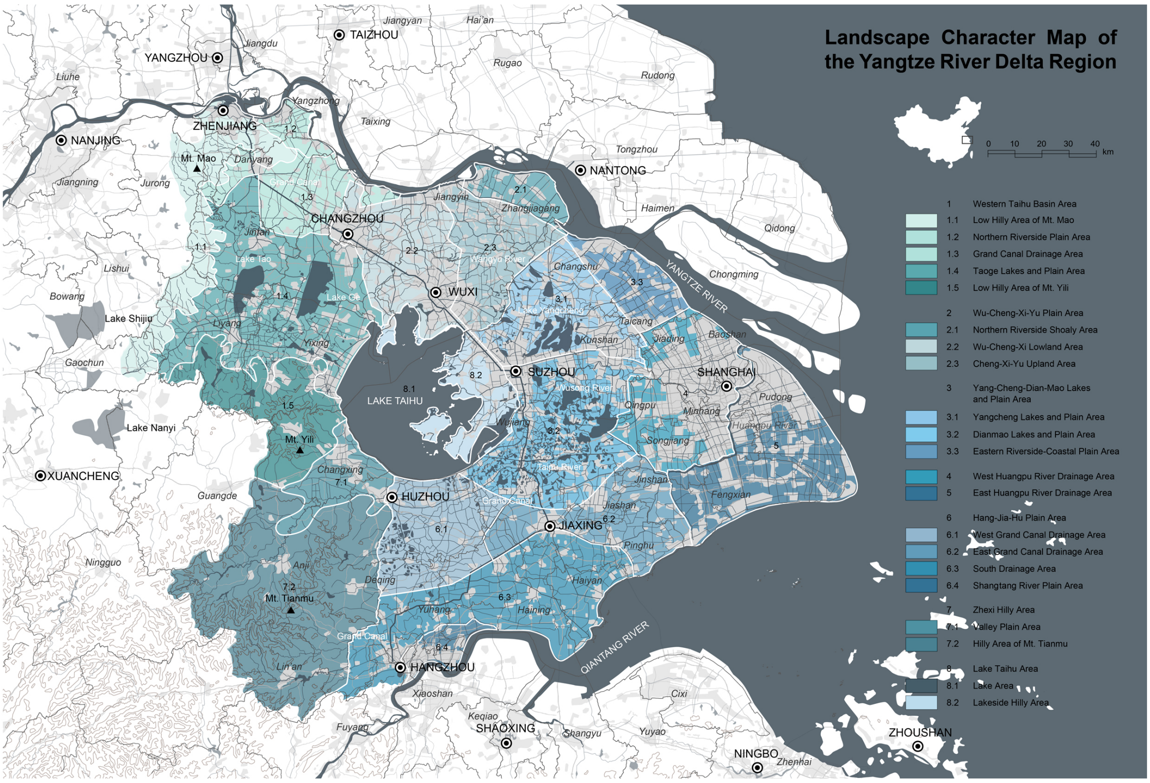


Figure 5.4 Landscape Character Map of the Yangtze River Delta Region

Source: Author's map. For enlarged version see Appendix A.

Using a quantitative overlay, the draft regional landscape character map was outlined by overlaying these two regionalization maps to identify the broad patterns of the physiographic and hydraulic units (Figure 5.4). The overlapped boundaries of these units were further revised by conforming to the natural boundaries of mountains, rivers, and canals as well as

---

WGS84. The ArcMap layers from the Taihu Basin Database (1995–2000) were also adjusted to the WGS84. This procedure prepared the two base maps and ArcMap layers for the next overlaying step. The two base maps were overlaid with the ArcMap layers of natural and hydrological morphologies in Adobe Illustrator: The contour lines of natural morphology were generated from the “DCW 1990 Countour Elevations” of the CHGIS dataset; the hydrological morphology was drawn based on the water layer from the Taihu Basin Database and was renewed according to the Atlas of the Yangtze River Delta 2015. The urbanized area, locations of cities, counties, and towns were drawn according to the Google Map 2015; the road network was obtained from the Open Street Map 2015.

by comparing the landscape characteristics of each unit with its neighboring areas. The historical topographic maps (1:250,000, 1954) produced by the U.S. Army and Google satellite images were used as a reference to adjust the overlapping boundaries. 21 regional landscape character areas were identified and named by referring to the names of division areas in the two regionalization maps. Their characteristics were described within the categories of physiographic, hydrological/hydraulic, and land use characteristics, including a description of the vulnerability of cultural landscapes to changes due to flooding and urbanization, as well as their potential for green-blue infrastructure in future urban development (Appendix B, Table 5.10). At this scale, the defined boundary lines of regional character areas are imprecise due to the limited details on the base maps.

At the local authority scale, the same quantitative overlay method could not be applied since there are no accessible municipal or local maps comparable to those at the regional scale. Thus, a combined qualitative and quantitative approach was developed to characterize the metropolitan delta landscape with distinct landscape character areas and types at municipal level and with detailed maps at larger scales or in higher resolutions. The layer of municipal administrative boundaries was added to the regional landscape character map to show the amount of landscape character areas and the richness of landscape characteristics of each delta city. From among the eight delta cities, Suzhou municipality was selected as the case study city because of its most diverse landscape characteristics that are intimately associated with the structures of water and polder systems. Seven character areas[30] were demarcated in this procedure and were presented in the draft landscape character map of Suzhou (Table 5.2).

[30] The Lake Area is not included as a landscape character area of Suzhou because it has a more or less natural lake landscape that is unlike the cultural landscapes of the other areas, with specific elements and structures.

Table 5.2 Description of the Drafted Landscape Character Areas of Suzhou

Source: Physiographic, hydrological/hydraulic, and agricultural land use characteristics adapted from Gong (1988, pp. 63–69); Wang (2006, pp. 33–34, 40–44); Zhu et al. (1988, pp. 21–25); contemporary characteristics of urban and industrial land use specified by the author.

No.	Landscape Character Areas	Description of Landscape Characteristics		
		Physiographic Characteristics	Hydrological/Hydraulic Characteristics	Land Use Characteristics
2	Wu-Cheng-Xi-Yu Plain Area			
2.1	Northern Riverside Shoaly Area	This new alluvial plain has been forming by shoals at the mouth of the Yangtze River. It has a flat topography, 4–6 m in elevation. This area has worse heat resource than the plain area in the east.	Most of this area is below the flood water level of the Yangtze River and is protected by the levee. This area has rich water resources and a good drainage system that ensures most farms be exempt from flooding and waterlogging.	This area has advanced modern agriculture and is a major area for cotton production. It has a highly mixed urban and polder landscapes, in which the highly urbanized city proper of Zhangjiagang as well as the industrial and port clusters superimposed on a standardized polder landscape.
2.3	Cheng-Xi-Yu Upland Area	This area is 3–4 m in elevation and has sparsely distributed hills around 200 m. Most of this area is located in a flat lacustrine plain with a crisscross water network. The regular farms in this area are highly productive and have good irrigation and drainage conditions.	This area controls and prevents floods from the western hilly area that might invade via the Grand Canal.	This area has aquatic farming, silk and pig breeding as the three main sideline production. This area has highly fragmented urban and industrialized rural landscape, including a network of small and middle sizes counties and towns, and widespread township and village enterprises.
3	Yang-Cheng-Dian-Mao Lakes and Plain Area	The northeastern riverside part is an upland area, 6–8 m in elevation; middle part is around 4–5 m; and the southeastern part is lowland, around 2.8–3.5 m.	This area is sprinkled with numerous lakes and water surface, accounting for 19 % of the whole area. The Yangcheng and Dianmao Plain areas function as a flood corridor of the Taihu Basin. Polder area composes 45.5 % of the whole area, in which polder mergence and standardization were firstly conducted among all sub-areas. The waterlogging issue of the low-lying plain limits the advantages of rich climate and soil resources for agricultural production.	Rich heat and water resources make this area an important grain production area. The southern part is an ideal area for double or triple cropping.

3.1	Yangcheng Lakes and Plain Area	This area is very low-lying with an average elevation of 2 m, which is below the flood water level. This area has a large water area consisting of dense canals and lakes. Most of this area is polder area, 3–4 m in elevation.	The streams and canals connecting to the Yangtze River were dredged and controlled by sluices. Run off in this area could drain efficiently to the Yangtze River. Polder area accounts for 49.7%.	Lake Yangcheng is a major area for fish and crab farming. The areas adjacent to Kunshan city and the Sino-Singapore Industrial Park are one of the most rapidly expanding metropolitan areas in the Taihu Basin.
3.2	Dianmao Lakes and Plain Area		This area has 24.7% of water surface and 39.3% polder area. Rivers and canals in this sub-area discharge into two directions: eastward into the Wusong River and southeastward into the Huangpu River via Lake Dianshan.	This area is relatively less populated and has a sparse road network because of the large water area. Due to the lagging urbanization and industrialization process, this area still has a high quality polder landscape.
3.3	Eastern Riverside-Coastal Plain Area	This area is located in a riverside, coastal plain, 4–5 m in elevation, increasing from north to south. This location is vulnerable to typhoon, and its proximity to large water body influences the climate of this area. This area has good heat conditions and abundant sunshine.	This area has rich water resources and good drainage. This area has a dense water network consisting of tide-influenced shallow, narrow canals.	This area has moderately high-lying fields that are suitable both for paddy and non-irrigated fields. It has an intensive and efficient farming system and is a major cotton and linen production area. In the meanwhile, this area has intensive urban and industrial land uses and is under high pressure of future development.
6	Hang-Jia-Hu Plain Area	This area is located in a flat plain. It has a large proportion of water area and a crisscross water network. The elevation decreases from southwest to northeast: The area along the Hangzhou Bay is 5–7 m in elevation; the central plain is about 3.5–4.5 m; the eastern part is about 3.2 m; and the area neighboring the Dian-Mao Plain and the upper reach of the Huangpu River are below 3.0 m.	The main water flow direction is from west to east, and the Grand Canal crosses this area in a north-south direction. This area has the worst drainage conditions among all eight hydraulic units as the west-east drainage route (more than 100 km) is inefficient. Thus, the southward canal connecting the Hangzhou Bay was built to be the primary one for drainage.	The mixed paddy and non-irrigated fields as well as the dense water network form a stereoscopic agriculture production of grain, cash crops, silk, and aquaculture.

6.1	West Grand Canal Drainage Area	This sub-area is at a relatively higher elevation. The most low-lying part—Linghu area is 2.8–3.5 m.	Large areas of lakes were reclaimed and turned into polder areas (68.3%). This area has a dense water network and is under threat of waterlogging.	This area is relatively less populated and has a sparse road network because of the distribution of numerous lakes and a dense water network. This area has rich agricultural production resources and few rural industries. Due to the lagging urbanization and industrialization process, this area still has high quality polder landscape based on a stereoscopic farming system of the mulberry dike-fish pond complex.
8	Lake Taihu Area			
8.2	Lakeside Hilly Area	The hilly area is situated in the north and east lakeshore. This area has dispersed hills at an elevation of 100–300 m and has a piedmont plain area of around 5 m.	The piedmont area has relatively high-lying fields with sparse streams, whereas the plain area has a dense water network. This area has good irrigation and drainage conditions.	The plain part is a highly productive area with intensive farming. The piedmont area has high vegetation cover and is a major production area of sub-tropical fruit trees (e.g. citrus, Chinese bayberry, and loquat). This area is close to the city proper of Suzhou, which is heavily populated and has advanced infrastructure for urban and industrial developments.

5.3 VISUAL IDENTIFICATION AND FIELD SURVEY

This draft character map of Suzhou was further refined by visual identification and field surveys. The characteristics of the identified physiographic and hydraulic units were compared by a *random sampling*[31] (Deming & Swaffield, 2011, p. 131) of the historical topographic maps (1:50,000, 1983), as well as Google Map and Tianditu (satellite images and survey maps, 2014). More character areas were identified during this process.

In order to confirm the newly identified character areas, field surveys (March–June, 2014) were conducted through these areas of Suzhou. The *perceptual characteristics* of these areas were documented based on the method of LCA, including information, such as *key elements*, *key characteristics*, structural character[32] (Tudor & Natural England, 2014, p. 39), as well as current status and future risks of each area. The characteristics were recorded in survey sheets. This step gathers legible and tangible landscape elements and structures of each area, such as canals, dikes, tree belts, vernacular dwelling styles, and parcellation pattern. This work of visual identification and field surveys in combination with the mapping approach were implemented as an iterative process to revise the draft character map of Suzhou.

5.4 MAPPING, DESCRIPTION AND CLASSIFICATION

The mapping, description, and classification of landscape character areas and types follow a combined qualitative and quantitative approach (Figure 5.5). This approach is divided into six sections, and the outcomes include a landscape character map of Suzhou, a description table of landscape structures, and a classification of landscape types.

---

[31] A random sampling is "the selection of data where the investigator has no influence upon the choices, which are made by chance (measured arithmetically)" (Deming & Swaffield, 2011, p. 131).

[32] The hierarchical approach of *key elements*, *key characteristics*, structural character (adapted from *landscape character*) is generated from the LCA guidance (Tudor & Natural England, 2014, p. 39) and Jessel (2006, see Sect. 2.2.1) for documenting landscape character and monitoring their changes. In this research, key elements are considered as those particularly prominent elements that contribute to key characteristics. Key characteristics are "those attributes that are visually prominently and consistent throughout a particular Landscape Type" (Worcestershire County Council, n.d.). The changes in key characteristics will cause a deterioration of landscape character, thus they could be used as indicators to monitor landscape changes, and could lead to different measures in landscape practices (Tudor & Natural England, 2014). Structural character is a combination of its key characteristics, which shows the spatial interactions between different key characteristics. This can lead to an evaluation of the *significance* that different attributes could contribute to landscape character (Worcestershire County Council, 2012).

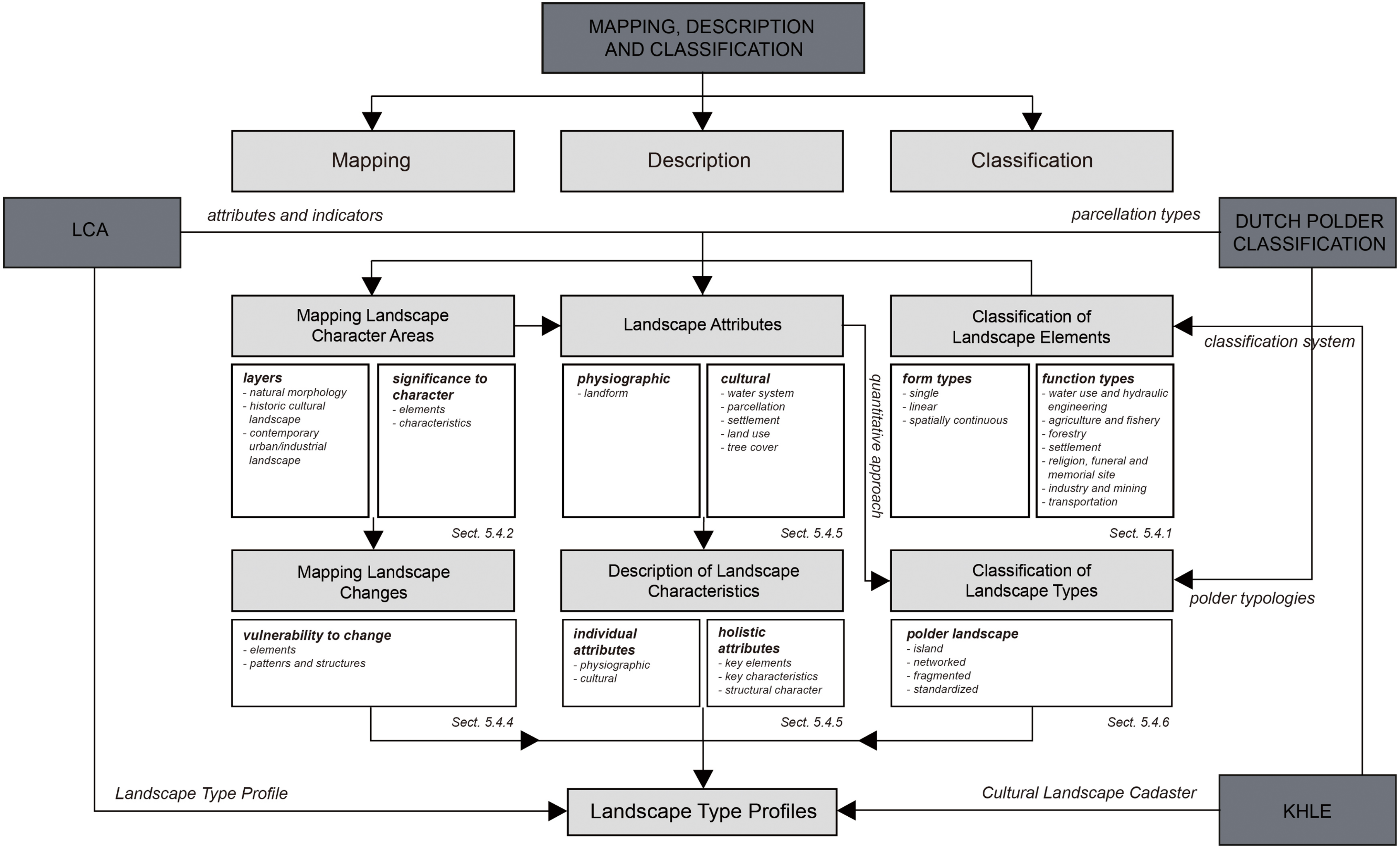


Figure 5.5 A Combined Qualitative and Quantitative Approach of Mapping, Description and Classification

Source: Author's flowchart.

5.4.1 CLASSIFICATION OF HISTORIC CULTURAL LANDSCAPE ELEMENTS

According to the analysis of terms in Chapter 2, landscape elements are individual components that constitute a landscape, whereas landscape structures are formed by the elements and their perceivable and comprehensible interrelations. Landscape structures, or the underlying landscape types as the logic of organizing elements in distinct spatial patterns, define the characteristics of a particular landscape. Thus, landscape elements are used as analytic items in this research for defining, mapping, and describing landcape characteristics and structures of particular landscape character areas or types (see the hierarchical approach in Sect. 2.2.1).

The classification of landscape elements is the primary step for the next mapping and description sections. By referring to the German KHLE classification systems (see Sect. 3.5) as well as the literature review and field surveys of landscape elements in the YRD, 105 elements were identified. They were classified into seven clusters of function types: water use and hydraulic engineering, agriculture and fishery, forestry, settlement, religion, funeral and memorial site, industry and mining, and transportation (Appendix B, Table 5.11). Additionally, these elements were categorized into three clusters of form types: single, linear, and spatially continuous elements (Appendix B, Table 5.12).

In the case study of Suzhou, 37 key elements that substantially shape the landscape structures were chosen from among the 105 elements in categories of five function types to map, describe, and define landscape character areas and types (Table 5.3).

Table 5.3 Key Elements for Mapping and Describing Landscape Character Areas

Source: Author's table.

Function Types	Key Elements
Water Use and Hydraulic Engineering	dikes, polder embankments, sluices, ditches, ponds
Agriculture and Fishery	cropland, paddy fields, field paths, field ridges, fishponds, fishpond embankments, huts, orchards
Forestry	nurseries, avenue trees, trees along canals, dikes, fishpond embankments, polder embankments, or roads, ancient trees
Settlement	block of residences, colonnades, moats, pagodas, traditional gardens, vernacular dwellings
Transportation	docks, canals, water lanes, towpaths, alleys, paths, stone embankments, streets, village roads, bridges

5.4.2 MAPPING LANDSCAPE CHARACTER AREAS

As illustrated in Chapter 3, landscape "as a palimpsest" still bears the traces of visible forms and morphologies of earlier layers and includes the landscape elements from various time periods. Presuming that the current landscape structures are *palimpsests* (Corboz, 1983, see Sect. 3.2) formed by different historic layers that are superimposed on top of the others, these structures could be decomposed into three layers[33]: The base layer of natural morphology shows the forms of natural landscapes shaped by local topographical and hydrological conditions; the overlaid layer of historic cultural landscape indicates the forms (mostly geometric) of agricultural landscapes shaped by the interaction between farming, hydraulic activities of reclamation and poldering, and natural landscapes; and the top layer of contemporary urban/industrial landscape shows the form of urban land use such as urban housing, infrastructure and industry that are newly superimposed on agricultural landscapes. The mapping approach at municipal and local scales was conducted using a morphogenetic analysis (see also Chap. 4) of these three layers.

We conducted a *representative sampling* (Deming & Swaffield, 2011, p. 131)[34] at the first stage of mapping based on the results of the random sampling in Sect. 5.3. At the municipal scale, the typical sections (about 10×15 km) of the drafted landscape character areas were mapped and analyzed at 1:25,000[35]. The outlines of Google satellite images and survey maps of Tianditu (2015) were selectively copied out to interpret the overall landscape morphologies and structures in the following way. We transferred characteristic landscape elements in the satellite images into the layers of natural morphology (e.g. water, contour lines), historic cultural landscape (e.g. field or polder enclosure, fishpond textures, and blocks of rural dwellings), and contemporary urban/industrial landscape (e.g. urban blocks, industrial areas, infrastructure). For instance, in the mapping of the lakeside polder area: The natural morphology layer indicates the water system of lakes, canals, and drainage ditches; the historic cultural landscape layer is comprised of patterns of parcellation, enclosure, and fishponds; and the contemporary urban/industrial landscape layer is represented with new

---

[33] The three layers defined here were adapted from the overlapped three layers described by Steenbergen (2008): "The natural landscape which reflects the history of its geological origins; the man-made landscape that was created in the confrontation between the natural form and a reclamation grid; and the city, with a pattern of urban functions in relation to the traffic network as its foundation"(p. 16).

[34] A representative sampling is the opposite of a random sampling. It is "the process of selecting data in order to be able to draw statistical conclusions that extend beyond the actual data analyzed, most typically about a wider population from which it is drawn. Representative techniques involve careful proportional and categorical selections of respondents, sites, objects, etc., that depend very much on the conceptual constructs guiding the study" (Deming & Swaffield, 2011, p. 131).

[35] The mapping results at the local authority scale are from the Mapping Seminar "Design Historic Cultural Landscape Elements as Green-blue Infrastructure—Suzhou, China" at the Professorship of Landscape Architecture and Regional Open Space (LAREG), Technical University of Munich, Summer Semester 2015.

urban housing (expanded around rural dwellings), industrial areas, and the transport network; the built-up areas are drawn as abstract volumes, and are rendered with shadow to enhance the 3D spatial effect (Figure 5.6).

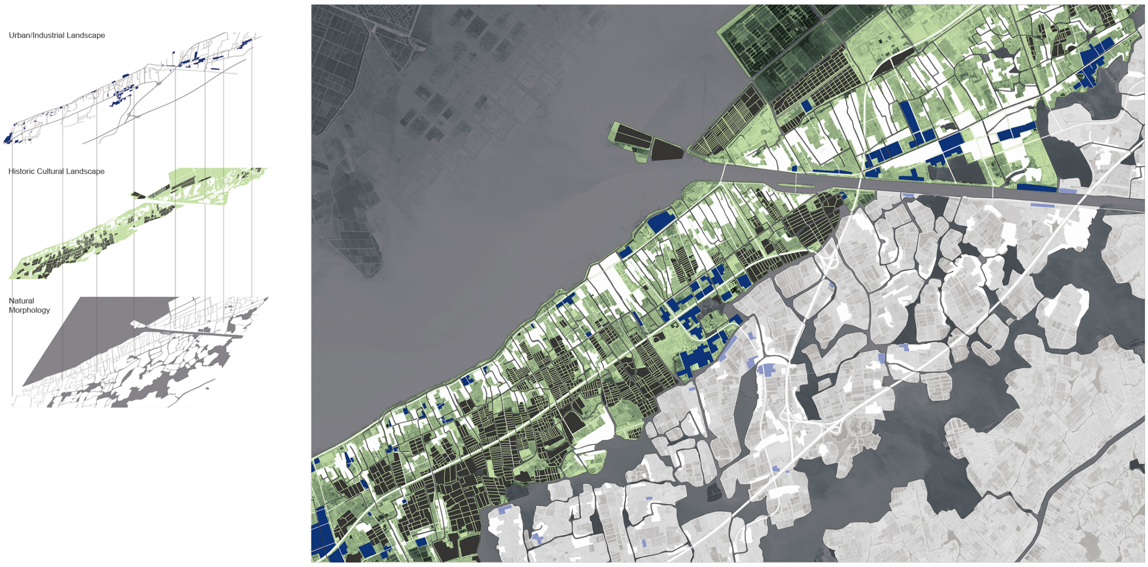


Figure 5.6 Mapping of the Lakeside Polder Area at the Municipal Scale of 1:25,000

Source: Drawn by Miao Yang, based on Google Maps 2010, in the TUM LAREG Mapping Seminar 2015. Three landscape layers are added by the author.

At the local scale, each landscape area (about 0.8×1.2 km) was further visualized at 1:5,000, which is almost the minimum scale for urban and landscape planning. More details of landscape elements in Google satellite images and Tianditu survey maps (2015) were mapped to interpret the spatial configuration of elements. Correspondingly, we mapped the layer of natural morphology (e.g. rivers, canals, lakes, woodland, and trees), historic cultural landscape (e.g. field/polder enclosure and parcellation shaped by country roads, field paths, and drainage ditches; orchards and plantation; ponds and fishponds; farmsteads and rural dwellings), and contemporary urban/industrial landscape (e.g. urban housings, factories, roads, and green spaces) by overlaying characteristic elements. For example, the same area of the lakeside polder area was zoomed in on and mapped with more details of elements (Figure 5.7): The natural morphology layer indicates the canals and Lake Taihu as well as the linear avenue trees, canalside tree belts, tree groups associated with settlements, and woodland along the Taihu Levee; the historic cultural landscape layer is represented with the farmsteads and dwellings, the polder enclosure and parcellation shaped by the country roads, field paths and drainage ditches, and relatively new land use of standardized fishponds; the contemporary urban/industrial landscape layer is shown with the factories and a road network. The Google satellite imagery was placed beneath to show the field texture. The dwellings, factories and trees were rendered with shadow to enhance the 3D spatial character.

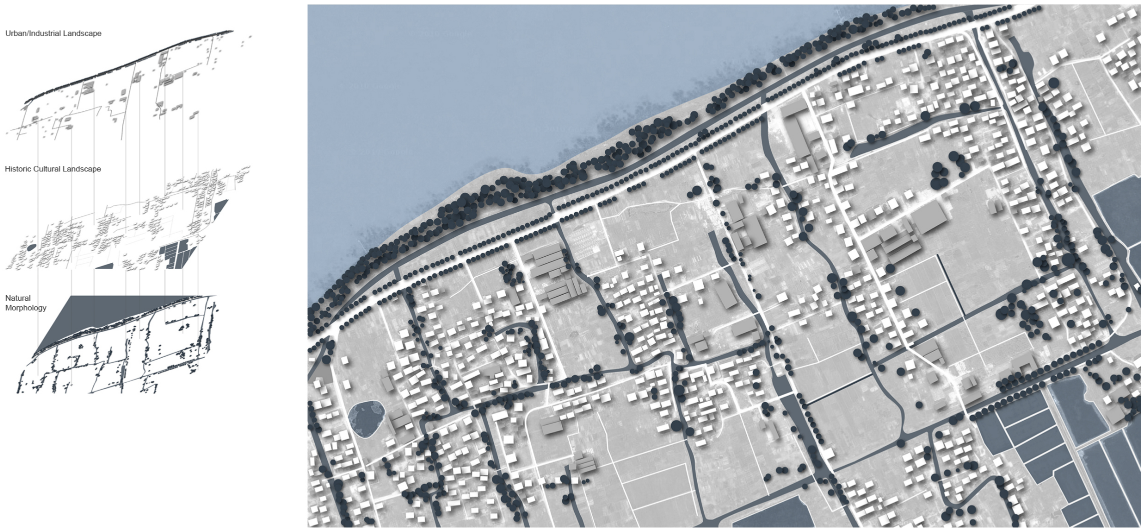


Figure 5.7 Mapping of the Landscape Character Area—Lakeside Polder Area at the Local Scale of 1:5,000

Source: Drawn by the author based on the satellite images from Google Maps 2015.

Thereafter, the complexities and varieties of the combination of elements were generalized and reduced to deduce the *basic form* of a landscape structure[36] (Argan, 1996, p. 243). Here, a basic form is interpreted as an "internal formal structure" (ibid.) or as an "archetype" (Steenbergen, 2008, p. 15; Thiis-Evensen, 1987), and will serve to develop landscape types as a result of such a generalization process. The basic form of the landscape structure in the lakeside polder area was deduced by an abstraction and reduction of landscape elements (Figure 5.8): The linear tree belts and woodland along the levee are drawn as abstract volumes; farmsteads and dwellings are generalized as blocks; the field enclosure and parcellation are outlined by mapping the country roads, field paths and drainage ditches; the new agricultural and urban elements are excluded in discussion as they haven't altered the basic form of the landscape structure but only overlapped it.

According to the mapping results of the landscape structures at 1:25,000 and the deduced basic forms at 1:5,000, we observed that the characteristics of these structures and basic forms are primarily shaped by their natural morphologies, such as topography and the patterns of water elements (e.g. rivers, canals, ditches, and lakes). Furthermore, these characteristics are also associated with the landscape elements in historic cultural and contemporary urban/industrial layers: The forms of field enclosure and parcellation (e.g. country roads, field paths, and drainage ditches) also outline these structures; the patterns of settlement (e.g. rural dwellings, farmsteads), vegetation cover (trees, woodland), and new agricultural (fishponds, orchards and plantations), and urban and industrial land use (e.g. urban blocks, industrial areas, infrastructure) all influenced the appearances of these landscape structures. These results will assist in the development of attributes for classifying

[36] Argan argues "the type is to be regarded as a scheme which is derived from reducing the whole of formal variants to a common basic form" (1996, p. 243).

landscape types, and will aid the evaluation of the significance of different elements and structures that could contribute to the landscape character of a particular type.

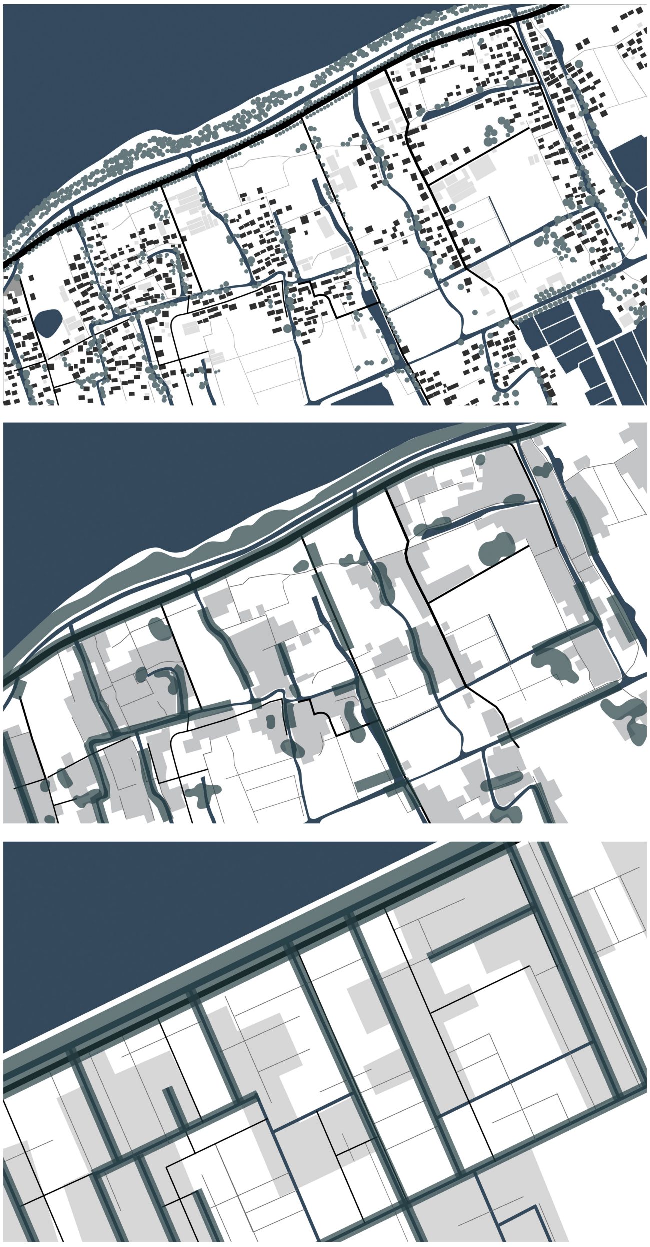


Figure 5.8 Deducing Process of the Basic Form of the Lakeside Polder Landscape

Source: Drawn by the author.

5.4.3 MUNICIPAL LANDSCAPE CHARACTER MAP

Based on the outcomes of desktop research, field surveys and mapping, 13 discrete landscape character areas were identified within the administrative boundary of Suzhou municipality (Figure 5.9).

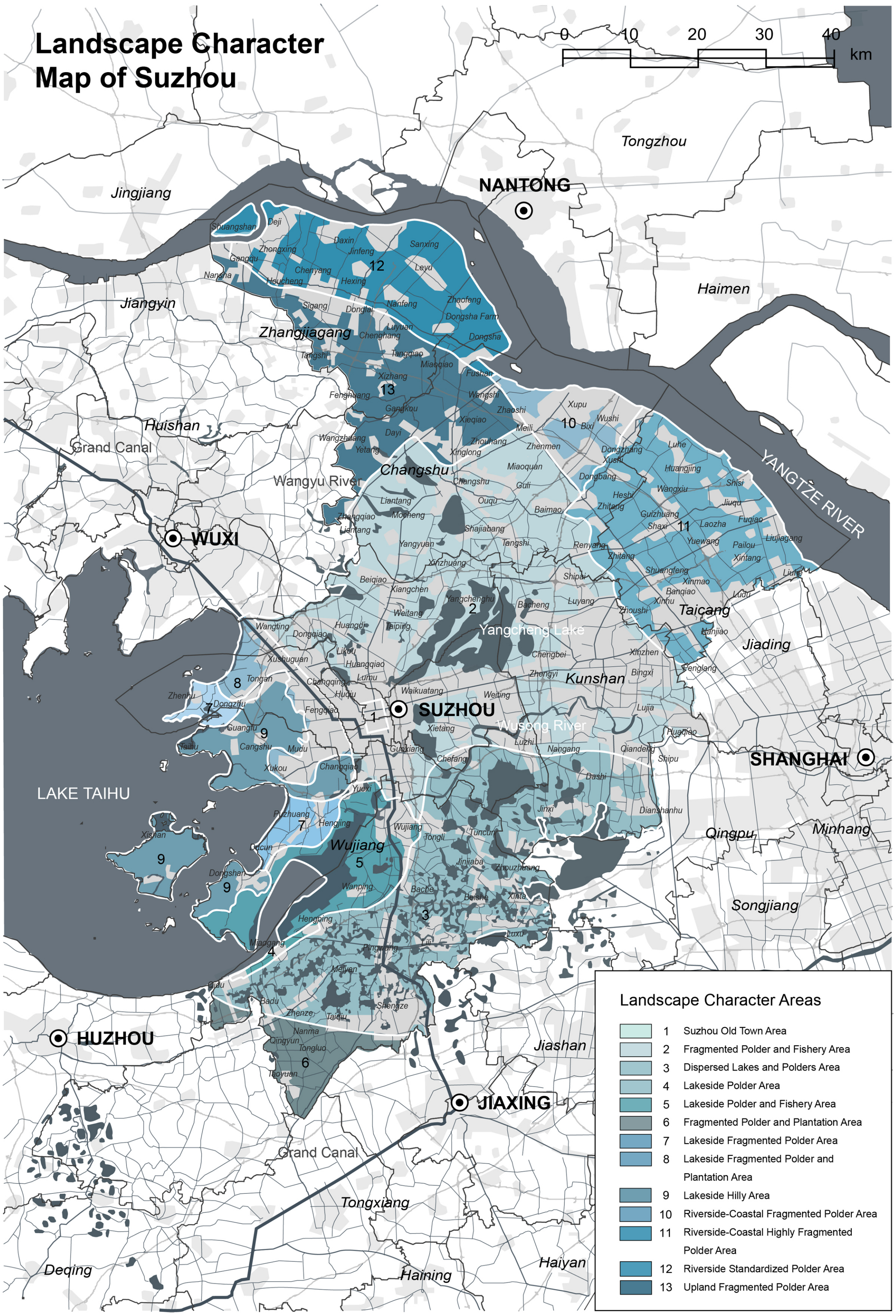


Figure 5.9 Landscape Character Map of Suzhou Municipality

Source: Author's map.

To identify landscape character areas and create the landscape character map, dealing with the boundaries of these areas is a key procedure. However, it is almost impossible and therefore pointless to distinguish the ever-changing boundaries of urban, rural, and natural areas in the rapidly expanding metropolitan areas of Suzhou. Contemporary urban, suburban, rural, and natural landscapes are considered as components of an entire character area rather than distinguishing one from the others. This means one character area may include historic urban landscapes of a city proper or several town cores, as well as highly mixed urban, polder or hilly landscapes in their hinterlands. The hydraulic division map (1:550,000, 1997), historical topographic maps (1:25,000 or 1:50,000 from 1910s–1940s, see Figure 4.21; 1:50,000, 1983), and satellite images (15 or 30 m resolution, 1980s–2012) were used as references to distinguish the landscape characteristics of one area from the neighboring areas. Historic landscape character—forms and patterns of polder and water systems—mostly shaped by agricultural and hydraulic activities were evaluated as the primary determinant rather than modern, but generic, urban or industrial landscape character. New agricultural land use such as for orchard, plantation and fishery, which overlapped with the former cultivated land, mostly paddy fields, were also taken into account as they have significantly influenced the present appearances of polder landscapes. Besides these cultural factors, physical boundaries such as rivers, lakes, canals, and mountains were also used as a subordinate determinant during the adjustment of the boundaries.

Nevertheless, there is still a limitation to defining boundary lines. More precise boundaries or more character areas might be identified if provided with historical topographic maps of the full territory (accessible ones are incomplete pieces) of Suzhou or satellite images in higher resolution.

5.4.4 MAPPING LANDSCAPE CHANGES

In comparison with the relatively stable landscape character of the British cases, landscape structures in the YRD change rapidly and dramatically, especially in the metropolitan areas in Suzhou due to the new development of real estate, rural industries, and mass infrastructure. In order to visualize this progressive overlay process of natural morphology, historic cultural landscape and contemporary urban/industrial landscape, mapping the rapid landscape changes is necessary. At the regional scale, first indications of the vulnerability of cultural landscapes and their potential for green-blue infrastructure were given (Appendix B, Table 5.10). At the municipal scale, the following step makes the transformation and destruction process of historic landscape elements and structures in metropolitan areas visible and concrete.

The mapping work in this section focuses on analyzing the overlay process of the contemporary urban/industrial landscape layer onto the historic cultural landscape layer. The common rules of transformation and the co-evolution of landscape elements were studied by analyzing one single element or several inter-related elements. The temporal-spatial landscape transformation since the early 1980s[37] was studied by monitoring and mapping the topographic maps (1:50,000, 1983), Google satellite images (2000s–2010s) and other remote sensing images (1980s–2010s)[38]. The topographic maps of the early 1980s display the historic structures of cultural landscapes (e.g. field/polder parcellation and enclosure, and fishpond textures) that overlapped the natural morphologies (e.g. water systems). Moreover, the mapping of satellite images from the 2000s–2010s indicates how the rapidly expanding urban and industrial land use (e.g. urban residential and industrial areas) and infrastructure (e.g. road networks and railways) have overlaid and destroyed historic cultural landscapes.

For example, we overlaid the successive landscape structures of the lakeside polder area from 1983, 2004, to 2013 at 1:50,000 (Figure 5.10). From 1983 to 2004, the growing fishpond areas replaced the arable land, and after 2004, the morphology of fishponds changed dramatically along the new grid road network after 2004; during the three decades, the rapidly expanding mixed residential and industrial areas along the new road network were superimposed onto the historic landscape layer. Furthermore, the detailed changes of landscape morphologies and structures were exemplified in three sections at 1:15,000, from 2004 to 2013. The mapping results of Section A show the construction of the highway and the new road grid has driven the structural changes of canal and fishpond systems in this area; Section B indicates the expansion of industrial areas along the two primary roads; and Section C represents the common rule of urbanization and industrialization in rural areas by drawing the mixed residential and industrial blocks that have sprung up along the new road network (Figure 5.11).

To sum up, it is predominately the expanding urban/industrial (e.g. housing, industries, and mass infrastructure) and the newly emerging agricultural land uses that have changed the character of historic cultural landscapes. The changes in water system patterns are mainly owing to the growing land uses of standardized fishery, transport, urban housings, and industry. The parcellation patterns have been altered by the standardized fishponds, urban and industrial areas, and in some cases, discrete or interlocking orchards and plantations have been superimposed on most of fields within their historic parcellation patterns. The changes in settlement patterns are to a large extent because of the expanding urban housing and industrial areas. The changes of tree cover character are intimately related to the new land uses of orchards and plantations. Furthermore, different characteristics have different levels of vulnerability to change: In general, the water system and parcellation patterns are more stable as they are related to the permanent structures and character shaped by land reclamation, poldering, and paddy-fish-silk farming since ancient times (see Chap. 4); whereas the patterns of tree cover, settlement and land use are more vulnerable to functional and structural changes in current and future urbanization and industrial development. The

---

[37] See Sect. 3.14. The year 1978 was defined as the dividing point in timeline between historic and contemporary landscapes.

[38] The results of the mapping of landscape changes were achieved by teamwork in the Mapping Seminar 2015.

outcomes of this section could aid the evaluation of the vulnerability of particular attributes, which might lead to different measures in landscape practice.

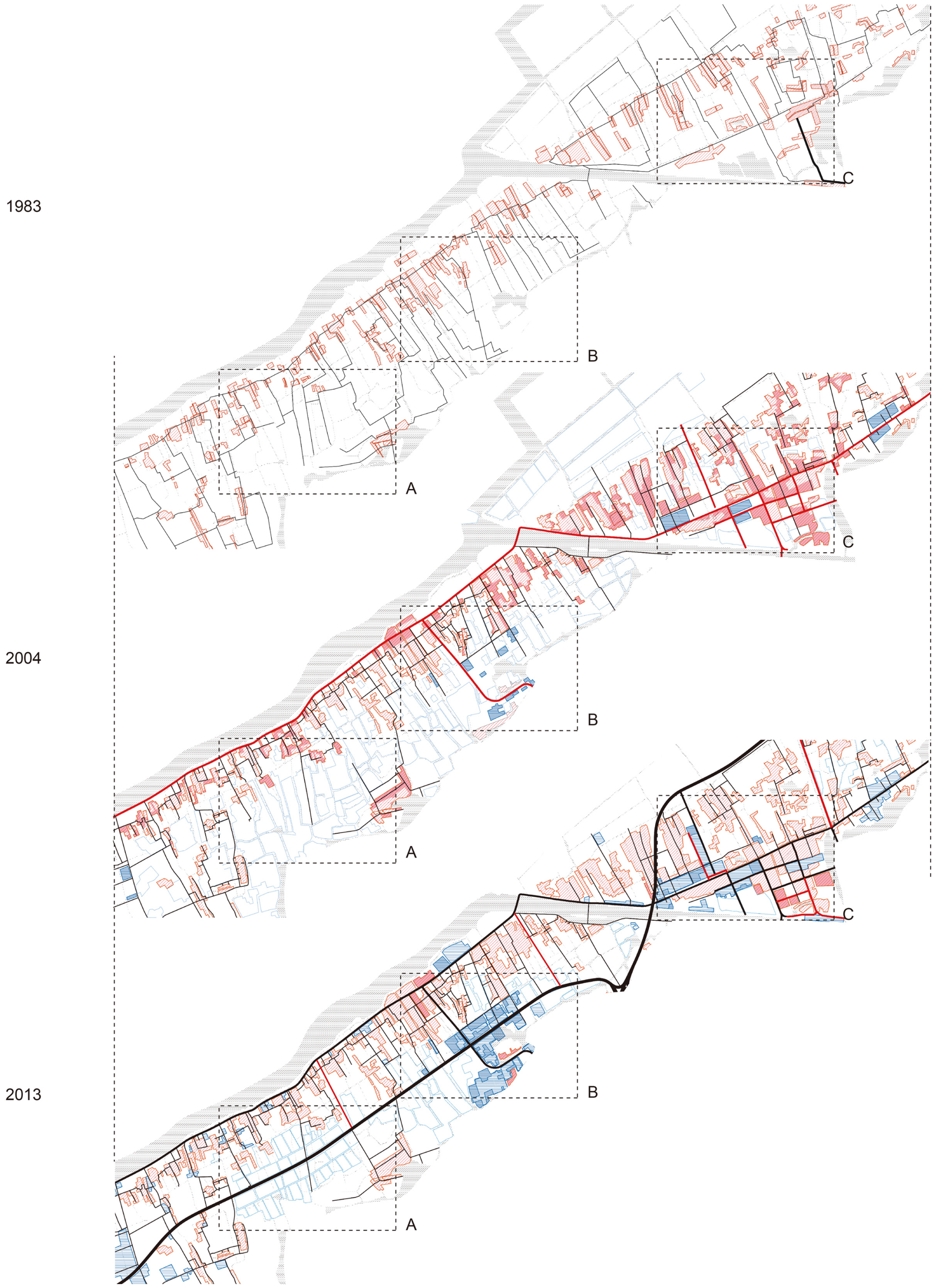


Figure 5.10 Overlay of the Successive Landscape Structures of the Lakeside Polder Area from 1983, 2004, to 2013 at 1:50,000

Source: Drawn by Miao Yang in the Mapping Seminar 2015 and revised by the author.

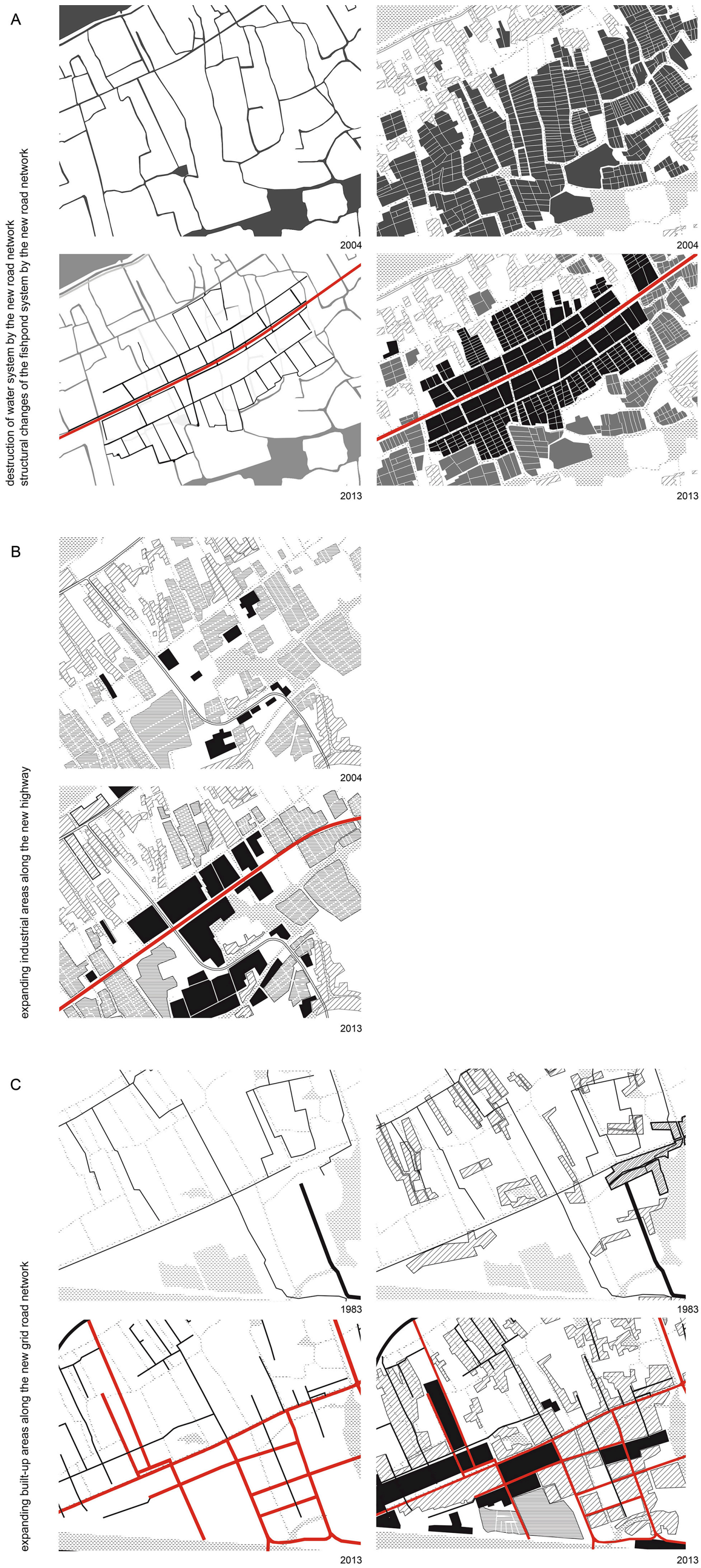


Figure 5.11 Detailed Mapping of Landscape Structural Changes at 1:15,000

Source: Drawn by Miao Yang in the Mapping Seminar 2015 and revised by the author.

5.4.5 DESCRIPTION OF LANDSCAPE CHARACTERISTICS

The results of the previous mapping section show the basic forms—typical patterns and structures as recurring and varying forms—of each landscape. These patterns can be described by *individual attributes* (*Shuxing*). By discovering key elements (that carry the attributes) and key characteristics (that conjoin the attributes), the individual attributes will be related, leading to typical structural character.

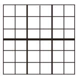
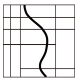
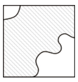
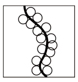
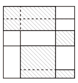
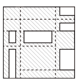
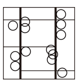
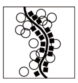
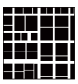
By referring to the Worcestershire LCA, two types of attributes, physiographic and cultural are differentiated (see Sect. 3.4.4): One physiographic (*landform*) and three cultural (*tree cover*, *settlement*, and *land use patterns*) attributes were adapted. The additional but site-specific attributes: *Parcellation pattern*[39] was adapted from the *parcellation types* of Dutch polders (De Wit, 2009, p. 37); *water system pattern* was generated from the mapping results. All these attributes together cover all patterns and structures found in mapping (Table 5.4). The description of the three holistic attributes *key elements*, *key characteristics*, and *structural character* follows a hierarchical approach (see Footnote 5) based on the results from field surveys and mapping. The qualities of the 13 landscape character areas identified were documented according to the nine attributes (Table 5.5), which will assist in the subsequent classification step.

---

[39] The study of parcellation patterns primarily focuses on the morphological characteristics of parcels. Land tenure is not discussed, as its characteristics are dynamic and complicated due to the land reforms and urbanization (from the collective ownership of rural land to the state ownership of urban land), especially after the 1950s.

Table 5.4 Description of Landscape Attributes

Source: The sections of tree cover, settlement, and land use patterns are adapted from Worcestershire County Council (2013, pp. 15–16); the section of parcellation pattern is adapted from De Wit (2009, p. 37). All descriptions are based on a summary of landscape characteristics found in the 13 landscape character areas of Suzhou.

Patterns	Attributes	Forms of Patterns	Description of Attributes
Water System Pattern the spatial characteristics of water systems, including the forms and patterns of rivers, streams, lakes, canals, and ditches	organic network		a continuous network of dispersed lakes and canals, whose form is related to the distribution and organic shapes of the surrounding polders reclaimed from lakes and marshes
	geometric network		a continuous network of canals with a strongly geometric pattern owing to polder standardization after the 1950s
	hybrid network		a continuous network of streams and canals with a hybrid character that has both geometric or curving forms
	fragmented network		a continuous network of curving canals in a branched structure with a fragmented character, which is normally composed of a main chain canal with one or more subsidiary branches
	fragmented		highly fragmented (curving) streams and canals, not in a continuous network
	dispersed		dispersed natural streams and ponds associated with settlements, normally in hilly areas
Tree Cover Pattern "the spatial juxtaposition of individual trees and woodland cover" (Worcestershire County Council, 2013, p. 16)	continuous		"woodland cover dominating the area" (ibid.)
	linear		tree belts along linear water elements, such as rivers, canals or ditches, or along other linear elements like roads, dikes or polder embankments
	discrete		"separate and clearly defined blocks of woodland" (ibid.), normally are orchards or nurseries that superimposed on the fields within the historic framework of parcels
	interlocking		"frequent woodland blocks and/or wooded corridors forming physically or visually linking patterns, creating the impression of a heavily wooded landscape"(ibid.); normally are dense orchards or nurseries that were superimposed on former fields, whose parcellation pattern is still visible
	scattered		"pattern defined by densely or thinly scattered trees" (ibid.) mostly associated with dikes (e.g. polder and fishpond embankments)
	groups		"the pattern of tree cover is solely characterised by discrete groups and/or small assemblages of trees, usually associated with farmsteads and or rural settlements" (ibid.)
Settlement Pattern the spatial characteristics of	rectangular blocks		a roughly rectangular pattern of urban settlements framed by streets

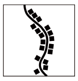
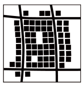
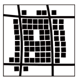
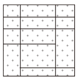
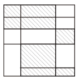
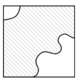
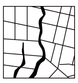
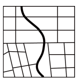
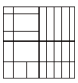
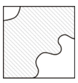
historic urban or rural settlements	linear canalside		linear single villages along the canals, normally lines of or narrow bands of dwellings on one side or both sides of canals
	nucleated canalside		discrete large single towns or expanded villages, normally situated at the junctions of canals
	clustered canalside		"multiple settlement nuclei (discrete small villages and/or hamlets)" (Worcestershire County Council, 2013, p. 15), normally situated within a framework of canals
	nucleated wayside		discrete large single villages along roads
	dispersed dwellings		"scattered farmsteads and occasional rural dwellings" (ibid.)
Land Use Pattern the characteristics of dominant (or mixed) land use types shaped by physical features of land, agricultural activities, and urbanization; new agriculture-related land uses (e.g. fishery, orchard and plantation) are also included	residential		dominance of densely populated residential areas in historic urban or town cores, including residence complexes with classic gardens, rows of townhouses (normally one or two-story timber-framed dwellings), and single-family houses
	cropping		dominance of cropping landscape, including (predominantly) rice, wheat and vegetables
	fishery		dominance of fishery landscape, with fishponds framed by dikes in a geometric fabric; the new standardized fishponds were built in an industrial way no longer following the historic parcellation pattern
	orchard		dominance of orchard landscape for fruit production; this new land use is expanding and superimposed on the cropping landscape
	plantation		dominance of plantation landscape with nurseries for ornamental plants and other cash crops such as mulberry trees, cotton and tea; this new land use is expanding and superimposed on the cropping landscape
	woodland		"heavily wooded landscape" (ibid.)
Parcellation Pattern the spatial characteristics of enclosure and parcellation defined by the forms of field ridges and paths, canals and ditches, and dikes; the parcellation patterns of polders are identified according to the levels of rationalization (De Wit, 2009)	fractal geometry		a fractal pattern of parcellation associated with the forms of water systems (e.g. ditches, canals and lakes) and field boundaries
	hybrid system		a sub-regular pattern of parcellation with a mixture of straight and curving boundaries, this pattern is normally a result of "a gradual transition from the fractal to the rational system" (De Wit, 2009, p. 37)
	rational parcellation		a geometric pattern of parcellation with mainly straight boundaries
	unenclosed		an unenclosed pattern of continuous woodland in the hilly area

Table 5.5 Description of Landscape Characteristics of Identified 13 Landscape Structures

Source: The attributes of landform, tree cover pattern, settlement pattern, and land use are adapted from the Worcestershire LCA (Worcestershire County Council, 2013). All descriptions are based on the landscape characteristics found in field surveys and the mapping of 13 landscape structures identified in Suzhou.

No.	Landscape Character Areas	Individual Attributes						Holistic Attributes		
		Physiographic	Cultural							
		Landform	Water System Pattern	Parcellation Pattern	Settlement Pattern	Land Use Pattern	Tree Cover Pattern	Key Elements	Key Characteristics	Structural Character
1	Suzhou Old Town Area	low lying plain	hybrid network	rational parcellation	rectangular blocks	residential	linear tree belts, scattered trees, tree groups	sluices, avenue trees, ancient trees, blocks of residences, colonnades, moats, pagodas, traditional gardens, docks, canals, water lanes, alleys, stone embankments, streets, bridges	the patterns of water system, urban parcels, and settlements	Two paralleled grids of intersecting roads and canals define the regular urban fabrics and the structure of this historic urban landscape.
2	Fragmented Polder and Fishery Area	very low lying plain	fragmented network	fractal geometry	linear canalside, nucleated canalside	fishery	linear tree belts, scattered trees, tree groups	polder embankments, sluices, ditches, fishponds, fishpond embankments, huts, trees along canals/fishpond embankments/roads, ancient trees, vernacular dwellings, docks, canals, towpaths, paths, village roads, bridges	the patterns of water system, parcellation, and settlement, the land use pattern of fish farming	The fragmented canal network and fractal enclosure pattern outline this landscape structure; the linear canalside settlements, tree belts, especially the geometric fabric of fishponds, strengthen this structure.
3	Dispersed Lakes and Polders Area	very low lying plain	organic network	fractal geometry	linear canalside, nucleated canalside	cropping, fishery	linear tree belts, discrete woodland, scattered trees, tree groups	polder embankments, sluices, ditches, cropland, paddy fields, field paths, field ridges, fishponds, fishpond embankments, huts, orchards, nurseries, trees along canals/polder embankments, ancient trees, colonnades, vernacular dwellings, docks, canals, stone embankments, village roads, bridges	the patterns of water system, parcellation, and settlement, the integrated land uses of rice and fish farming	The organic shaped water system and fractal enclosure patterns shape the basic landscape structure; the linear canalside settlements and tree belts highlight this structure.
4	Lakeside Polder Area	very low lying plain	hybrid network	hybrid system	linear canalside, clustered canalside	cropping, residential	linear tree belts, tree groups	dikes, polder embankments, sluices, ditches, cropland, paddy fields, field paths, field ridges, fishponds, fishpond embankments, trees along canals/dikes/roads, ancient trees, vernacular dwellings, docks, canals, village roads, bridges	the patterns of water system, parcellation, and settlement	The sub-regular canal network along the Taihu lakeshore shapes the basic framework and characteristics of this structure; the dense linear and clustered canalside settlements as well as tree belts typify this structure.

5	Lakeside Polder and Fishery Area	very low lying plain	hybrid network	hybrid system	linear canalside, nucleated canalside	fishery, orchard, plantation	linear tree belts, interlocking woodland, tree groups	dikes, polder embankments, sluices, ditches, cropland, paddy fields, field paths, field ridges, fishponds, fishpond embankments, huts, orchards, nurseries, trees along canals/dikes/fishpond embankments/roads, ancient trees, vernacular dwellings, docks, canals, village roads, bridges	the patterns of water system, parcellation, and settlement, the mixed land use of fishery, orchard, and plantation	The sub-regular canal network and enclosure pattern shape the basic landscape structure; the linear canalside settlements and tree belts strengthen this structure; the mixed fishponds as well as interlocking orchards and plantations superimposed on most fields within their historic parcellation patterns.
6	Fragmented Polder and Plantation Area	very low lying plain	fragmented network	fractal geometry	linear canalside, nucleated canalside	cropping, orchard, plantation	linear tree belts, interlocking woodland, tree groups	polder embankments, sluices, ditches, fishponds, fishpond embankments, huts, trees along canals/fishpond embankments/roads, ancient trees, vernacular dwellings, docks, canals, towpaths, paths, village roads, bridges	the patterns of water system, parcellation, and settlement, the mixed land use of cropping, orchard, and plantation	Patterns of the fragmented canal system and fractal enclosure define the basic landscape structure; the linear canalside settlements frame the canal network; orchards and plantations have predominantly superimposed on the fields with a still visible historic parcellation pattern.
7	Lakeside Fragmented Polder Area	low lying plain	hybrid network	hybrid system	linear canalside	cropping, orchard, plantation	linear tree belts, discrete woodland, tree groups	polder embankments, sluices, ditches, cropland, paddy fields, field paths, field ridges, fishponds, fishpond embankments, orchards, nurseries, trees along canals/roads, ancient trees, vernacular dwellings, docks, canals, village roads, bridges	the patterns of water system, parcellation, and settlement, the mixed land use of cropping, orchard, and plantation	The sub-regular canal network and enclosure pattern outline the basic landscape structure; the linear canalside settlements and tree belts strengthen this structure; discrete orchards and plantations have replaced parts of fields within their historic parcellation patterns.
8	Lakeside Fragmented Polder and Plantation Area	low lying plain	fragmented network	hybrid system	nucleated canalside	cropping, orchard, plantation	linear tree belts, interlocking woodland, tree groups	sluices, ditches, cropland, paddy fields, field paths, field ridges, fishponds, fishpond embankments, orchards, nurseries, trees along canals/roads, ancient trees, vernacular dwellings, docks, canals, village roads, bridges	the patterns of water system, parcellation, and settlement, the mixed land use of cropping, orchard, and plantation	The fragmented canal system and hybrid enclosure pattern define the basic landscape structure; the nucleated settlements mark the junctions of the irregular canal network; interlocking orchards and plantations have superimposed on most fields with a still visible historic parcellation pattern.
9	Lakeside Hilly Area	hilly area	dispersed	unenclosed	nucleated wayside	woodland	continuous woodland, tree groups	cropland, field paths, ridges, trees along roads, ancient trees, vernacular dwellings, docks, canals, paths, village roads	the landforms and the tree cover character	The nucleated wayside settlements and occasional scattered fields are distributed dispersedly in continuous woodland.

10	Riverside-Coastal Fragmented Polder Area	low lying plain	hybrid network	hybrid system	linear canalside	cropping	linear tree belts, discrete woodland, tree groups	dikes, polder embankments, sluices, ditches, cropland, paddy fields, field paths, field ridges, fishponds, fishpond embankments, trees along canals/dikes/roads, ancient trees, vernacular dwellings, docks, canals, paths, village roads, bridges	the patterns of water system, parcellation, and settlement	The sub-regular canal network and enclosure pattern shape the landscape structure; linear canalside settlements and tree belts strengthen this structure.
11	Riverside-Coastal Highly Fragmented Polder Area	low lying plain	fragmented	hybrid system	linear canalside, dispersed dwellings	cropping	linear tree belts, scattered trees, tree groups	dikes, polder embankments, sluices, ditches, ponds, cropland, paddy fields, field paths, ridges, trees along canals/dikes, ancient trees, vernacular dwellings, docks, canals, paths, village roads, bridges	the patterns of water system, parcellation, and settlement	The fragmented canal system and hybrid enclosure pattern define the basic landscape structure; the linear canalside settlements and dispersed rural dwellings frame the canal network.
12	Riverside Standardized Polder Area	low lying plain	geometric network	rational parcellation	linear canalside	cropping	linear tree belts, discrete woodland, tree groups	dikes, polder embankments, sluices, ditches, ponds, cropland, paddy fields, field paths, field ridges, trees along canals/dikes, ancient trees, vernacular dwellings, docks, canals, paths, village roads, bridges	the patterns of water system, parcellation, and settlement	The geometric canal network and enclosure pattern outline the basic landscape structure; the linear canalside settlements and tree belts strengthen this structure; this polder landscape has a planned character.
13	Upland Fragmented Polder Area	low lying plain	fragmented	hybrid system	linear canalside, nucleated canalside, dispersed dwellings	cropping	linear tree belts, tree groups	polder embankments, sluices, ditches, ponds, cropland, paddy fields, field paths, field ridges, trees along canals, ancient trees, vernacular dwellings, docks, canals, paths, village roads, bridges	the patterns of water system, parcellation, and settlement	The fragmented canal system and hybrid enclosure pattern define the basic landscape structure; linear settlements, dispersed rural dwellings, and linear tree belts frame the canals.

5.4.6 CLASSIFICATION OF LANDSCAPE TYPES

On scrutiny of the key characteristics and structural character of the 13 landscape structures described, the significance of the key characteristics was evaluated, and their overlapping relationships became apparent. Because of the dominance of the topography and the comparatively minor influence of cultural landscape structures in the differentiation between lowland landscape and hilly landscape, the following classification will focus on lowland landscape (the hilly landscape occurring in Area 9 is no longer discussed). By taking this focus, it becomes more apparent, how the recurring and varying man-made hydraulic forms shape the lowland landscapes: They define the parcellation patterns by structuring directly the forms and boundaries (mainly water elements) of parcels; they are strengthened and highlighted indirectly by the settlement and tree cover patterns. The contemporary agriculture-related land uses are superimposed on these historic structures, while the historic water and parcellation patterns are still retained. Therefore, water system and parcellation patterns are the primary attributes that contribute to the landscape character in the YRD lowlands, whereas land use, settlement, and tree cover patterns are the subsidiary attributes.

For the lowland landscapes, the characteristics of the remaining 12 lowland landscape structures were compared with the pre-determined attributes to classify landscape types using a quantitative approach[40] (Figure 5.5). By taking the two primary attributes of water system and parcellation patterns, seven landscape types can be classified, including one historic urban landscape (in Area 1) and six polder landscapes; the structures within the six polder landscape types still display similarities and varieties, thus a revision of criteria for classifying polder landscapes is required.

Therefore, the Dutch polder classification was adapted for the second time to generate a polder landscape typology based on the criteria *basic forms* (water system and parcellation patterns) and *polder technologies* (see Sect. 4.3.2). According to the polder typology developed for the YRD in Chapter 4, there are four still existing polder types: *Hu-Dang*, *Lou-Gang*, *Jing-Bang*, and modern standardized polders. The criteria of basic forms were specified according to types: The *Hu-Dang*, *Lou-Gang*, and *Jing-Bang* polders have either fractal or hybrid parcellation, and varying water system patterns at different levels of fragmentation; the modern standardized polders have geometric water systems and rational parcellation[41].

---

[40] See the illustration of the quantitative approaches in LCA and KHLE (Sect. 3.4.1 and 3.5.3).

[41] A revision was made to clearly distinguish the modern standardized polders from the other three types. The *Hu-Dang*, *Lou-Gang*, *Jing-Bang* polders have been partly to fully regulated from fractal to rational systems by polder mergence and standardization since the 1950s. However, they still bear their ancient characteristics with either fractal or hybrid parcellation, depending on the stage of completion in this transition. Thus, these polders are discussed and considered as their original types rather than as

By comparing the basic forms and polder technologies of the 11 polder landscapes found in Suzhou with the four historic polder types, we found that the 11 polder landscapes fit into the four historic types[42] (Figure 5.12). The identified four polder landscape types in Suzhou were named according to the identical features from their basic forms, namely: island, networked, fragmented, and standardized. To sum up, the island type has organic water networks and fractal parcellation; the networked type has hybrid water systems and parcellation; the fragmented type has water system patterns at different levels of fragmentation, from hybrid network, fragmented network to fragmented, as well as fractal or hybrid parcellation; the standardized type has geometric water systems and rational parcellation.

As a key conclusion, basic forms (water system and parcellation patterns) but first of all polder technologies, form the implicit rules that predominantly shape the characteristics of polder landscapes and can be used as criteria to develop a polder landscape typology.

---

standardized polders. Only fully transformed polders are classified as standardized polders.

[42] For the seven categories of polder landscapes defined by the two primary attributes, The three categories of polder landscapes, the Dispersed Lakes and Polders Landscape (Area 3), the Lakeside Networked Polder Landscape (Area 4 and 5), and the Riverside Standardized Polder Landscape (Area 12), respectively correspond to *Hu-Dang*, *Lou-Gang*, and modern standardized polders; and the four categories of fragmented polder landscapes were defined as the same type of *Jing-Bang* polders.

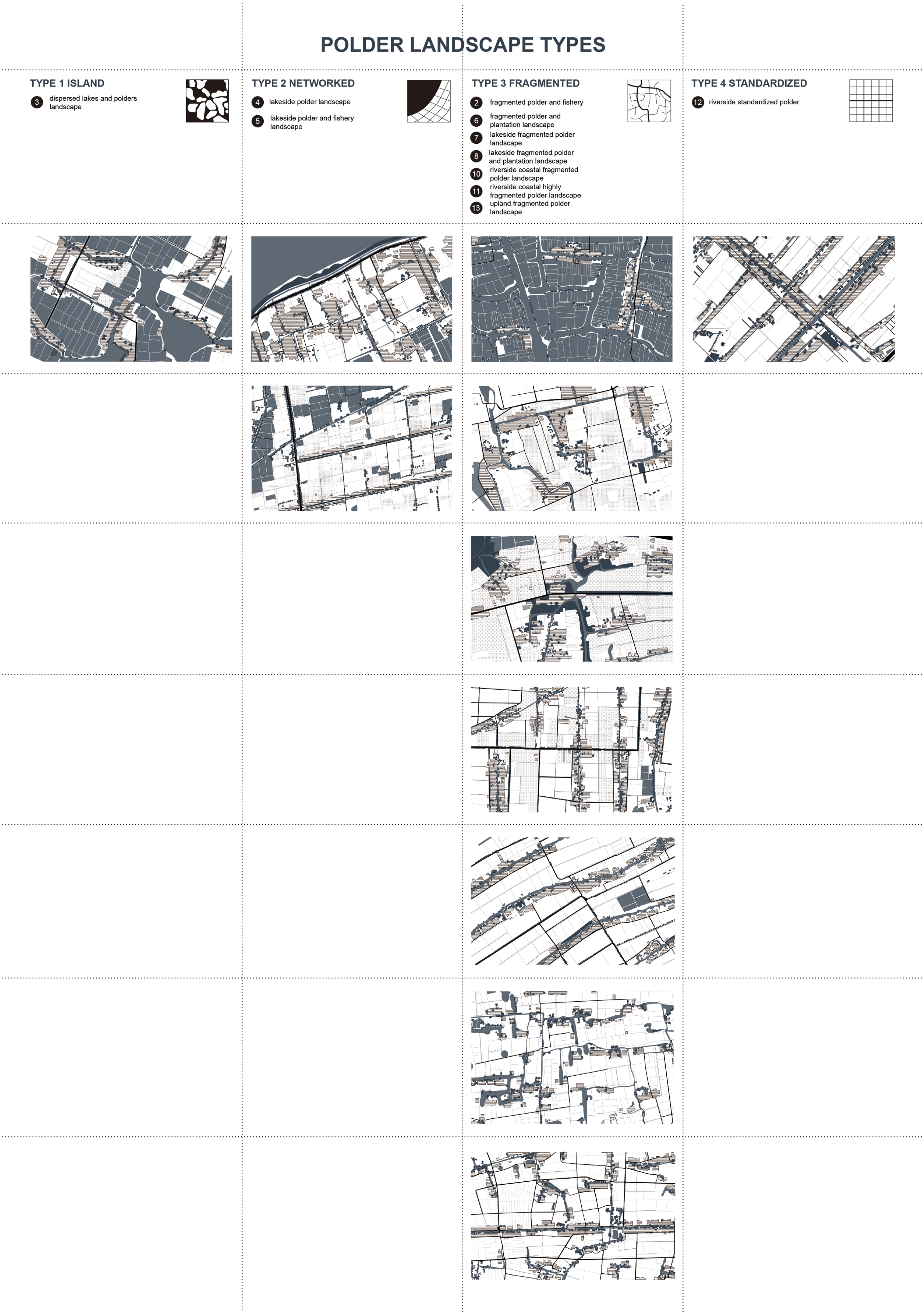


Figure 5.12 A Typology of Polder Landscapes

Source: Drawn by the author.

5.5 PRACTICE. RESEARCH BY DESIGN

A research by design project, working on the Taihu lakeshore area, was implemented in the Seminar "Design Historic Cultural Landscape Elements as Green-Blue Infrastructure" at the Professorship of LAREG. This project explored how historic cultural landscape elements and patterns could be integrated into future urban development. This project demonstrates how polder landscape elements and structures have shaped and interacted with each other in the historic cultural landscape layer and assesses how these elements and structures could coexist with and consistently function in the contemporary urban/industrial landscape layer. We analyzed the historic landscape character by mapping the landscape elements of canal and road systems, as well as the structures of historic settlements and agricultural landscapes. We illustrated the current demands and development models of industry, housing, modern agriculture, and tourism. Finally, we summarized the potential methods and strategies of using historic landscape elements as permanent forms and green-blue infrastructure at three levels: preservation and maintenance, reuse and conversion, and critical reconstruction.

5.5.1 TAIHU LAKESHORE AREA

Lake Taihu is located in the middle of the YRD. As the third largest freshwater lake in China, it has an area of about 2,338 km^2 and a shoreline of 393.2 km. The historic *Lou-Gang* polder landscape, which was shaped by the drainage pattern of the lake basin, nowadays is at risk of destruction and a loss of landscape character due to the rapid pace and reckless model of urban development. The remaining *Lou-Gang* polders are mainly distributed on the southeast, south and northwest lakeshore, which are no longer a continuous, complete system. In this project, three typical sub-areas were selected from each lakeshore area as case studies (Figure 5.13).

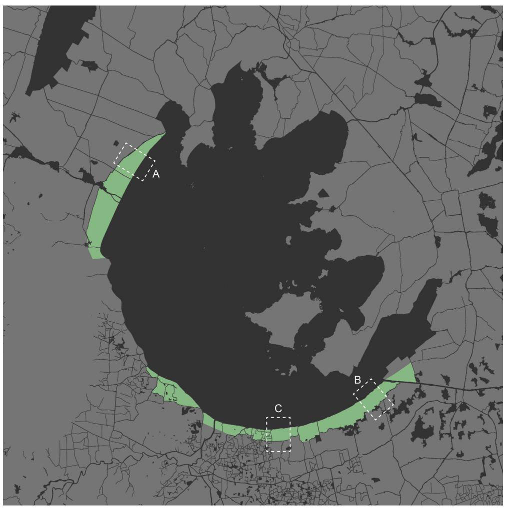


Figure 5.13 Locations of Three Lou-Gang Polder Areas

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015 and revised by the author.

5.5.2 MAPPING LANDSCAPE STRUCTURES OF THREE LOU-GANG AREAS

We mapped, analyzed, and further discussed the morphologies and functions of historic cultural landscape elements in four categories: canal system, road system, historic settlements, and agricultural landscape.

AREA A (YIXING)

Area A lies on the northwest lakeshore and is within the territory of Yixing. The *Lougang* canals in this sub-area drain the runoff from the western hilly area to Lake Taihu. The canal system is a continuous network with a hybrid character, which has a mixture of geometric structure and curving forms. Most of these *Lougang* canals are straight and have similar interval distances. The historic settlements are distributed linearly along the canals, in between which is mainly cultivated land. We analyzed the landscape structure of this area by mapping the layers of canal system, agricultural landscape, road system and settlements of a typical section (Figure 5.14).

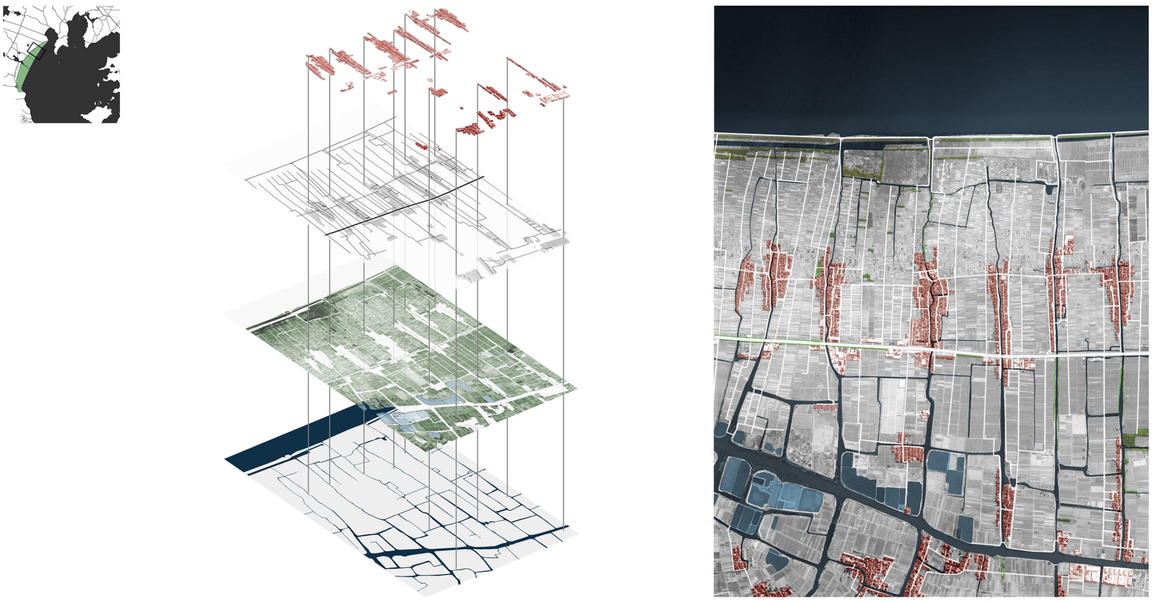


Figure 5.14 Landscape Structure Analysis of a Typical Section in Area A

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015 and revised by the author.

AREA B (WUJIANG)

Area B is located on the southeast lakeshore and is within the territory of Wujiang. The canal system works as water outlets, which drain runoff from Lake Taihu eastward to the sea. The canal system in this sub-area is a continuous hybrid network, as in Area A. Area B has more dense settlements than the other two sub-areas, including clustered town cores and other linear canalside villages. The main agricultural land use is fishery rather than cropping. We analyzed the landscape structure using the same mapping method as in Area A (Figure 5.15).

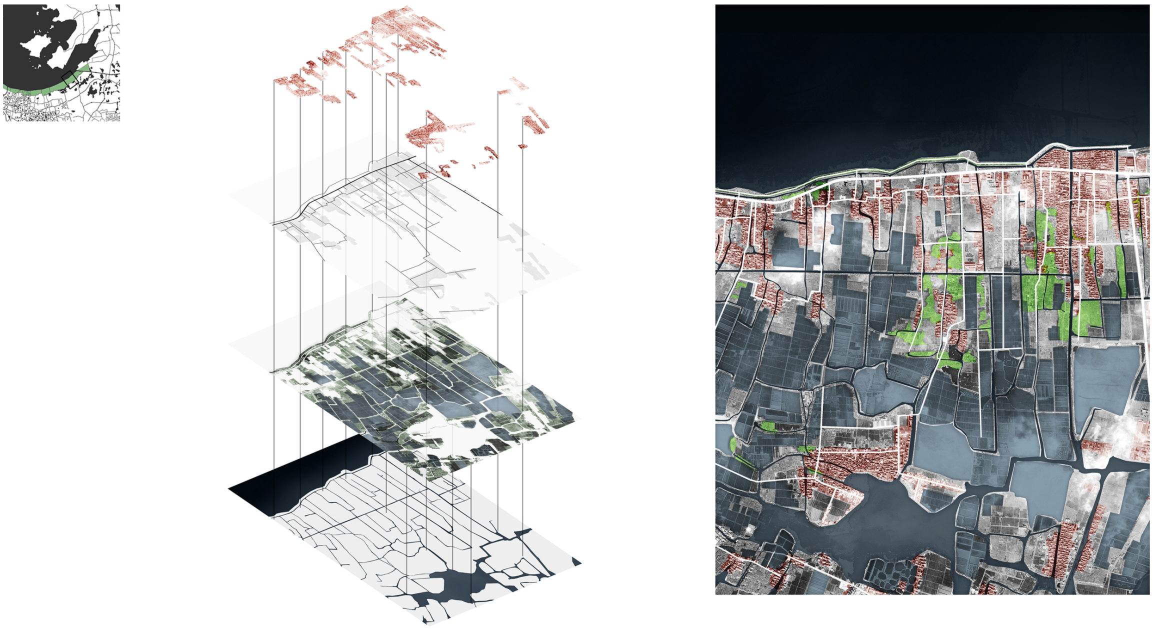


Figure 5.15 Landscape Structure Analysis of a Typical Section in Area B

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015 and revised by the author.

AREA C (WUXING)

Area C lies on the south lakeshore and is within the territory of Wuxing County. The *Lougang* canal system here works both as water outlets and inlets of Lake Taihu. These canals drain water from the southwestern hilly area to Lake Taihu via the Dongtiao and Xitiao Stream, and they also drain water southwards out of the lake. Area C has a mixed agricultural land use of fishery and cropping. We analyzed the landscape structure by mapping the same four layers (Figure 5.16).

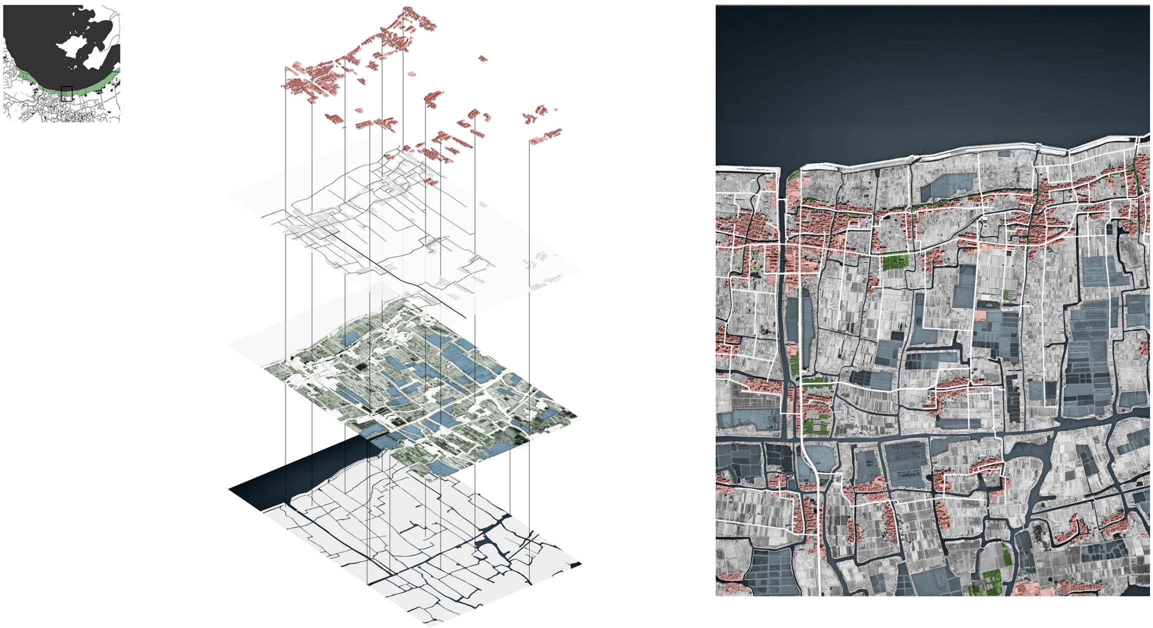


Figure 5.16 Landscape Structure Analysis of a Typical Section in Area C

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015 and re-laid out revised by the author.

5.5.3 LANDSCAPE STRUCTURE ANALYSIS BY LAYERS

HISTORIC LOUGANG CANAL SYSTEM

Polder landscapes in the lakeshore area are organized and structured by the irrigation and drainage systems. Besides shaping landscape structures, the canal system also has played a vital role in flood control, water transport, agriculture production, and the amenities of the living environment in the Taihu Basin.

According to the functions of these *Lougang* canals, they can be divided into three types:

- the wide canals that parcel the polders, which are important waterways for transportation and for draining and retaining floodwater. This canal type includes *Lougangs* running perpendicularly to the shoreline and *Tangs* that are paralleling to the shoreline (names for canals, see Table 4.1).
- the narrow canals in between the settlements. The waterfront of these narrow canals, including docks and bridges, is usually used as public space for village life as well as for transportation.
- and irrigation ditches in polders. These ditches also divide plots and retain floodwater.

By abstracting the canal system layer from these three sub-areas, we arrived at three similar patterns, which indicate the common structure of the *Lougang* system (Figure 5.17). These *Lougangs* were built every 300 to 500 m, which are like capillary tubes and function efficiently for discharging floods. The *Tangs* were built to connect the *Lougangs* and also as transport links in an east-west direction. These *Tangs* are the main watercourses connecting the whole lakeshore area and are usually 2.5 to 3 km away from the lakeshore.

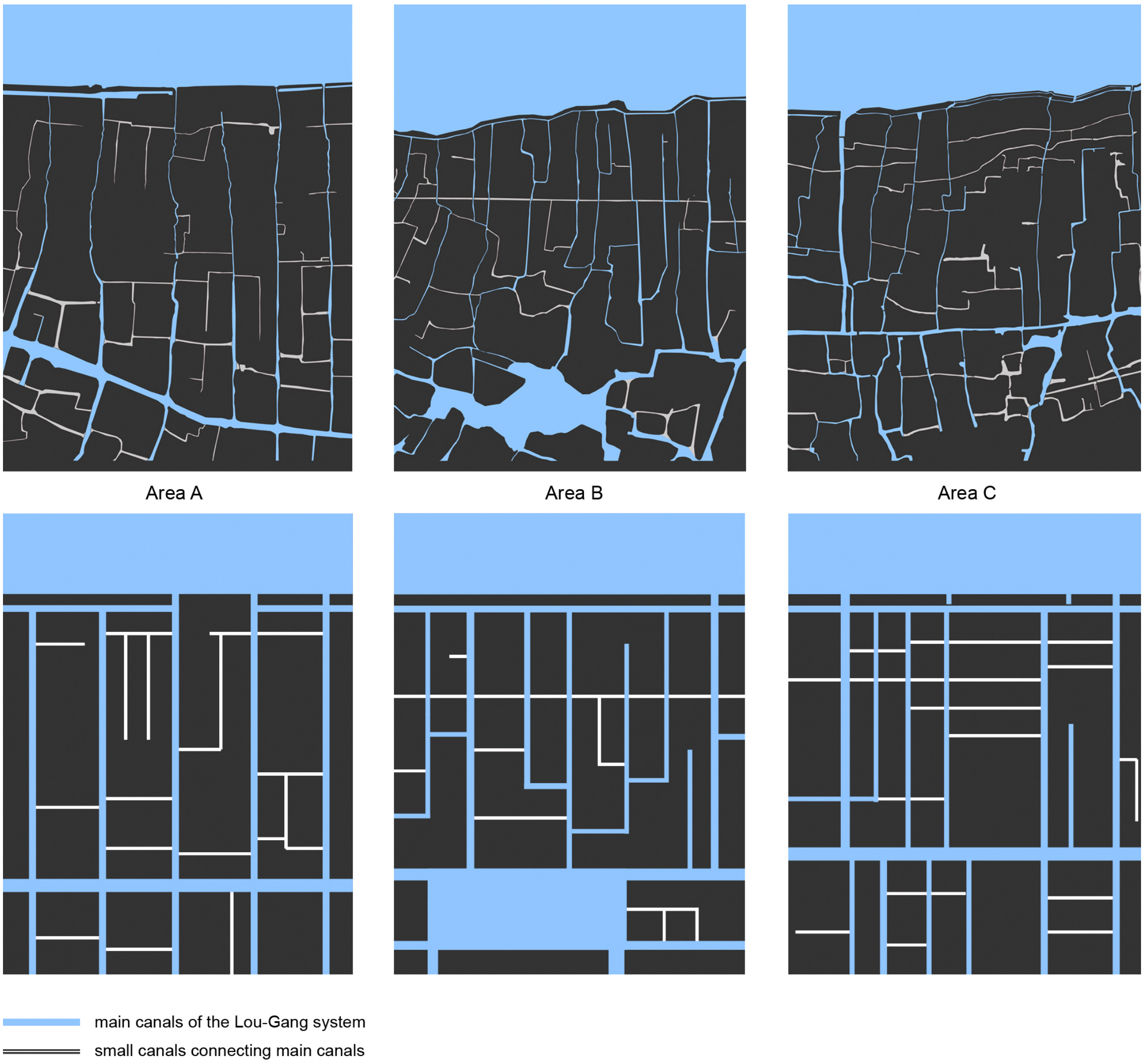


Figure 5.17 *Lougang* Canal Systems of the Three Sub-areas

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015 and revised by the author.

HISTORIC STRUCTURE OF AGRICULTURAL LANDSCAPE

According to the findings in the mapping, the agricultural landscapes in this lakeshore area are structured by the morphologies and textures of paddy fields and fishponds. We observed two types of agricultural production and their distinguishable characteristics reflected in parcellation and enclosure (Figure 5.18):

- Traditional extensive agriculture has created the fractal patterns of small field parcels around the villages. This type of agricultural landscape accommodates the local residents' everyday life and has a cultural meaning in keeping the village alive and creating a sense of community.
- Modern intensive agriculture has shaped the rational parcellation of the large open farmland. The growing industrialized aquaculture has generated geometric fabrics that superimposed on the original paddy fields. This new intensive agriculture has changed the appearance of traditional paddy and fishery landscapes in this area.

HISTORIC SETTLEMENT STRUCTURE

LINEAR STRUCTURE

Before the 1980s, water transport was the main means of transportation in the Taihu Basin. Thus, towns, markets and villages were mostly built and developed along waterways. In this lakeshore area, the linear structures of *Lougang* canals shaped the settlement patterns as the roads and dwellings were built parallel to the canals (Figure 5.19).

SPATIAL RELATIONS OF CANALS, DWELLINGS AND COURTYARDS

In China, traditional dwellings mainly face the south to allow the maximum exposure of windows, walls, and courtyards to the sun while making better use of the monsoon in hot summers. To satisfy the demand for orientation, several spatial combinations of dwellings and canals were developed (Figure 5.20). By mapping the orientations and layouts of dwellings and canals, we found that the structures of linear settlements vary according to the flow directions of canals. More specifically, the intervals between dwellings and the layout of courtyards are different when the dwellings are situated along an east-west or a north-south canal. When the canal flows in an east-west direction, the dwellings are normally situated adjacent to each other with front yards facing the roads or canals, forming a mixture of private and public spaces on the waterfront or roadside. In the case of north-south canals, the courtyards are situated in between dwellings, which creates relatively private spaces.

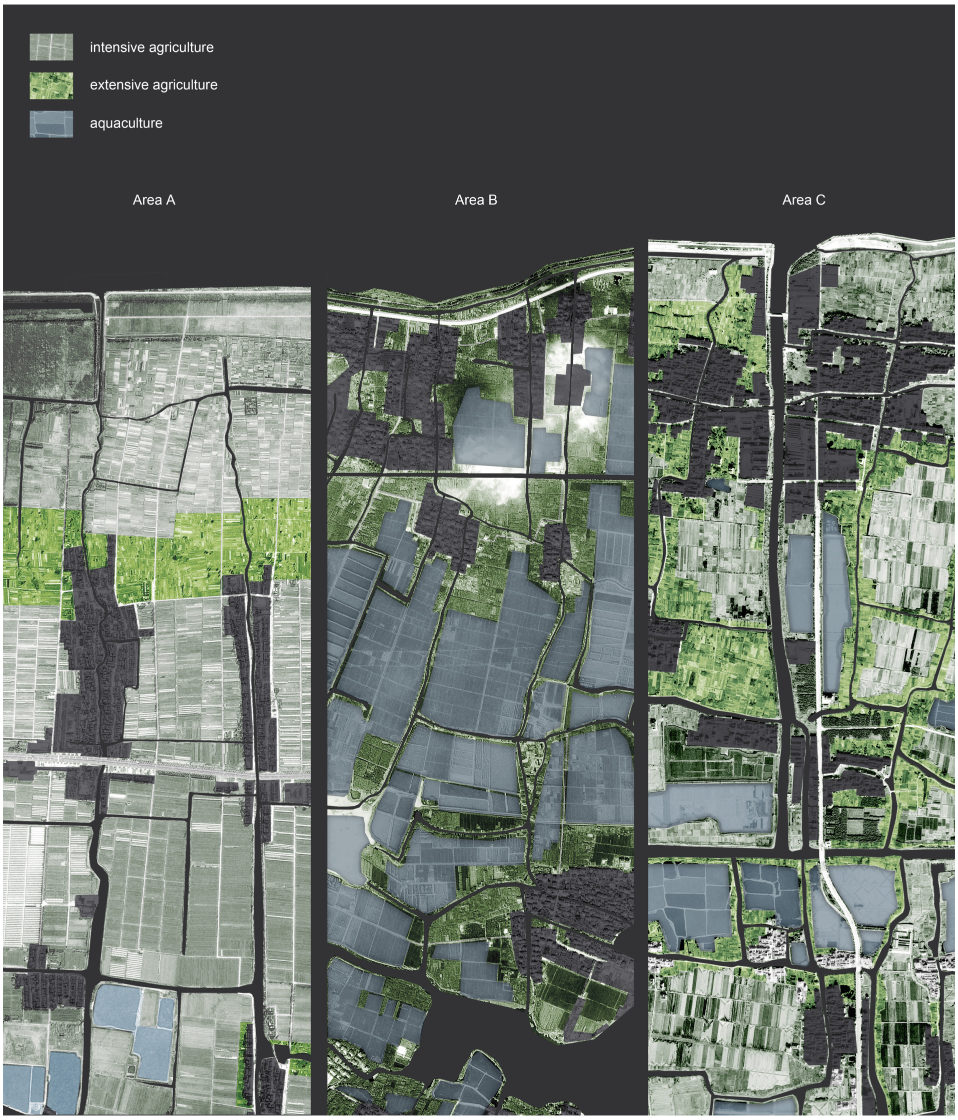


Figure 5.18 Structures of the Agricultural Landscapes of the Three Sub-areas
Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

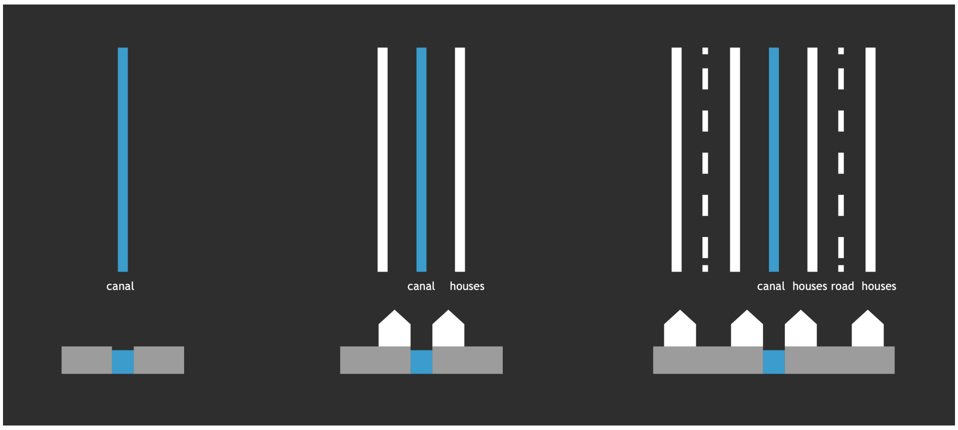


Figure 5.19 Linear Structures of Settlements
Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

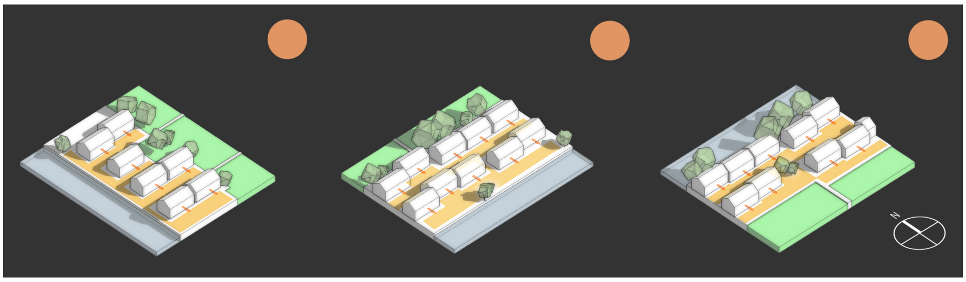


Figure 5.20 Spatial Relations of Canals, Dwellings and Courtyards

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

HISTORIC ROAD SYSTEM

As water transport used to be dominant, the road systems were developed after the canal systems to connect the neighboring villages and farmland. The historic road systems normally follow similar structures to the canal systems: either perpendicularly to the shoreline or parallel to it (Figure 5.21). The main roads that are perpendicular to the Taihu shoreline connect the villages with surrounding farmland; and the roads that are parallel to the shoreline link the adjacent villages (Figure 5.22).

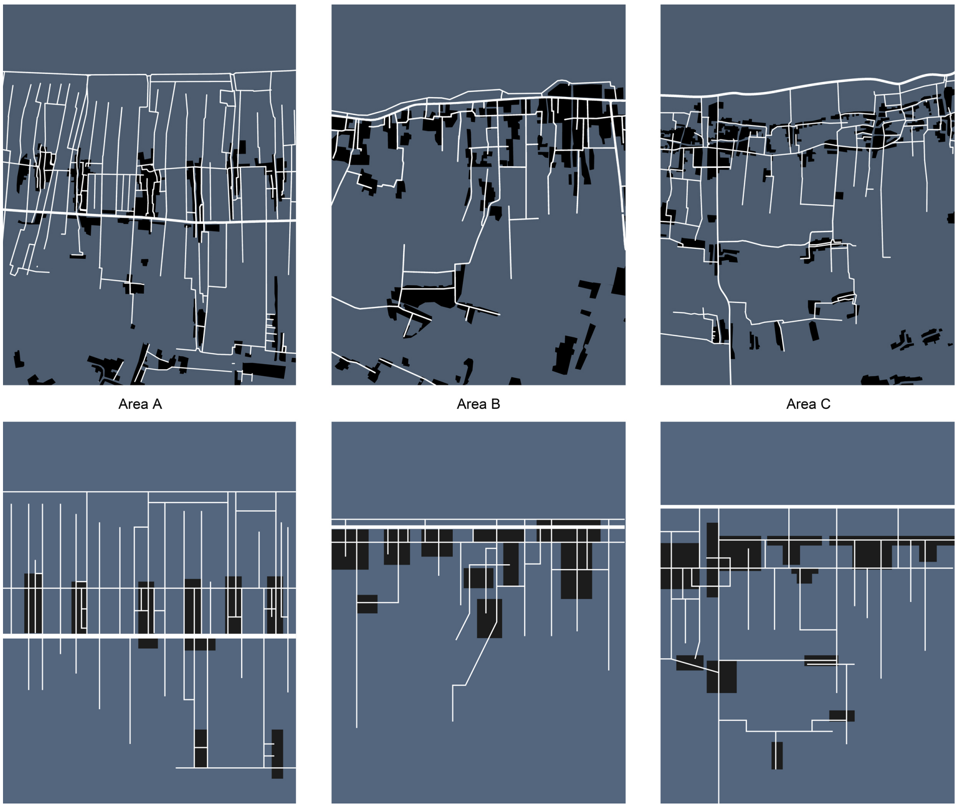


Figure 5.21 Structures of Road Systems and Settlements of the Three Sub-areas

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

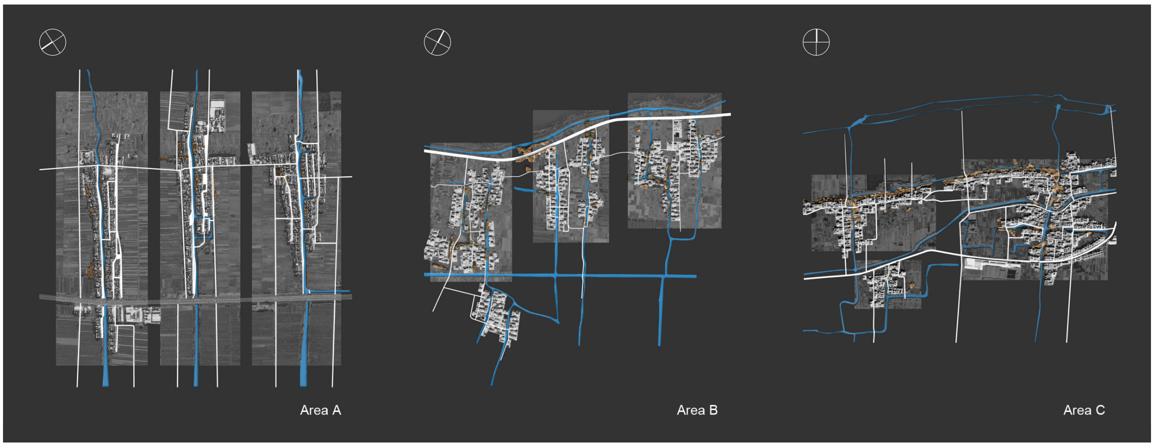


Figure 5.22 Road System Structures of the Three Sub-areas

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

5.5.4 NEW DEVELOPMENT MODELS BASED ON HISTORIC LANDSCAPE STRUCTURES

Based on the analysis of historic landscape structures in this area, we discussed the current development models of industry, housing, agriculture, and tourism, and how these developments have influenced these structures. Furthermore, we explored the possible methods of designing historic landscape elements as permanent forms and green-blue infrastructure for future development.

INDUSTRIAL DEVELOPMENT MODEL

The industrial development in this lakeshore area dates back to the early 2000s, and we summarize two main development models: the intensive industrial areas at the conjunctions of main roads and the scattered rural industry within or adjacent to settlements. Most of these industrial areas have been transformed from the original agricultural land. Especially in these intensively developed industrial areas, most of the narrow canals have been filled in, whereas the main canals were widened and straightened (Figure 5.23). These channelized canals with a hard-edged waterfront have thus lost their ecological value. This caused the degradation of living environment and further more led to the decline of water-based settlements. The new urban road systems were built in grids along the channelized canals and were superimposed on the historic rural road systems.

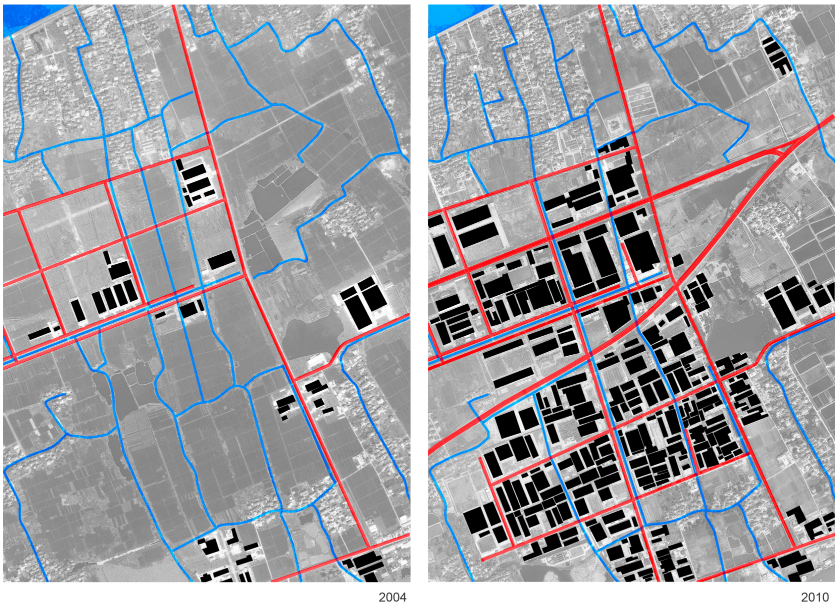


Figure 5.23 An Example of Industrial Development from 2004 to 2010

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

The proposed new development model seeks to integrate the historic canal systems by retaining the main canals and by keeping and enhancing their natural waterfronts as buffer zones for flood management and pollution reduction. Reusing the main structure of the historic road system could reduce new roads, which might cut off canals, and keep the continuity and the visual access to canals. Furthermore, it is necessary to have buffer zones in between the rapidly expanding industrial areas and the historic settlements and agricultural landscapes. We compared and mapped the historic landscape structures and the current and new industrial development models (Figure 5.24).

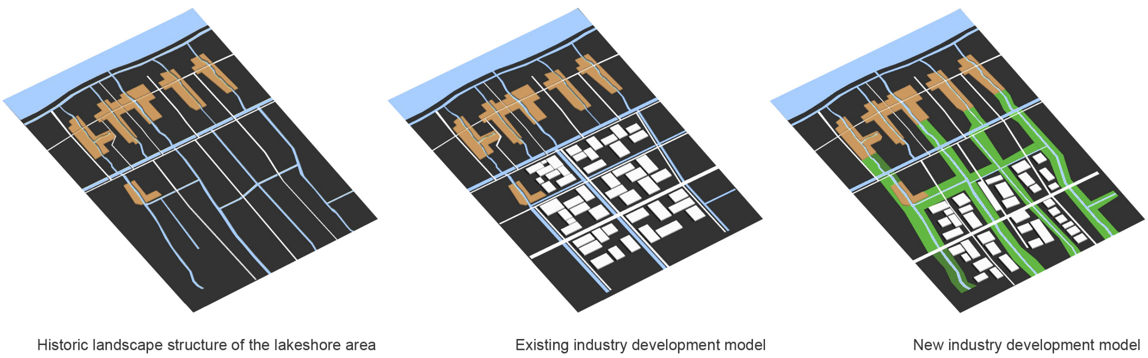


Figure 5.24 Historic Landscape Structure and the Current and New Industrial Development Models

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015 and revised by the author.

HOUSING DEVELOPMENT MODEL

The current development model of urban housing in this area, like most new town development in China, simply imposes new residential blocks without considering the geophysical conditions or historic landscape structures of the site. These new residential blocks are normally developed as gated communities with private green space. Historic settlements have been gradually demolished for these new residential quarters. The historic rural road systems superimposed on or have been erased by new grids of urban road systems. The main structures of historic canal systems remaining have nowadays been turned into channelized frames around the residential blocks; the waterfronts of these canals lost their spatial quality and ecological function (Figure 5.25).

We developed a new housing development model, which will utilize the waterfronts of canals as public spaces around new housing developments by reconsidering the spatial relations of the canal and road systems (Figure 5.26). The new urban road system could be developed based on the historic one, and be separated from the canal system to reduce the number of roads across the canals. Historic settlements, especially the ones along the lakeshore, should be protected or cautiously renovated to preserve the historic settlement structure. The density, enclosure, and textures of historic settlements should be a reference for planning new housing.

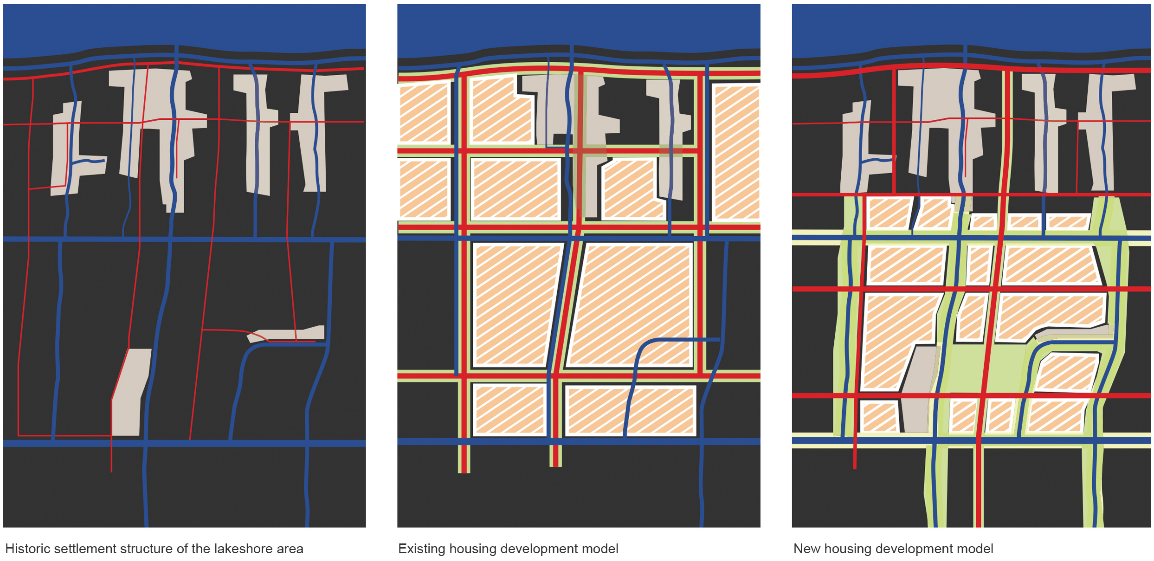


Figure 5.25 Historic Settlement Structure and the Existing and New Housing Development Models

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

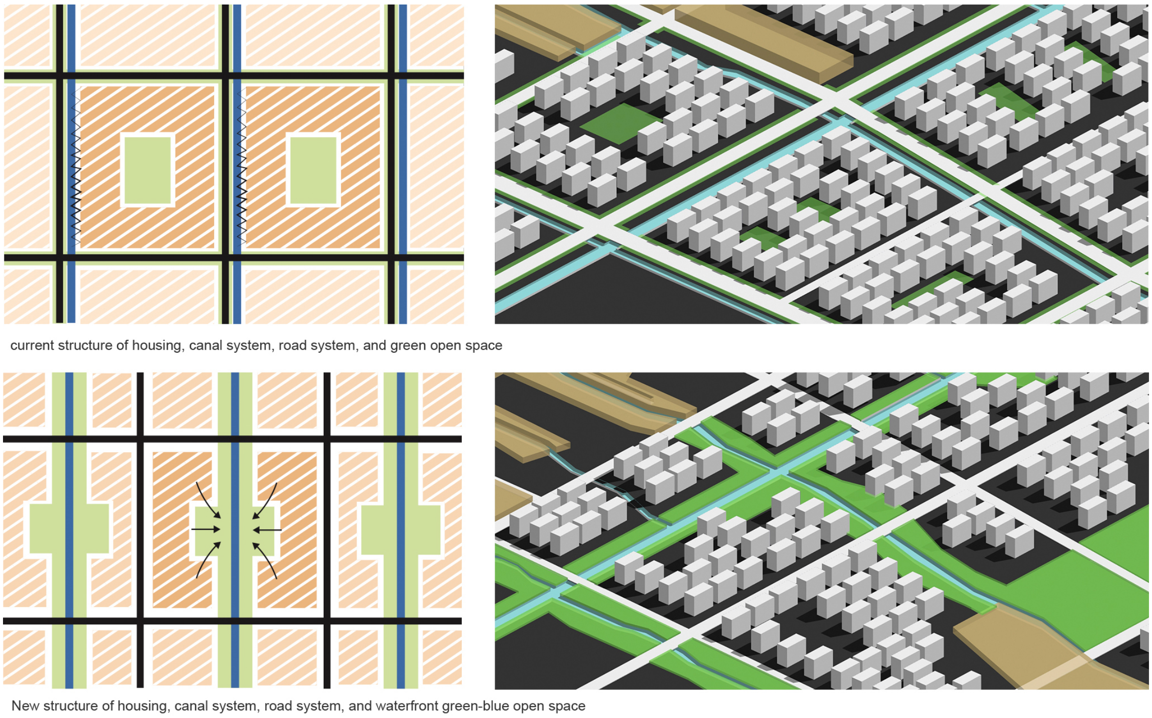


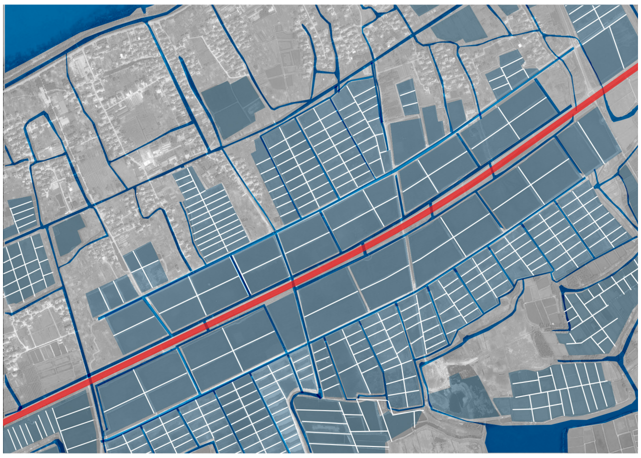
Figure 5.26 Structures of Housings, Canal and Road Systems, and Green Open Space in the Current and New Housing Development Models

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

MODERN AGRICULTURE DEVELOPMENT MODEL

Modern agriculture, which has developed in an industrial way, has also been rapidly expanding along main roads in the lakeshore area (Figure 5.27). To gain large regularly structured land for aquaculture, the historic canals were channelized and straightened with hard-edged waterfronts. The historic hierarchical canal system has been dramatically changed during this process. We proposed a new agriculture model, which will retain the main canal system and waterfront habitats, and will use the natural waterfront as buffer zones for flood retention and wastewater treatment (Figure 5.28). The sizes and locations of new industrialized fishponds should be restricted to certain planned areas, which will not destroy the structures of historic settlements and agricultural landscapes. The well maintained "*Lougang* Irrigation and Drainage System in Huzhou" (International Commission on Irrigation and Drainage, 2017) on the south lakeshore, as a heritage site, could be combined with the development of local tourism.

2004



2010

Figure 5.27 An Example of the Current Industrialized Development of Aquaculture

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

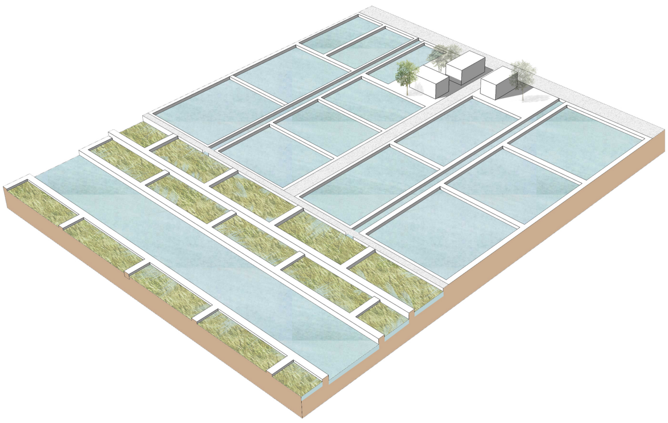


Figure 5.28 Proposed New Development Model of Aquaculture with Natural Waterfront as Buffer Zones

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

TOURISM DEVELOPMENT MODEL

The Lake Taihu area is one of the most famous national parks in China. The current tourism planning mainly focuses on the lakeshore area (lines) and a number of individual scenic spots (points). The current linear greenway (called the "landscape road" in this area) along the lakeshore is not consistent and is not connected with these scenic spots. To promote local tourism in the lakeshore area, we could excavate the value of the *Lougang* polder system as a cultural heritage site in combination with protection and maintenance of the unique farming system and mulberry dike-fish pond complex. We proposed a new tourism development plan to build a continuous greenway network, which will cover the remaining *Lougang* polder system and connect the existing landscape road with those scenic spots (Figure 5.29).

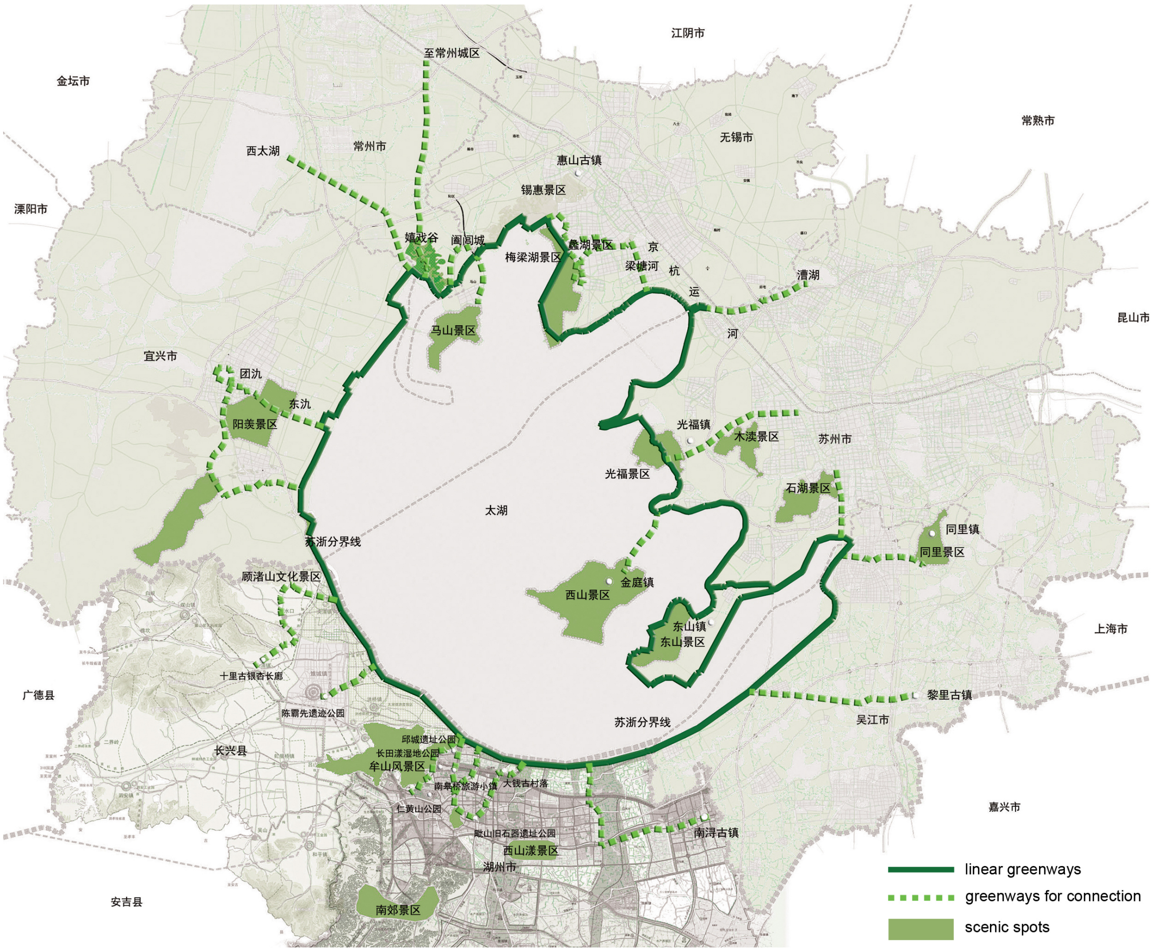


Figure 5.29 New Tourism Development Plan for the Taihu Lakeshore Area

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

5.5.5 SUMMARY

According to the previous discussion of the current and new development models in the Taihu lakeshore area, we summarized the demands, current situations, future trends and strategies for the future development of industry, housing, agriculture, and tourism. The method of using historic landscape elements of canal and road systems, settlements and agricultural landscape were also explored during the mapping and discussion. In conclusion, these elements could be utilized as permanent forms and green-blue infrastructure at three levels: the first level of conservation, retaining both the historic function and structure; the second level of transformation, retaining the historic structures by filling in new functions; the third level of critical reconstruction, developing new landscape structures based on the historic ones (Table 5.6).

Table 5.6 New Development of Industry, Agriculture, Housing and Tourism based on the Historic Landscape Structures

Source: Summarized by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

		Industry		Modern Agriculture		Residence		Tourism	
Demands		Regularly structured plots and convenient transportation		Regularly structured, large scale plots		High demand for land, high density, open space		Preserve the landscape characteristics and cultural heritage	
Current Situations		Usually develops along the main roads. Two types of development: 1 Intensive industrial area at the intersection of the roads; 2 Scattered rural industries near the settlements.		More and more large scale, regularly structured farms; Booming aquaculture industry around Lake Taihu		High density apartment buildings, lack of consideration of historic settlements		Current tourism planning focused mainly on the lakeshore (lines) and historic villages (points)	
Overall Strategies		Confine industrial areas to the structure of retained canal system with its waterfront habitats		Preserve the character of spatial structure by retaining the main canals and waterfront habitats; combine tourism with traditional agriculture		Canal and its waterfront as public green space; retain the original structure by keeping and enhancing the original canal system		Excavate the culture of *Lou-Gang* polder system; protect the unique agriculture mode "Mulberry dyke-fish pond"; develop nature & culture tourism along the Taihu lakeshore (belt)	
		Current/Trends	Strategies	Current/Trends	Strategies	Current/Trends	Strategies	Current/Trends	Strategies
Historic Landscape Structures	**Canal System**	Narrow canals are filled in, while the main canals are widened and straightened; the canals are losing their ecological value with the hard-edged waterfront.	Fill in the narrow canals and retain the main canals; keep the natural ecological waterfront as a flood buffer zone; reserve the canal system for future city development	The original canals are channelized or straightened with hard-edged waterfront; the historic hierarchical canal system is homogenized.	The main canal system and waterfront habitats should be retained; the buffer zone can be used for both flood prevention and waste water treatment.	New residential buildings are simply imposed blocks. Canals are mostly used as the border of a residential development. Community life is now away from canals.	Utilize the original canal as public space for the new residences by reconsidering the relationship between canal and road systems	Local tourism does not make use of the historic elements.	Enhance the connection between lakeshore and the surrounding villages by canals and their waterfront to connect tourism resources (lines and points)
	Road System	The new road system is built in grids. The new roads are usually built along the canals and superimposed on the original rural road system.	Retain the main structure of the original road system. Reduce the transverse roads, in order to keep the continuity of canals and visual access	New regularly structured road system is needed because of mechanization.		The original road system is abandoned.	Make use of the historic structure of road system; reduce the transverse roads in order to keep the continuity of canals and visual access		Extend the traffic lines between lakeshore, villages, and cities
	Historic Settlement	Industrial areas are normally transformed from agricultural land, and the air and water pollution caused by industry lead to the decline of historic settlements.		During the process of urbanization, extensive agriculture is replaced by modern agriculture which will cause further decline of villages.	For sustainable development of the historic settlements, it is necessary to restrict the size and location of the industrialized agriculture and to retain the traditional agriculture for the villagers.	Historic settlements are gradually demolished and replaced with new urban housing.	Historic settlements should not be rudely demolished but be carefully renovated; historical urban texture should be considered when building new residential areas.	Some of the historic settlements are demolished for service facilities for tourism.	Protect and renovate the villages near the lakeshore; also keep the cultural customs of these areas
	Agriculture Structure	Industrial areas are normally transformed from agricultural land.	For sustained development of the historic settlements, it is necessary to restrict the industrial areas and to retain the supporting traditional agriculture.	The historic structure and modes of agriculture are gradually replaced by modern ones.	As part of official cultural heritage, traditional agricultural structures could be retained in some places by combining with tourism.			The local tourism does not make use of the historic elements.	Combine the traditional agricultural mode with tourism

Three levels of utilizing historic elements as permanent forms and green-blue infrastructure	Retaining both the original function and structure	Retaining the original structure by adapting to new functions	Developing new structure based on the historic structure

5.5.6 DESIGN

Based on the typological analysis of the landscape structures, we selected the Miaogang Community as the focus area to design the new land use, housing, industry, canal and road systems, as well as the green open space system (Figure 5.30–31). We developed typical spatial constellations for historic polder landscapes in the context of new demands on industry, housing, agriculture, and tourism according to the summarized methods of protection, transformation, or critical reconstruction.

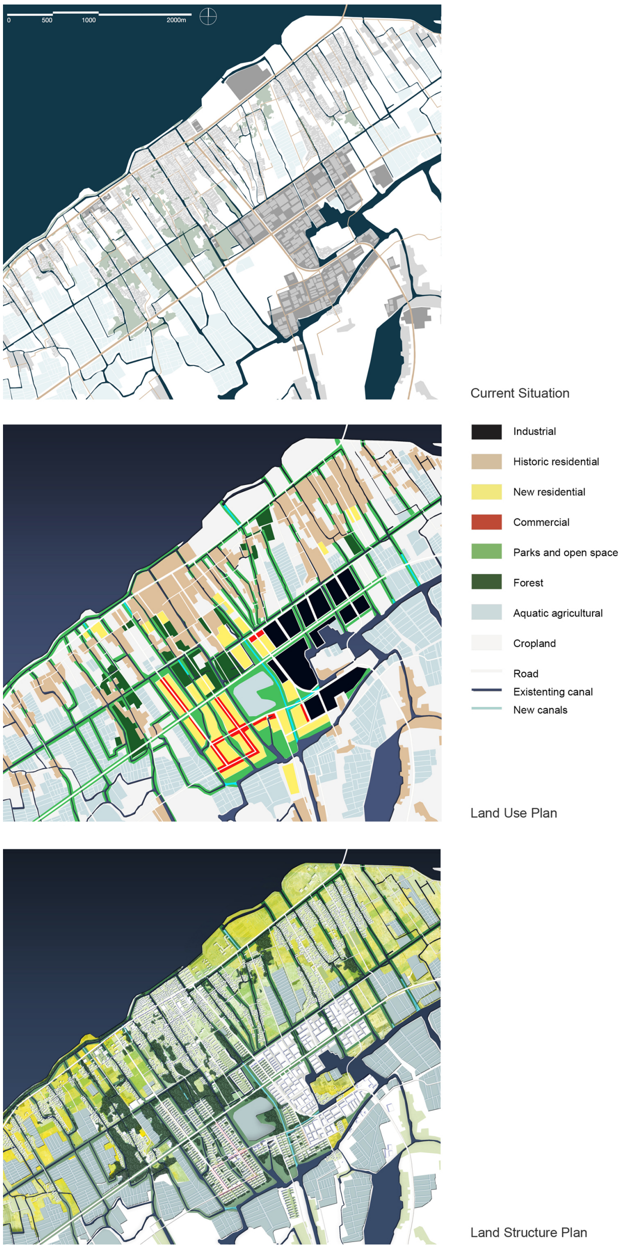


Figure 5.30 Land Use and Landscape Structure Plan for the Miaogang Community

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

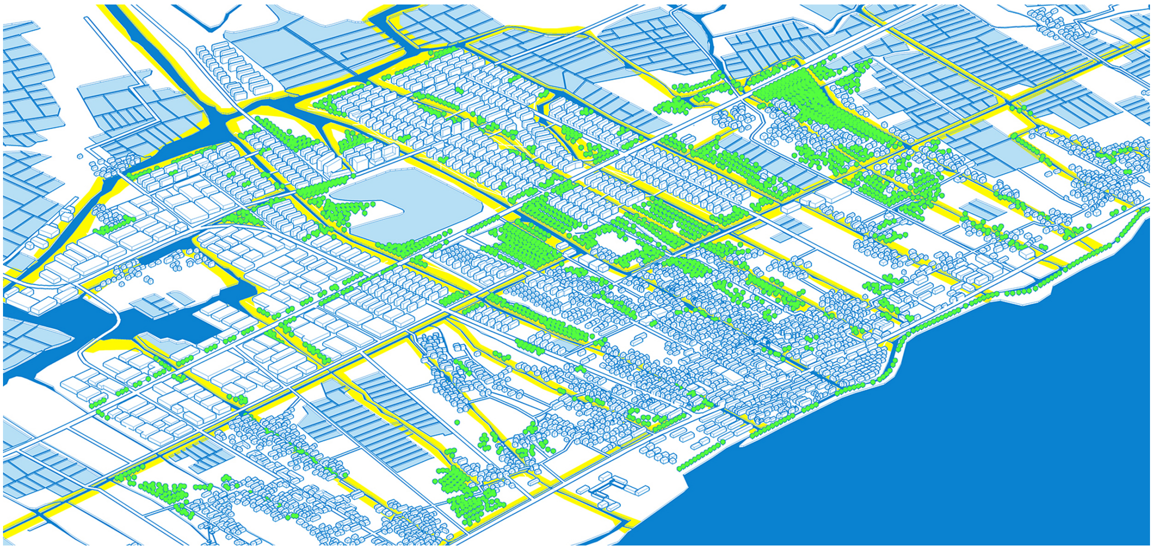


Figure 5.31 Bird's-Eye View of the Planned Miaogang Community

Source: Drawn by Miao Yang, Yongbin Wang and Boyan Liu in the Research by Design Seminar 2015.

5.6 LANDSCAPE TYPE PROFILES

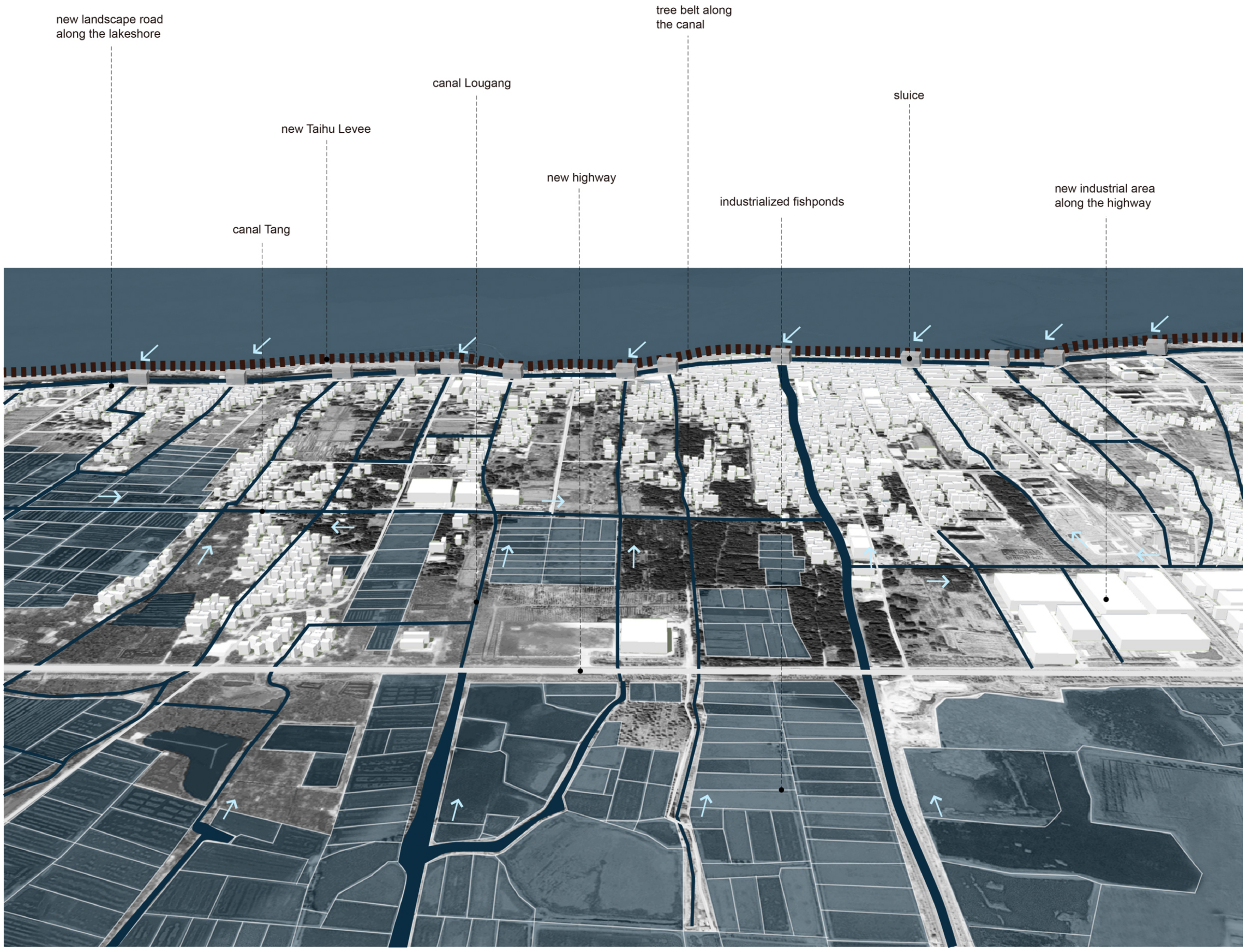
To document the outcomes of the typological approach, landscape profiles were developed by adapting the methods of Landscape Type Profiles (Worcestershire LCA) and Cultural Landscape Cadasters (KHLE, see Sect. 3.5.2). The profiles include the details of the cultural meaning and social function, historical development, patterns, significance, and landscape changes. Furthermore, based on the evaluation of the significance and vulnerability of key elements and characteristics, type-specific measures were developed for landscape conservation, management, and future development.

The contents of cultural meaning, social function, and historical development were drawn from the morphogenesis study of polder types in Chapter 4. The attributes of the five patterns were generated from the characteristics of landscape structures found in the mapping of landscape character areas (Sect. 5.4.2). The structural and functional changes of cultural landscapes were deduced from the mapping of landscape changes in Sect. 5.4.4, and the vulnerability of key characteristics was assessed by their risk of change and changing trends. The significance of character was measured by the degree of *visual prominence* of particular key elements and characteristics (Worcestershire County Council, 2012, p. 105) perceived in field surveys and mappings (Sect. 5.3 and 5.4.2). The measures for landscape practice were deduced according to the two levels of vulnerability and significance: primary and secondary.

With the motivation of protecting the relics of cultural landscapes while dealing with the rapidly expanding metropolitan areas in the YRD, we generated another two levels of transformation and *critical reconstruction* (Schöbel, 2016) from the European practice and tested them in a research by design project on the networked polder landscape type (Sect.

5.5). A specific profile for this type was created to document its landscape character and to generate type-specific measures. In this type, the primary elements, that have heritage value and are vulnerable to change, are recommended to be protected in their existing authenticity, such as the elements of the *Lougang* irrigation and drainage system; the omnipresent elements, that can *serve different functions over time* (ibid., p. 225) and are vulnerable to change, such as canals, vernacular dwellings, and villages roads, could be reused as green-blue infrastructure, and in local tourism and urban development; primary patterns and structures that can offer *coherence and sustainability* (ibid., p. 225) and are resilient to change, such as the visual axis to canals and the historic patterns of water system, parcellation and settlement, could be referred to or cautiously restored when developing new residential blocks, agricultural land use, and industrial areas.

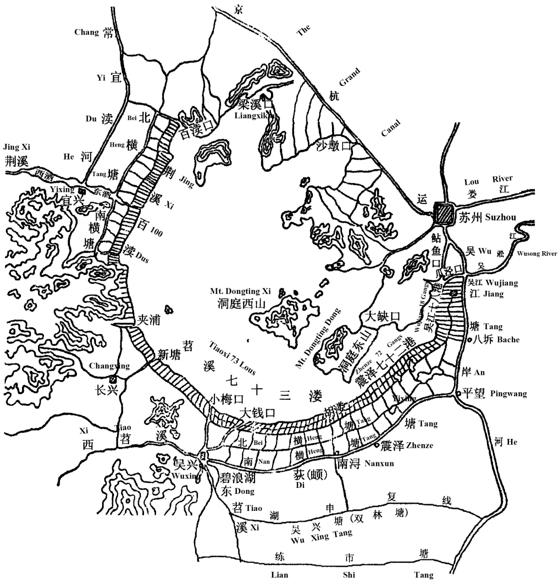
PROFILE OF THE NETWORKED POLDER LANDSCAPE



Model of the Networked Polder Landscape
Source: Drawn by the author.

NAME	Networked Polder Landscape/*Lougang Weitian Jingguan*
LOCATION	southeast Taihu lakeshore area, occurring in Areas 4 and 5
LANDFORM	very low lying plain (0–3 m)
CULTURAL MEANING AND SOCIAL FUNCTION	systematic reclamation, diking, and poldering to feed the increasing migrants from North China since the Tang Dynasty (618–907); this hydraulic project greatly promoted flood control, agricultural production, water transport, and the living conditions in this region.

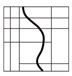
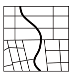
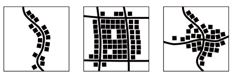
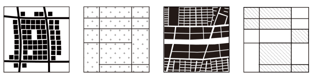
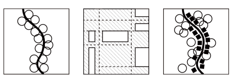
HISTORICAL DEVELOPMENT



Source: Adapted from Zheng (1987, p. 97) and translated by the author.

The reclamation from mudflats, construction of irrigation and drainage canals, and poldering activities together shaped the *Lou-Gang* polder system around the 8th century. The area situated in the west of the *Wujiang Tanglu* continuously silted and turned into land, and in the meantime eastern Lake Taihu gradually shaped (Miao, 1982). Over time, the *Lougangs* became denser and longer along with the continuous reclamation toward Lake Taihu. The 100 *Dus* in Jinxi (water inlets) along the west lakeshore date back to the North Song Dynasty; the 36 *Gangs* in Changxing and 38 *Lous* in Wuxing (both inlets and outlets) were built in the early Ming Dynasty; and the 18 *Gangs* in Wujiang (water outlets) and 72 *Gangs* in Zhenze (both inlets and outlets) were developed after the Mid Ming Dynasty. Since the 1950s, the *Lou-Gang* polder system has experienced a substantial decrease in number as well as a blockage and discontinuity of *Lougangs* during the urbanization process. The canal system has been long out of maintenance and is prone to severe silting. The landscape elements of *Lou-Gang* polder system, such as canals, sluices, stone bridges, embankments, and dikes are disappearing.

PATTERNS

Water System Pattern		hybrid network
Parcellation Pattern		hybrid system
Settlement Pattern		linear canalside, clustered canalside, nucleated canalside
Land Use Pattern		residential, cropping, and the mixed land use of fishery, orchard, and plantation
Tree Cover Pattern		linear tree belts, interlocking woodland, tree groups

SIGNIFICANCE OF ELEMENTS AND CHARACTERISTICS		
Key Elements	Primary (heritage value)	dikes, polder embankments, sluices, fishponds, fishpond embankments, trees along canals/dikes/fishpond embankments/roads, ancient trees, waterfront vernacular dwellings, canals (*Lougangs* and *Tangs*), bridges
	Secondary (omnipresent)	ditches, croplands, paddy fields, field paths, field ridges, huts, orchards, nurseries, vernacular dwellings, docks, canals, village roads
Key Characteristics	Primary	• the hybrid *Lougang* canal system along the lakeshore as water inlets of Lake Taihu; strong visual access to the canals • the hybrid parcellation pattern • the traditional rice-fish-silk farming system and its related land uses • the densely distributed linear and clustered canalside settlements
	Secondary	• the highly mixed land use of residential, cropping , fishery, orchards, and plantations • the tree cover character related to the land use of orchards and plantations
Structural Character		• the hybrid canal network and enclosure pattern shape the basic landscape structure • the linear canalside settlements and tree belts highlight the basic structure • the fishponds and interlocking orchards and plantations superimposed on most fields within the historic parcellation pattern
LANDSCAPE CHANGES		
Water System Pattern		• the historic *Lougang* canal system is deteriorating because of the decline of water transport since the 1980s • some narrow canals were filled in, whereas the main canals were channelized or straightened with a hard-edged waterfront • the construction of the new Taihu Levee has changed the functions of the sluices and *Lougangs* that intersect with the lakeshore
Parcellation Pattern		• the standardized fishponds have changed the historic parcellation patterns of paddy fields • the orchards and plantations superimposed on the historic parcellation but still follow its original patterns • in newly urbanized areas, new grids of roads have changed the historic landscape morphologies and urban fabrics
Settlement Pattern		• scattered factories were built within or in the surrounding of settlements • town cores have expanded based on new grids of roads • new housing developments, especially the gated communities of single-family houses and high-rise apartment buildings along the Taihu lakeshore have changed the view of lakeside settlement landscape

Land Use Pattern		• the new agricultural land uses of fishery, orchards and plantations have changed the appearance of traditional agricultural landscapes • the construction of new main roads and highways has driven the structural changes of canal and fishpond systems along them • new rural industries have developed along new main roads and highways and superimposed on the original paddy fields • the mixed industrial and urban areas have been expanding along the new road networks
Tree Cover Pattern		• the construction of the new Taihu Levee (1977–1985) and linear greenways has changed the view of the lakeshore • linear tree belts were planted along the new grids of roads • the interlocking orchards, nurseries, and plantations have significantly changed the tree cover character of this landscape type
VULNERABILITY TO CHANGE		
Resilient Characteristics		• the overall pattern of *Lougang* canal system is retained; strong visual access to canals and the green corridors along them • the overall parcellation pattern is retained; the parcels overlapped by orchards and plantations are restorable • the linear and clustered canalside settlement patterns are retained during urbanization
Vulnerable Characteristics		• the very low-lying topography of the polder areas entails a higher risk of flooding and waterlogging than the other types • the *Lougang* canal system is deteriorating and the trend will continue • the historic parcellation pattern is vulnerable to change due to expanding standardized fishponds, residential quarters, and industrial areas • the expanding new housing, especially the gated communities, might greatly change the historic settlement pattern in the future • the attributes of land use pattern are the most vulnerable to change since the transformation from rural to urban/industrial land use is irreversible; the traditional rice-fish-silk farming and its land use pattern is vulnerable to decline • the changes in tree cover character (e.g. pattern, species, density) might be driven by new development of green infrastructure (e.g. avenue trees, landscape roads, greenways, parks, normally by ornamental tree planting), local agricultural strategies and profits gained from orchards and plantations
MEASURES (adapted from the results of the Research by Design Seminar, by Miao Yang, Yongbin Wang and Boyan Liu, 2015)		
Conservation	Primary elements that have heritage value and are vulnerable to change	• to preserve the *Lougang* irrigation and drainage system, including the elements of sluices, dikes, polder embankments, canals (*Lougangs* and *Tangs*), bridges, etc. • to preserve and maintain the waterfront vernacular dwellings, especially those along the Taihu lakeshore • to preserve the linear tree belts along the canals, dikes and roads, and ancient trees

		• to maintain the traditional rice-fish-silk farming system and its related elements, e.g., paddy fields, fishponds, fishpond embankments, mulberry trees
Transformation	Omnipresent elements can serve different functions and are vulnerable to change	• to transform the canals and their waterfront as green-blue open spaces for future urban development, such as in new community parks and housing projects • to renovate the vernacular dwellings for local tourism development • to transform the orchards, nurseries, and plantations as green infrastructure when developing a new urban open space system • to make use of village roads and paths when planning permeable urban roads in new residential and industrial areas
Critical Reconstruction	Primary patterns and structures that can offer coherence and sustainability and are resilient to change	• to keep the visual access to canals and their waterfront • to develop new agricultural land use by following the historic parcellation patterns • to integrate the historic water system and parcellation patterns into new urban fabrics as spatial quality and identity • to build new residential blocks by following the historic patterns of field parcellation and settlement (e.g. density, enclosure, and morphologies)

5.7 MEASURES FOR RESTRUCTURING CULTURAL LANDSCAPES IN METROPOLITAN AREAS

By developing the typological approach, we intend to generate type-specific measures for historic polder or urban landscapes to tackle the loss of regional identity, cultural landscape degradation, and water issues in metropolitan areas of the YRD. In these rapidly expanding urban systems, landscape conservation is currently, and might be in future, restricted to the primary elements that have heritage value, but protection of the authentic primary patterns and structures of particular landscape types is unlikely to happen. Thus, this research developed another two levels of measures, transformation and critical reconstruction. By the three levels of measures, we might protect and manage the changes of historic cultural landscapes, ensure the permanence and resilience of elements and structures, and guide a more sustainable delta urbanization.

From the practice of the particular landscape type, i.e. the networked polder landscape, we extend the specific experience and discussion of restructuring historic cultural landscapes as permanent forms and green-blue infrastructure to the other historic polder and urban landscape types or the metropolitan delta landscape in general. The measures were summarized and sorted into three levels of conservation, transformation, and critical reconstruction, dealing with the corresponding elements and structures categorized by their significance and vulnerability (Table 5.7).

Table 5.7 Restructuring Historic Cultural Landscapes as Permanent Forms and Green-blue Infrastructure in Metropolitan Areas

Source: Adapted from Schöbel (2016). The italicized texts are direct quotations from this source; the other elements and structures added are generated from the landscape type profiles (Sect. 5.6) and the list of historic cultural landscape elements (Table 5.10). The repeated elements in the categories of primary and omnipresent can be distinguished according to their heritage value and status, such as the difference between the Grand Canal and the other omnipresent elements.

Elements and Structures	**Historic Urban Landscape**	**Historic Polder Landscape**	**Restructuring Metropolitan Delta Landscape**	
			Concepts	**Measures**
Primary Elements that have heritage value and are vulnerable to change	• city walls, gates, moats, sluices • bell towers, drum towers, memorial archways, pagodas • temples, churches and churchyards • traditional gardens, parks • avenue trees, ancient trees • water lanes, stone embankments, bridges ...	• canals, dikes, polder embankments, sluices • fishponds, fishpond embankments • avenue trees, linear tree belts, ancient trees • towpaths, bridges ...	**Conservation** to protect authentic elements	to protect the primary elements of historic urban and polder landscapes
Omnipresent Elements *that can serve for different functions over time* and are vulnerable to change	• canals, dikes • blocks of residences, colonnades, townhouses, markets • textile mills, industrial relics • streets, alleys, boat houses, docks, ports, harbors ...	• canals, dikes, polder embankments, ditches, ponds • paddy fields, field paths, ridges, fishponds, fishpond embankments, orchards, plantations, nurseries • linear tree belts • vernacular dwellings, homesteads • docks, paths, village roads ...	**Transformation** to reuse elements by adapting new functions	• to transform paddy parcels into building plots to limit their size and to keep their structural diversity • to transform canals into urban waterways for flood management and humidifying systems in public spaces • to transform fishponds into bioretention systems in public squares • to transform the village roads and paths into permeable urban streets ...
Primary Patterns and Structures that can offer *coherence* and *sustainability* and are resilient to change	• forms of the figure-ground plans • *fabric of the public open space* • *building alignments, parceling* • structures of canal and road systems • *visual axis, landmarks, panoramas* …	• natural morphologies: relief, hydrology, vegetation cover • basic forms of polder systems • water system patterns • parcellation patterns of fields, land tenure • settlement patterns and typologies (e.g. density, enclosure, and morphologies) • tree cover patterns • *visual axis, landmarks, panoramas* …	**Critical Reconstruction** to restructure the traces of historic forms and structures when developing new housings, infrastructure, and land use	• urban renewal based on the historic figure-ground plans and fabrics of public open space • to develop urban green-blue space systems based on the structure of historic canal systems • to build new residential blocks by following the historic patterns of field parcellation and settlement • to build or restructure business and industrial parks with reference to the historic water system and tree cover patterns • to build highways, railways and power lines by tracing the textures of agricultural land • to build wind farms and solar parks by following natural morphologies and cultural landscape structures ...

5.8 CONCLUSION

A typological approach was developed by adapting the basic framework of LCA, in combination with the HKLE and Dutch polder classification, for generating type-specific measures to restructure historic cultural landscapes in metropolitan areas. This approach emphasizes the water issues and the unconventional spatial character of metropolitan areas in the YRD delta region, thereby creating a new vision for landscape characterization, permanent forms of cultural landscapes, green-blue infrastructure in densely urbanized and dramatically changing metropolitan regions in the world.

5.8.1 REFLECTION ON RESEARCH METHODS

The landscape characterization and assessment developed in this chapter is an inclusive and integrated tool, specific for the metropolitan areas of the YRD. It demonstrates the possibility of studying a highly dynamic and complex metropolitan landscape, which varies largely from relatively static historic landscapes that are studied by conventional LCA or HLC (Historic Landscape Characterisation) approaches. It constitutes an innovative approach to studying urban, suburban, rural, and natural landscapes in the rapidly expanding metropolitan areas as components of a holistic entity rather than distinguishing them categorically. We have studied both the historic and contemporary landscape characteristics by mapping and analyzing the temporal process of landscape changes. New agricultural land use was also considered as it significantly influences the present appearance of historic landscapes. The hydraulic factor, as the most influential determinant for distinguishing landscape character in this region, is highlighted throughout the process. *Water system pattern*, as a new cultural attribute, was added to the case of Suzhou. The forms of water elements and structures were referred to during the development of the other cultural attributes, such as settlement and parcellation patterns. Both qualitative and quantitative approaches were implemented in the characterization. At the regional scale, the same quantitative method as in LCA was adopted to draft the regional landscape character map by overlying two obtained regionalization maps. At the municipal scale, a combined qualitative and quantitative approach was implemented to describe landscape character areas and to classify landscape types.

Conventional LCA is normally a systematic, top-down research method that is conducted by regional or local organizations requiring mass geographic data and field surveys. The flexible landscape characterization method developed here enables individual researchers to carry out landscape characterization research starting from any scale with limited accessible data and maps. The accessible open database, historical topographic map collections, and satellite images from both Chinese and international sources (normally having limited accessibility in China) are presented in the research process, and are vital for landscape character studies. Furthermore, ways of using these maps and data at various scales to identify, map, and describe landscape elements and structures have been well exemplified.

Nevertheless, there are still limitations to this approach. More precise boundaries for character areas, or more character areas and types might be identified if provided with satellite images in higher resolution or complete historical topographic maps from various periods. When the landscape characterization of all delta cities are complete, a more precise regional character map could be drafted. On the other hand, in these rapidly expanding metropolitan areas, it might be more reasonable to have overlapping boundary lines or wide boundary zones to show the transition of landscape character instead of the current precise boundary lines. How to draw these overlapped boundary lines or boundary zones would be a challenge. So far, only one polder landscape type of the *networked polder landscape* is well exemplified by a complete research and practice process. Further work should extend to all the other three polder landscape types, which will enable the comparison of different types and will make this work more complete. Another improvement could be developing a more systematic evaluation of the significance and vulnerability of landscape attributes and involving local stakeholders and experts in the assessment.

5.8.2 RESEARCH OUTCOMES

This research has adapted the basic framework of British LCA to identifying, classifying, mapping, and describing landscape character areas and types in the YRD region at the regional, municipal, and local scales. At the regional scale, 21 regional landscape character areas were classified by overlaying a physiographic map and a hydraulic map of the YRD region at a scale of approx. 1:2,500,000. At the municipal scale, Suzhou was selected as the case study city from among the eight delta cities, because it contains the most diverse landscape characteristics that are intimately associated with the typology of water and polder systems. Thereafter, the draft character map of Suzhou was further revised in an iterative process by visual identification and field surveys. Typical sections of these character areas were studied using a mapping approach at a scale of 1:50,000 or 1:25,000. Furthermore, the landscape changes were visualized by mapping the progressive overlay of natural morphologies, historic cultural landscapes, and contemporary urban/industrial landscapes. At the local scale, the landscape character areas of Suzhou were visualized at a scale of 1:5,000 to generalize the complexities of the combination of elements, and to deduce the basic forms of landscape structures. Based on the deduced basic forms, a combined qualitative and quantitative approach was implemented to describe the character areas and to classify the landscape types with attributes adapted from the Worcestershire LCA and from the parcellation types of Dutch polders, as well as generated from the mapping results. As a result, 13 landscape character areas of Suzhou were distinguished; 11 of which could be clustered into four landscape types by the criteria of basic forms (related to water system and parcellation patterns) but first of all polder technologies. The four polder landscape types identified in Suzhou fit into to the four historic types in the YRD defined in Chap. 4. These findings disprove the hypothesis that the formal variants of water elements and structures can classify landscape types in the delta region. In fact, basic forms and polder technologies form the implicit rules that predominantly shape the characteristics of polder landscapes and can be used as criteria to develop a polder landscape typology.

Furthermore, we designed the networked polder landscape, as one landscape type in the study area, for the Taihu lakeshore area. This case explored the possibility of using existing as well as restorable elements and structures of historic polder landscapes as permanent forms and potential green-blue infrastructure for new developments of urban housing, industry, modern agriculture, and tourism. In combination with the results from the characterization approach, a specific profile of this type was made to document its cultural meaning and social function, historical development, patterns, landscape changes, significance and vulnerability, as well as potential measures for landscape practice. From the practice of this particular landscape type, the discussion was extended to other historic cultural landscape types and the metropolitan delta landscape in general. The measures for restructuring the elements and structures of historic cultural landscapes as permanent forms and green-blue infrastructure in metropolitan areas were summarized and categorized into three levels: conservation, transformation, and critical reconstruction.

In conclusion, this typological approach is not only a historical but also a forward-looking instrument for guiding landscape practice. The research outcomes include the landscape character maps of the YRD and Suzhou, mapping results of landscape elements and structures at multiple scales, and landscape type profiles. These results could be used as source materials and references to aid cultural landscape and heritage conservation, landscape management, as well as planning and development in metropolitan areas in the YRD. In this way, a more integrative and resilient development model was examined for Suzhou and for the other YRD cities. Furthermore, this approach could serve as a model for developing landscape characterization instruments and for restructuring historic cultural landscapes for other rapidly expanding cities or regions in China as well as for other densely urbanized and dramatically changing metropolitan (delta) regions in the world.

CHAPTER 6 CONCLUSION

This chapter summarizes the conclusions drawn from each chapter. These conlcusions are structured in four subchapters. The first subchapter, *Bridging Research Gaps*, sums up the contribution of this research to the issues of historic cultural landscapes in the urbanization of China and as a design issue for green-blue infrastructure in metropolitan areas of the YRD region. The second subchapter, *Research Findings*, demonstrates the outcomes of the morphogenesis study of cultural landscapes in the delta region and of the multi-scale typological approach. The third subchapter is a reflection on the research methods, including the innovative parts of this inclusive and integrated tool for landscape characterization in the delta cities, as well as the limitations and potential improvements of this tool. The last subchapter introduces the possible application of the research outcomes in landscape conservation, management, planning, and future development.

6.1 BRIDGING RESEARCH GAPS

6.1.1 LANDSCAPE AND CULTURAL LANDSCAPE IN THE CHINESE CONTEXT

Landscape and cultural landscape have different meanings in the European and Chinese contexts. This has inflenced the attitutes towards and the perception of landscape in landscape architecture practices as well as in everyday life. In China, landscape is still predominantly understood as a perceptual view of scenery rather than as a habitat or infrastructure that accommodates everyday life. There is limited understanding of cultural landscape either as a category of world cultural heritage or as a dynamically shaped everyday landscape. Since almost every landscape in China is culturally formed, it is difficult for researchers and the public to understand the concept, meanings, and components of cultural landscape.

As in Europe, cultural landscapes are aesthetically appreciated. However, landscapes in China have experienced and are undergoing a loss of diversity, coherence, and identity. It is difficult to appreciate the scale of ongoing chaotic fragmentation of traditional urban or rural landscapes and disregard for local physical and cultural conditions. People have a certain ignorance about dramatic landscape changes, whether cultural heritage or ordinary everyday environments. To study and document the significant cultural landscape changes in China, three identical periods were identified in this research by comparison with their similar cultural landscape types of different time periods in Europe: the pre-industrial historic landscapes (pre-1949); the landscapes of collective agriculture during the early communist era (1949–1978/82); the contemporary landscapes of the reform era (post-1978). Historic cultural landscape in this research is defined as the pre-reform landscape (pre-1978).

6.1.2 CULTURAL LANDSCAPE AS A DESIGN ISSUE IN METROPOLITAN AREAS IN LANDSCAPE ARCHITECTURE

Cultural landscape is not a prevalent concept or topic in spatial planning, heritage protection policies, or landscape architecture theory and practice in China. Consideration of the cultural landscape as a design issue in landscape architecture when confronted with the on-going degradation of cultural landscape, frequent urban flood disasters, and the mass expansion of urban-industrial land use in China is urgently required. Chapter 3 summarzied the exisiting types of landscape practice dealing with cultural landscapes worldwide, the missing role of landscape architecture in China, as well as the potential offered by cultural landscape in metropolitan areas at three scales: regional, municipal, local/district.

Furthermore, in China, there are very few research studies on climate adaptive planning and design, urban forms of delta cities, metropolitan delta landscapes, etc. Landscape architects have not yet paid much attention to the design of cultural landscapes as spatial qualities and identities or as green-blue infrastructure in metropolitan deltas. Thus, Chapter 4 examined the contemporary delta landscape as an agglomeration of constructive, functional hydraulic systems, as well as historic cultural landscapes and heritage sites, which might support a more integrated and resilient spatial planning, based on rediscovering and reactivating the historic hydraulic heritage. Chapter 5 explored the measures for restructuring historic urban and polder landscapes as permanent forms and green-blue infrastructure in the metropolitan delta according to landscape types.

6.1.3 LANDSCAPE ANALYSIS INSTRUMENT IN METROPOLITAN AREAS

Studying landscape character and types at various scales to aid landscape practice is still relatively new, but is receiving increasing attention in China. The existing European tools are not optimal for studying a highly dynamic and complex metropolitan landscape, which differs from the relatively static historic landscapes that are studied by LCA or HLC approach. This research developed an inclusive, integrated analysis tool by adapting the existing instruments of LCA, HKLE, and Dutch polder classifications. This tool bridges the shortfalls of these existing instruments by creating a new vision for landscape characterization and practices in metropolitan areas. More specifically, historic cultural landscape elements were classified and used as analytical units to map and describe landscape structures and their associated characteristics. The urban, suburban, rural, and natural landscapes are considered as components of a holistic entity rather than distinguishing one from the others. The hydraulic character of the metropolitan delta landscape was especially emphasized during the characterization process by adapting the Dutch polder classifications. All these refinements in this specific case make this approach a useable reference for developing landscape characterization instruments for other rapidly expanding cities or regions in China as well as for those of other densely urbanized and dramatically changing metropolitan (delta) regions in the world.

6.2 RESEARCH FINDINGS

6.2.1 MORPHOGENESIS OF CULTURAL LANDSCAPES

The forms of cultural landscapes studied in this research are not random phenomena but a result of a transformational process. The historical study and mapping of this process have shown that the morphogenetic, technical, functional, and architectural changes in cultural landscapes, expressed in forms and structures, have been driven by the developments of land reclamation and hydraulic technologies, water conservancy, land use and farming systems, and urbanization and industrialization. During the pre-industrial and early communist eras, the continuous land reclamation and poldering, and the paddy-fish-silk farming system in the delta lowlands created stable and permanent structures and character of polder landscapes that endured for thousands of years. However, since the reform era (post-1978), historic site-specific elements and structures have been gradually swallowed by reckless development, while new cultural but generic mixed urban and industrial landscape elements have become prevalent. Landscape changes during this period are mainly driven by urbanization, industrialization and modern agriculture.

During the morphogenesis study of cultural landscapes, two substantial transformations of polder landscape structures were identified, from big to small, and back to big polder systems. The trends of the two transformations, in general, are from fragmented to more rational systems, which were intended to improve the resilience of the polders systems. The urbanization of polders in the reform era could be considered as the third fundamental transformation, in which urban and industrial landscapes have superimposed on the historic polder landscapes rather than changing the polder systems themselves. The on-going urbanization of polders results in structural and functional changes to former rural polders, which increases the vulnerability of these urbanizing polders to flooding.

Based on the results of the historical study, a typology of polders was developed by adapting the Dutch polder classifications, using the criteria of *basic forms* and *polder technologies*. Five polder types in the YRD were distinguished: the *Tang-Pu*, *Lou-Gang*, *Jing-Bang*, *Hu-Dang* and supplemented by the modern *standardized* polders. Presently, the *Tang-Pu* polder system no longer exists, whereas the other three historical polder types, namely *Jing-Bang*, *Lou-Gang* and *Hu-Dang*, function as palimpsests, still bearing their ancient characteristics while at the same time having been partly to fully transformed into standardized polders since the 1950s.

6.2.2 LANDSCAPE ELEMENTS AND STRUCTURES

According to the mapping results, the water-related landscape elements and structures have contributed to the fundamental structure of the historic cultural landscapes. They define the parcellation patterns by structuring directly the forms and boundaries of parcels; they are strengthened and highlighted indirectly by the settlement and tree cover patterns. Therefore, water system and parcellation patterns are the primary attributes that contribute to the landscape character in the YRD lowlands. Furthermore, different characteristics have different levels of vulnerability to change: The water system and parcellation patterns are more stable as they are related to the permanent structures and character shaped by land reclamation, poldering, and paddy-fish-silk farming since ancient times; whereas the patterns of tree cover, settlement and land use are more vulnerable to change in current and future urbanization and industrial development. Therefore, elements and structures of water system and parcellation have higher priority in landscape and urban planning practice. The type-specific measures were summarized and sorted into three levels of conservation, transformation, and critical reconstruction, dealing with the corresponding primary, omnipresent elements, and primary patterns and structures categorized by their significance and vulnerability. By these measures, the elements and structures of historic urban and polder landscapes can be protected or redeployed as spatial qualities and identities.

6.2.3 LANDSCAPE CHARACTER AREAS AND TYPES

The results of the typological approach include the following: At the regional scale, 21 regional landscape character areas were classified for the whole YRD by overlaying a physiographic and a hydraulic map. At the municipal scale, in the case study of Suzhou, 13 landscape character areas were distinguished; four polder landscape types occurring in 11 areas were classified by the criteria of basic forms (related to water system and parcellation patterns) and polder technologies. The four polder landscape types that were identified in Suzhou fit into the four historic polder types in the YRD described in the morphogenesis study of the delta landscape (Chap. 4). As a key conclusion, basic forms but, more importantly, polder technologies form the implicit rules that predominantly shape the characteristics of polder landscapes and can be used as criteria to develop a typology.

6.3 REFLECTION ON RESEARCH METHODS

6.3.1 FLEXIBLE LANDSCAPE CHARACTERIZATION APPROACH

Conventional LCA is normally a systematic, top-down research project that is conducted by regional or local organizations with a request for mass geographic data and field surveys. This makes LCA almost impossible to carry out by individual researchers or in some regions with limited accessibility to data. In this research, we developed a flexible landscape characterization approach, which could start from any scale, without existing national, regional or municipal landscape character maps as in the British cases.

6.3.2 COMBINED QUALITATIVE AND QUANTITATIVE APPROACH

Both qualitative and quantitative approaches were implemented in the characterization process. At the regional scale, a similar quantitative method as in LCA was conducted by overlying two obtained regionalization maps to draft the regional landscape character map. At the municipal and local scales, a combined qualitative and quantitative approach, comprised of the sections of mapping, description and classification was implemented to map and describe landscape character areas, and to classify landscape types.

6.3.3 DATA COLLECTION AND INSTRUCTIONS FOR USE

The accessible open database, historic topographic map collections, and satellite images from both Chinese and international sources are presented in the research process, which are vital for historic landscape studies while normally having limited accessibility in China. Furthermore, ways of using these maps have been well exemplified in both the morphogenesis study of polder types and in the characterization process of identifying, mapping, and describing landscape character areas and types.

6.3.4 LIMITATIONS AND IMPROVEMENTS OF THE TYPOLOGICAL APPROACH

There are still limitations in this approach. More precise boundaries of character areas, or more character areas and types might be identified if provided with satellite images in higher resolution or complete historic survey maps of various periods. When the landscape characterization of all delta cities is finsihed, a more precise regional character map could be drafted. On the other hand, in these fast-growing metropolitan areas, it might be more reasonable to have overlapped boundary lines or wide boundary zones to show the transition of landscape character instead of precise lines. How to draw these overlapped boundary lines or boundary zones could contribute to the improvement of this method. So far, only one landscape type, the networked polder landscape, is well exemplified by a complete research and practice process. Further work should extend to the other three types, which will enable the comparison of different types and will make this work more complete. Another improvement could be developing a more systematic evaluation of the significance and vulnerability of landscape attributes and involving local stakeholders and experts in the assessment.

6.4 POTENTIAL APPLICATION OF RESEARCH OUTCOMES

The typological approach developed here is not only a historical but also a forward-looking instrument to guiding landscape practice. The research outcomes include the landscape character maps of the YRD and Suzhou, mapping results of landscape elements and structures at multiple scales, and a landscape type profile. These outcomes could assist in cultural landscape and heritage conservation activities, as well as in future landscape planning, management, and development plans in the metropolitan areas of the YRD region. By transforming and integrating the existing or restorable historic landscape elements and structures as permanent forms and green-blue infrastructure into new developments of housing, infrastructure, and land use, we could explore a more integrated and resilient development model for Suzhou as well as for the other delta cities.

6.4.1 APPLICATION IN CULTURAL LANDSCAPE AND HERITAGE CONSERVATION

The current heritage preservation system in China primarily protects individual monuments and heritage buildings while neglecting their historic settings and surrounding built environments. Apart from national parks or several strictly protected world heritage cultural landscape sites, little attention has been paid to historic urban or rural landscapes, let alone the superimposed modern, but generic urban and industrial landscapes. This research develops a more inclusive and integrated approach to identifying, documenting and assessing both heritage cultural landscapes and especially everyday landscapes that are most vulnerable to, or have undergone, structural and functional changes.

The comprehensive method for landscape character study and its outcomes could provide references and guidelines for cultural landscape and heritage conservation in the YRD region. It deals with not only individual elements but also holistic landscape structures—the combinations of elements. The documentation system of landscape character, developed in the typological approach, could be further extended to an open digital database, such as the GIS based KHLE projects in Germany, which could make the conservation and planning activities of historic cultural landscapes accessible, visible, and transparent. As a result, local communities may get involved in these activities and become sensitive to the influences of their everyday life on surrounding historic landscapes. Thus, such a characterization approach could promote public awareness of the components, character, and values of historic cultural landscapes in the YRD region, and could enable a discussion of challenges and strategies of cultural landscape and heritage conservation in the context of metropolitan areas.

6.4.2 APPLICATION IN LANDSCAPE PLANNING, MANAGEMENT, AND DEVELOPMENT

This research has discussed the historic cultural landscape in the fast-growing YRD as a design issue. We discovered and summarized ways of using these existing or restorable elements and structures of historic urban and cultural landscapes as permanent forms and as green-blue infrastructure for new urban developments at three levels of conservation, transformation, and critical reconstruction. Through these researches and practices, we have explored a more integrated and resilient development model for Suzhou, as well as for the other delta cities.

The typological approach developed in this research is a forward-looking approach that could aid future landscape architecture practice dealing with cultural landscapes at multiple scales. Landscape profiles based on types, as a final product of this approach, include the details of the cultural meaning and social function, historical development, patterns, landscape changes, the significance and vulnerability, as well as measures for landscape conservation, management, and development. These outcomes can be used as source materials and references for landscape and open space structure planning, green-blue infrastructure plans and strategies, as well as for establishing landscape development concepts and policies in management and enhancement of historic cultural landscapes in rapidly expanding metropolitan areas of the YRD region and beyond.

APPENDICES

APPENDIX A ENLARGED FIGURES

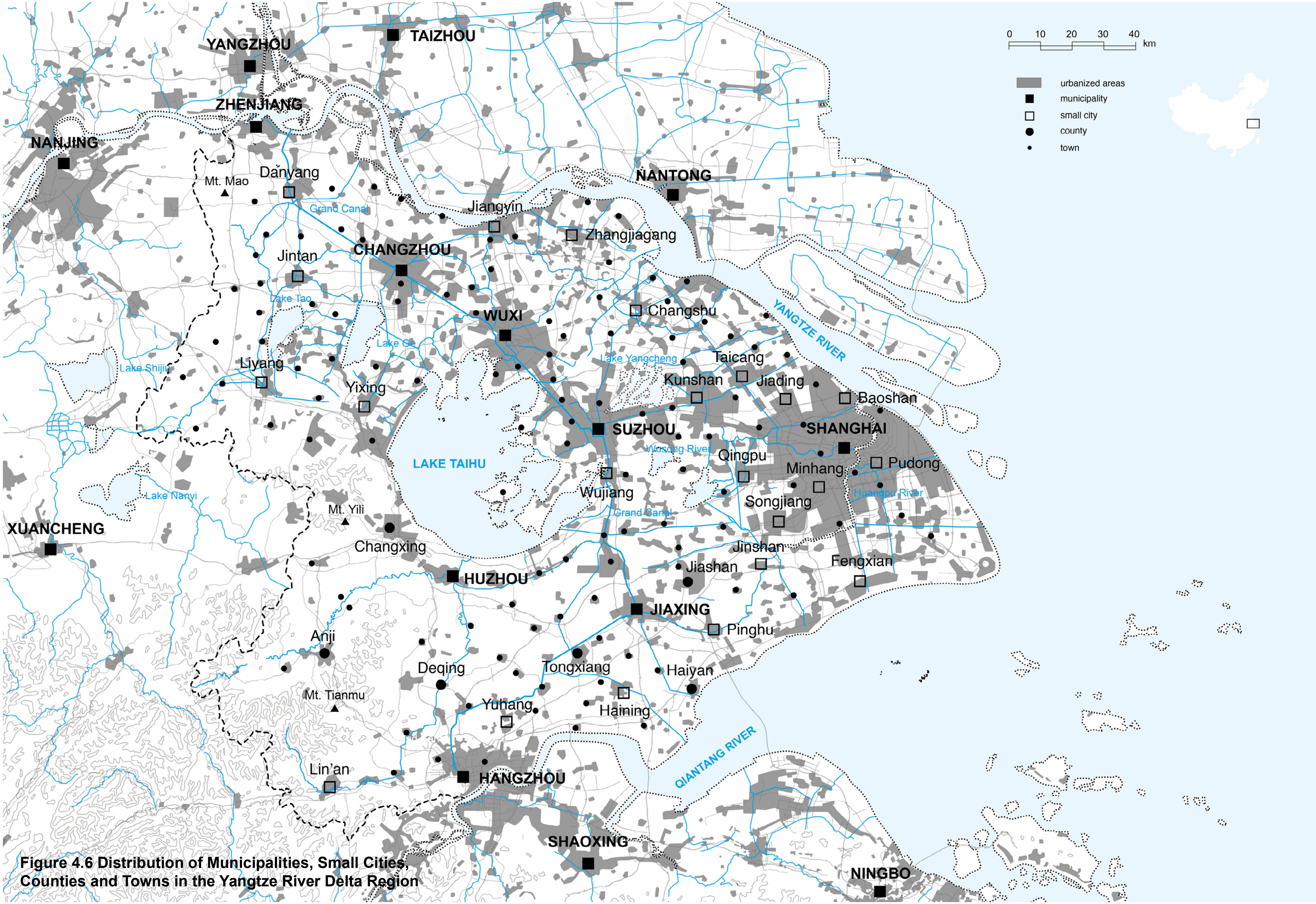


Figure 4.6 Distribution of Municipalities, Small Cities, Counties and Towns in the Yangtze River Delta Region

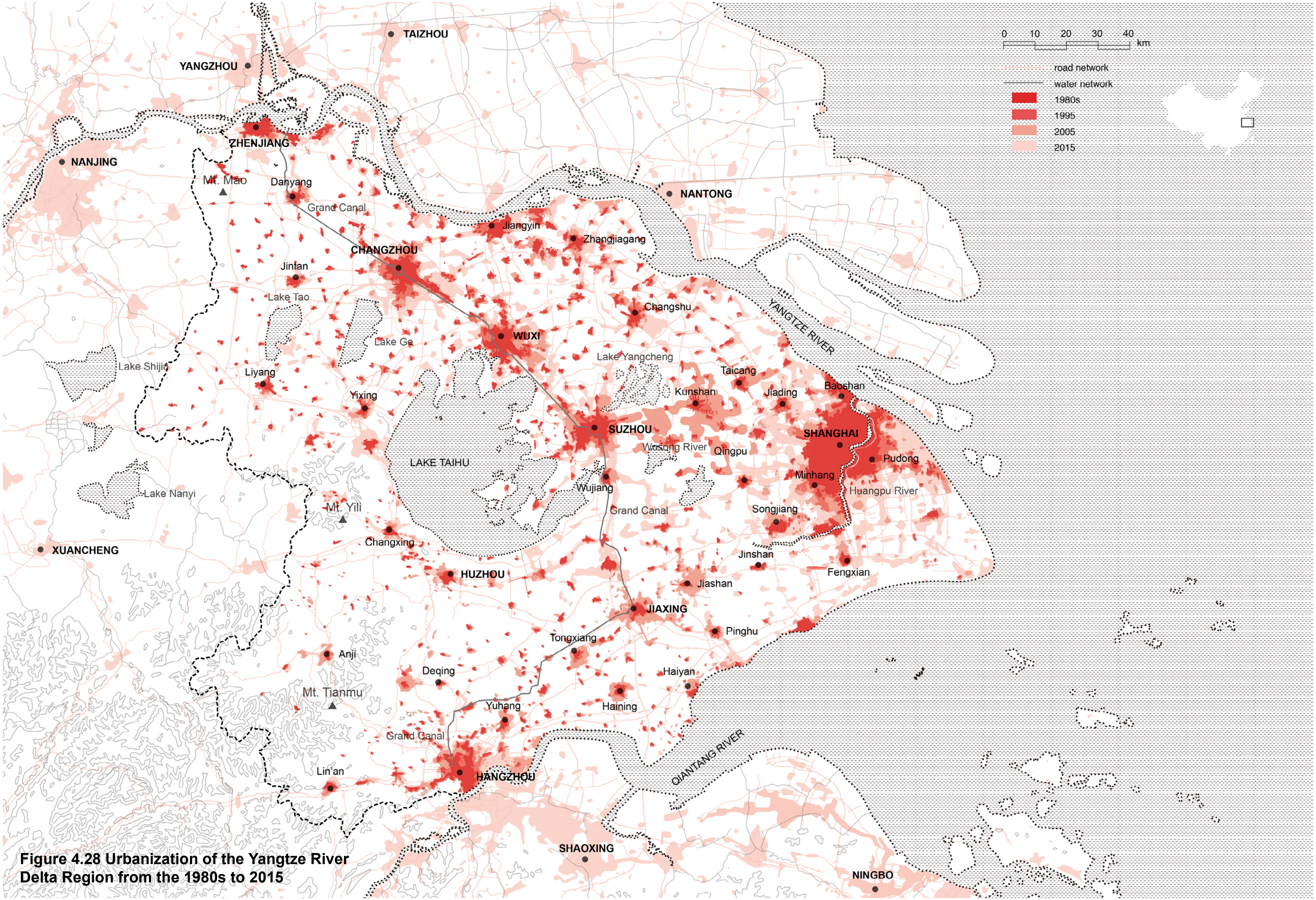


Figure 4.28 Urbanization of the Yangtze River Delta Region from the 1980s to 2015

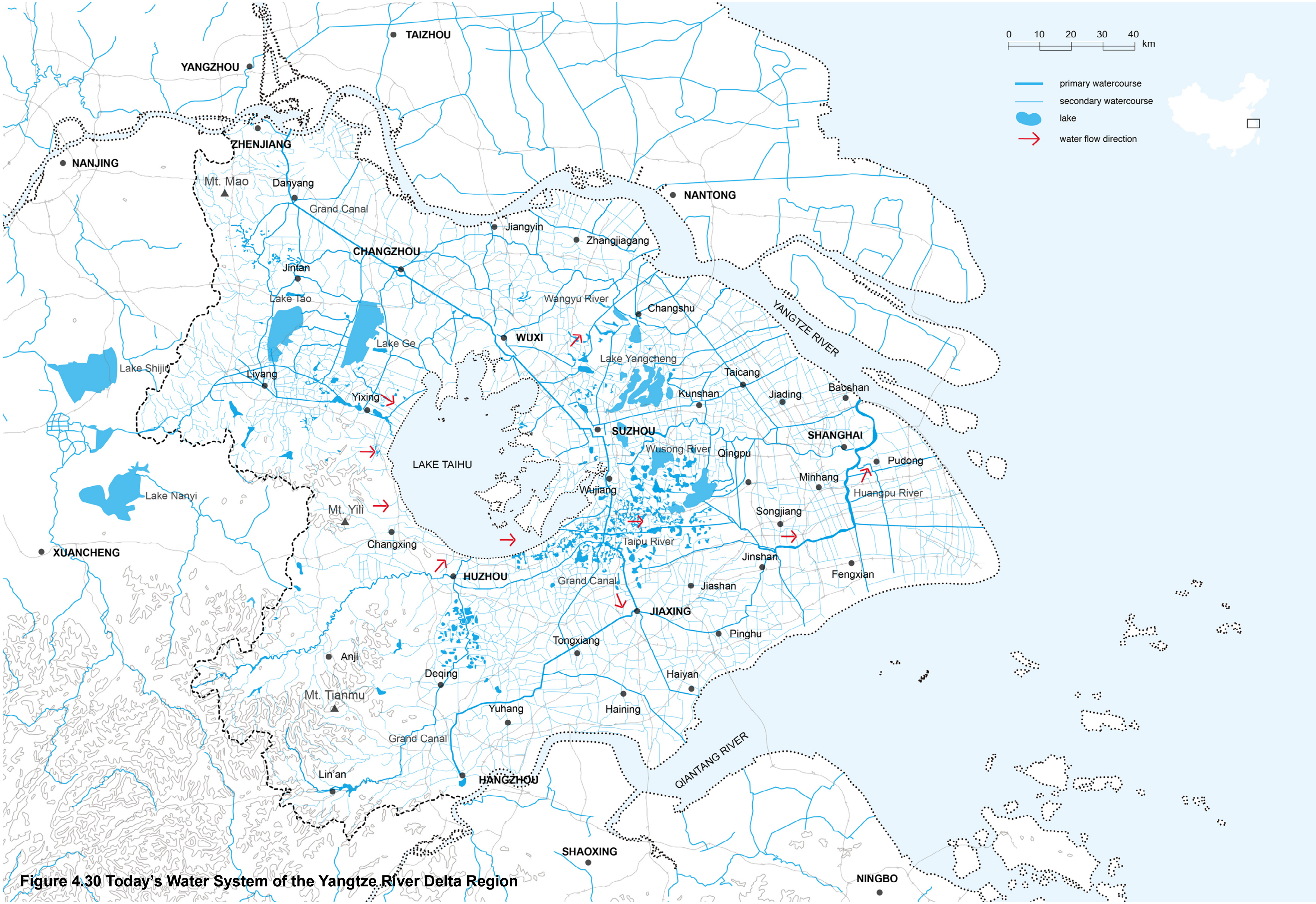


Figure 4.30 Today's Water System of the Yangtze River Delta Region

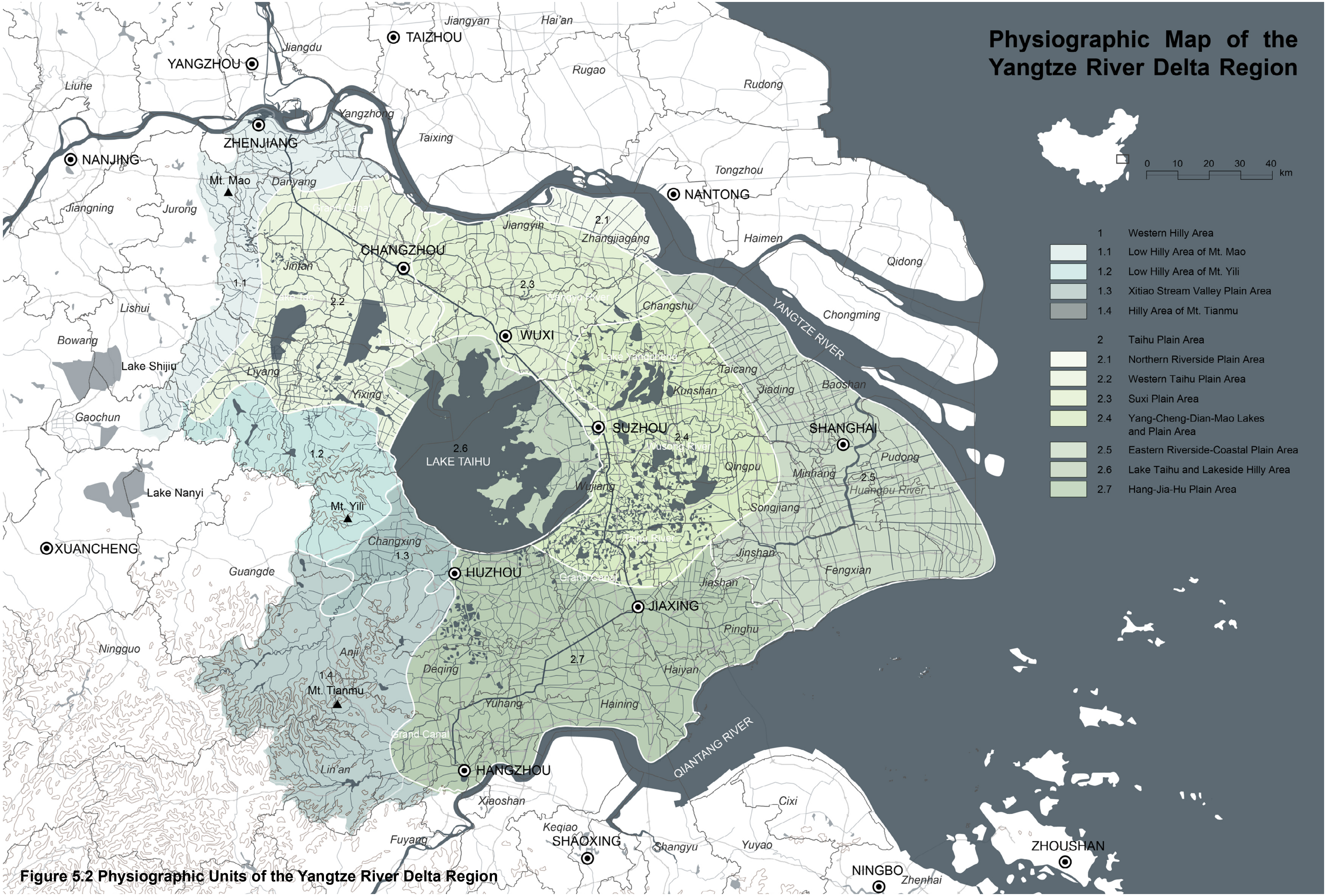


Figure 5.2 Physiographic Units of the Yangtze River Delta Region

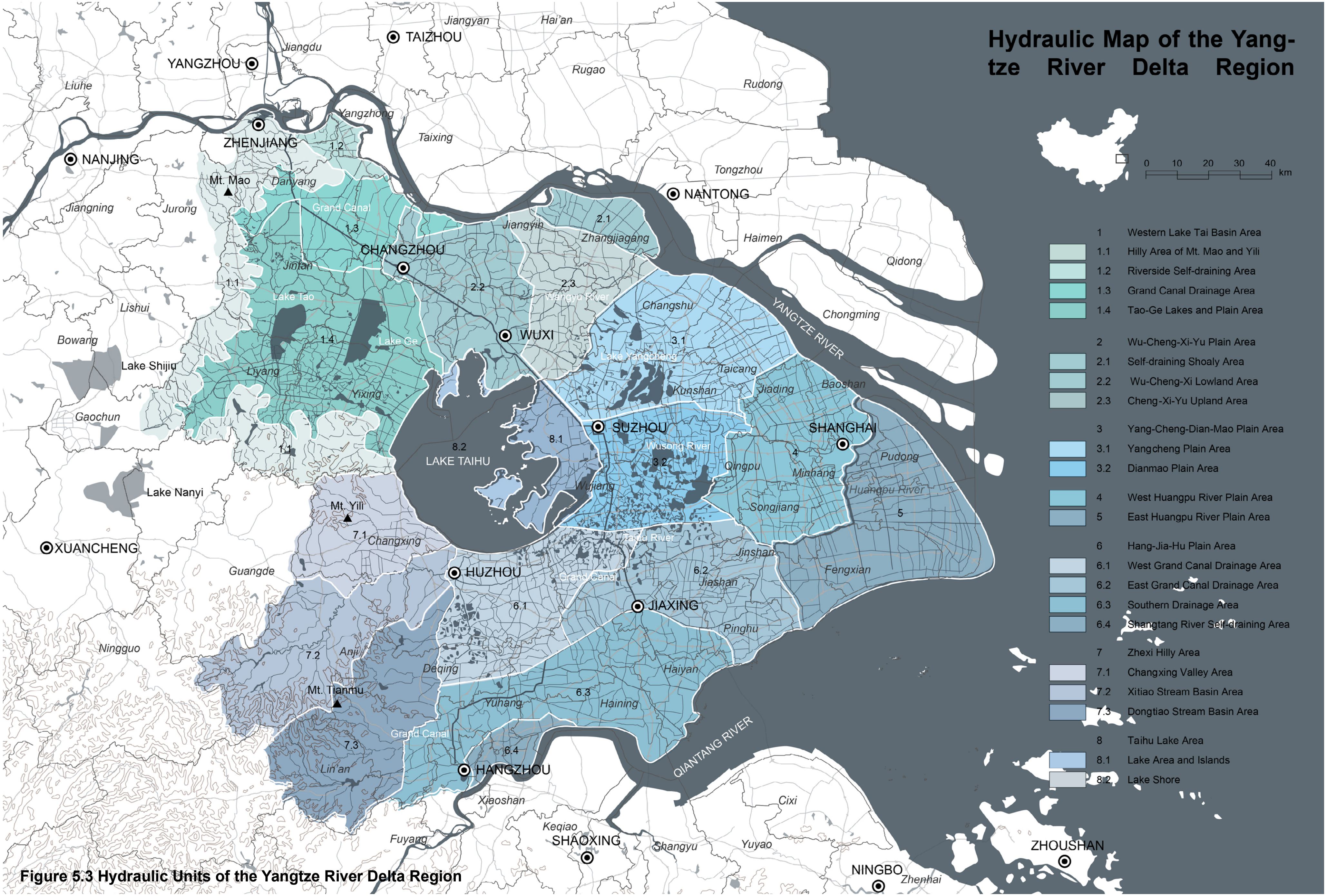


Figure 5.3 Hydraulic Units of the Yangtze River Delta Region

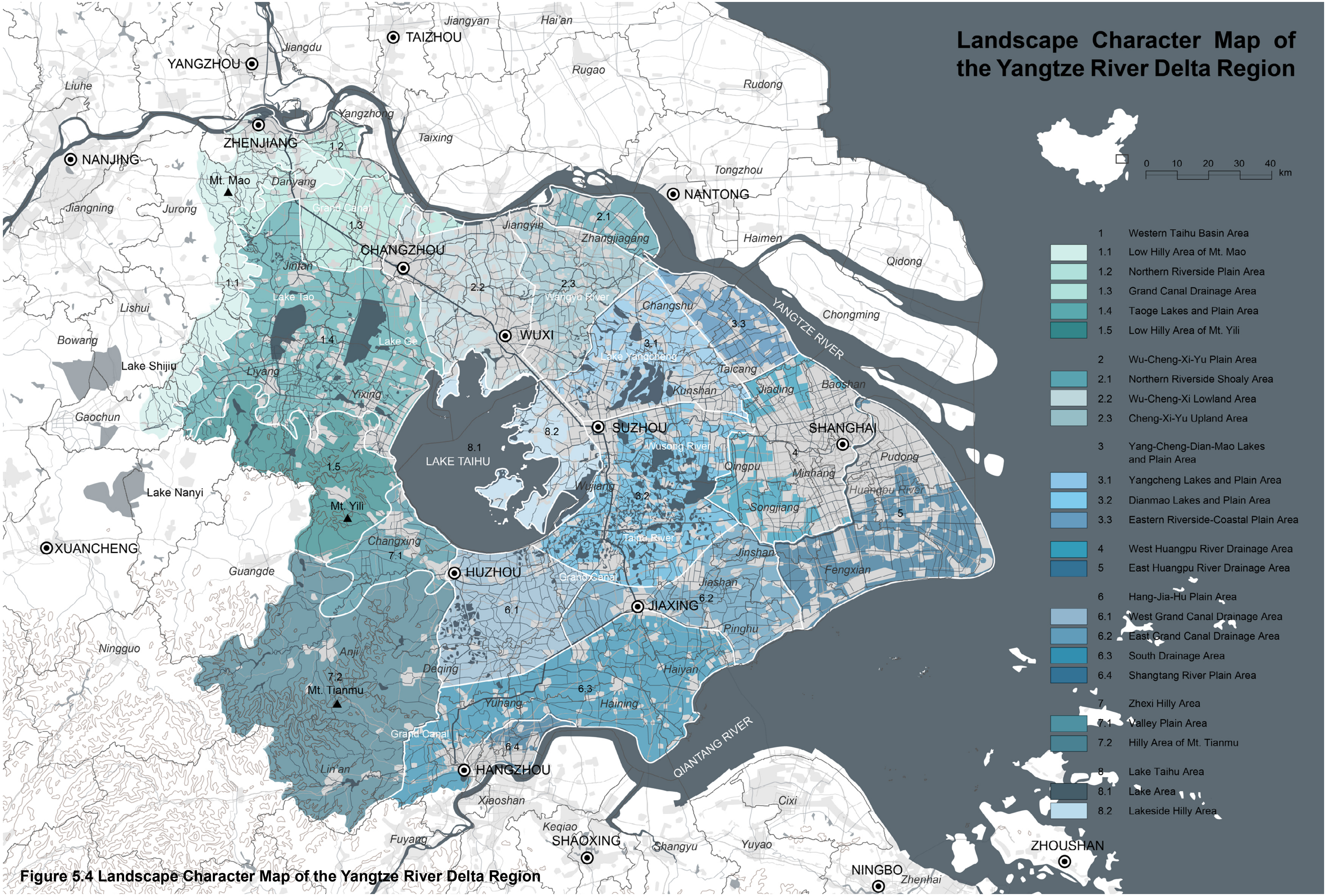


Figure 5.4 Landscape Character Map of the Yangtze River Delta Region

APPENDIX B OTHER RELEVANT TABLES

Table 5.8 Description of Physiographic Units

Source: Adapted from Zhu et al. (1988, pp. 21–25). The texts were reinterpreted and translated by the author.

No.	Geophysical Units	Description of the Sub-units
1	Western Hilly Area	This area includes four sub-units.
1.1	Low Hilly Area of Mt. Mao	The elevation of this area is relatively higher than the other sub-areas: Mountain Mao is around 200–300 m; farms in this area are located between 15–30 m altitude. Soil erosion leads to the loss of fertile land because of former extensive farming. This area is vulnerable to drought.
1.2	Low Hilly Area of Mt. Yili	This area has an elevation of 50–400 m, with a rolling landform. This area has rich natural resources such as bamboo, tee and chestnuts and is suitable for production of both rice and evergreen fruit trees (e.g. citrus and Chinese bayberry).
1.3	Xitiao Stream Valley Plain Area	This area is situated in the valley plain of the Xitiao Stream with an elevation of 3–7 m. This valley area has crisscross streams and canals, fertile soils for both grain and cash crops production (e.g. oil-yielding crops and mulberry). This area has a combined agriculture of grain, cash crops, animal husbandry, and aquatic farming.
1.4	Hilly Area of Mt. Tianmu	This hilly area has the Longwangshan Peak of 1587 m, and the elevation decreases from the southwestern area to the northeast. The hilly area has good water and heat conditions, vegetation cover and rich mountain resources.
2	Taihu Plain Area	This area includes seven sub-divisions.
2.1	Northern Riverside Plain Area	This alluvial plain was formed by shoals at the mouth of the Yangtze River. It has a flat topography, 4–6 m in elevation. The heat conditions of this area is not as good as the eastern plain area, but it has rich water resources and a good drainage system that ensures the most farms be exempt from the flooding and waterlogging. This area is a major area for cotton production. The large amount of water surface is an advantage for aquatic farming.
2.2	Western Taihu Plain Area	This area has an average elevation of 5–8 m with a gently rolling landform. The eastern part, especially along Lake Taihu, has good heat, water and soil conditions, which make this area highly productive of double cropping rice; the northern and middle parts are at a higher elevation, which have poor irrigation and drainage conditions and a few scattered streams; the middle part is a less productive area that is vulnerable to drought and waterlogging; the polder area in the southwestern part is lower than 5 m and is influenced by flooding and waterlogging. This area has a large water surface that enables the development of aquatic farming.
2.3	Suxi Plain Area	This area is 3–4 m in elevation and has some sparsely distributed hills around 200 m. Most of this area is located in a flat lacustrine plain with a crisscross water network. Farms in this area have a regular parcellation and have a well-maintained irrigation and drainage system, which makes this area highly productive. Aquatic farming, silk production, and pig breeding are the three main sideline production.
2.4	Yang-Cheng-Dian-Mao	This area is very low-lying with an average elevation of 2 m and is sprinkled with numerous lakes.

	Lakes and Plain Area	This area has a large water area and rich aquatic resources. In addition, rich heat and water resources make this area an important grain production area in Jiangsu Province. The southern part is an ideal area for double or triple cropping. However, the waterlogging issue because of topography limits the advantages of climate and soil resources for agricultural production.
2.5	Eastern Riverside-Coastal Plain Area	This area is located in a riverside, coastal plain, 4–5 m in elevation, increasing from the north to south. It has good heat conditions and abundant sunshine for cotton production. Proximity to large water body influences the climate of this area and this area is vulnerable to typhoon.
2.6	Lake Taihu and Lakeside Hilly Area	Lake Taihu has an area of 2427 km^2 and the lakeshore is 405 km in length. The lake area has rich aquatic resources and has a long fishery history. The reclaimed area has been growing since 1949 and reached 160 km^2 in the late 1980s. The hilly area is situated in the north and east lakeshore and is 100–300 m in elevation, which is a major production area of sub-tropical fruit trees (e.g. citrus, Chinese bayberry and loquat) in Jiangsu Province.
2.7	Hang-Jia-Hu Plain Area	This area is located in a flat plain with a crisscross water network. The main water flow direction is from west to east, and the Grand Canal crosses this area in a north-south direction. The most low-lying part—*Linghu* area is 2.8–3.5 m in elevation; the drainage area along the Grand Canal is 3.5–4.5 m and has mixed paddy and non-irrigated fields; the Qiantang River shore area has higher elevation of around 4.5–7.5 m. The mixed farmland and the dense water network formed a stereoscopic agriculture production of grain, cash crops, silk, and aquaculture.

Table 5.9 Description of Hydraulic Units

Source: Adapted from Wang (2006, pp. 40–44). The percent of water and polder area were documented in the 1990s.

No.	Hydraulic Units	Area (km^2)	Water Area Percent	Polder Area Percent	Description of the Sub-units
1	Western Taihu Basin Area	7896.5	7.5%	19.8%	This area has a complex topography with mountains joining with polders. This area is situated in the upper reaches of Lake Taihu and is the primary source of floods. The run off primarily drains to Lake Taihu and secondarily to the Yangtze River. The deficient drainage causes both flooding and waterlogging.
1.1	Hilly Area of Mt. Mao and Yili	2501.7	1.5%		
1.2	Riverside Self-draining Area	326.8	0.9%		
1.3	Grand Canal Drainage Area	1211.8	3.5%	17.7%	
1.4	Taoge Lakes and Plain Area	3856.2	13.1%	34.9%	The surrounding area of Lake Tao and Ge is low-lying and has an elevation of 3.5–5 m. Polder area accounts 86 % of the whole area.
2	Wu-Cheng-Xi-Yu Plain Area	3614.7	6.9%	19.4%	The Grand Canal flows through the city proper of Changzhou and Wuxi. Flood prevention of this area focuses on controlling floods from the western hilly area that might invade via the Grand Canal.
2.1	Self-draining Shoaly Area	415.7	2.4%		
2.2	Wu-Cheng-Xi Lowland Area	1767.6	7.3%	37.6%	The triangle zone between the Xicheng, Xihuang and Grand Canal is the main polder area.
2.3	Cheng-Xi-Yu Upland Area	1431.4	7.6%	2.6%	
3	Yang-Cheng-Dian-Mao Plain Area	4314.1	19.0%	45.5%	This area is sprinkled with numerous lakes. Water surface accounts for 19 % of the whole area. This area has a large amount of polder area. The polder mergence and standardization was firstly conducted in this sub-area. The northeastern riverside part is an upland area, 6–8 m in elevation; middle part is around 4–5 m; and the southeastern part is a lowland area, around 2.8–3.5 m.
3.1	Yangcheng Plain Area	2572.2	15.2%	49.7%	The streams and canals connecting to the Yangtze River were dredged and controlled by sluices. Water in this area could drain efficiently to the Yangtze River.
3.2	Dianmao Plain Area	1741.9	24.7%	39.3%	This area has 24.7 % percentage of water surface. Streams and canals in this area discharge run off into two directions: eastward into the Wusong River and southeastward into the Huangpu River via Lake Dianshan.
4	West Huangpu River Drainage Area	2165.1	10.5%	95.8%	The historic city proper of Shanghai is situated in the northeastern part of this area. Floods from Lake Taihu and tides from the Huangpu River influence this drainage area, and tide prevention is more pressing than flood prevention.
5	East Huangpu River	2301.1	9.8%	100%	The Chuangyang and Dazhi River drain run off into the Huangpu River and the East China Sea from east to west;

	Drainage Area				the Jinhui *Gang* discharges water into the Huangpu River and the Hangzhou Bay from north to south. This area is under the threat from floods and tides, especially costal storm surges.
6	Hang-Jia-Hu Plain Area	7480.3	11.5%	67.2%	This area has a large proportion of water area and has numerous lakes, mostly located in the triangular area of Wujiang. The elevation decreases from southwest to northeast: The area along the Hangzhou Bay is 5–7 m in elevation; the central plain is about 3.5–4.5 m; the eastern part is about 3.2 m; and the area neighboring the Dian-Mao plain and the upper reach of the Huangpu River is below 3.0 m. This area has the largest polder area among all eight units (reached 3000 polders in the 1970s) but has the worst drainage conditions as the west-east drainage route (more than 100 km) is inefficient. The southward canal connecting the Hangzhou Bay was built to be the primary one for drainage.
6.1	West Grand Canal Drainage Area	1980.9	14.8%	68.3%	This sub-area is at a relatively higher elevation
6.2	East Grand Canal Drainage Area	2089.8	14.3%	84.4%	This sub-area is at a relatively lower elevation
6.3	South Drainage Area	3068.8	8.6%	62.2%	
6.4	Shangtang River Self-draining Area	340.8	2.5%		
7	Zhexi Hilly Area	5930.9	3.3%	13%	This area is mainly hilly area, of which the plain area accounts only 22.3 % and is mainly situated in the middle and lower reaches of the Dongtiao and Xitiao Stream and the Changxing Valley Plain. Floods coming from this area primarily flow into Lake Taihu and secondarily into the Hang-Jia-Hu Plain. This area has poor drainage capacity.
7.1	Changxing Valley Area	1352.3	4.9%	30.8%	
7.2	Xitiao Stream Basin Area	2272.8	3.5%	7.7%	
7.3	Dongtiao Stream Basin Area	2305.8	2.1%		
8	Lake Taihu Area	3192.0	74.5%	4.5%	Lake Taihu has shallow water with an average depth of around 1 m. The islands are located in the middle of lake; small hills situate along the northern and southern lakeshore and the highest peak is around 300 m. The floods in Lake Taihu Area mainly come from the Western Taihu Basin Area and the Zhexi Hilly Area. The floods discharge northwards into the Yangtze River via the Wangyu River and eastwards into the Huangpu River via the Taipu River. The water flow could be controlled by the sluices in the mouths of water outlets in the east lakeshore. The Taihu Levee (Jiangsu part) was constructed during the 1970s and 1980s.
8.1	Lake Area and Islands	2427.0	96.3%	5.9%	
8.2	Lake Shore	765.0	5.3%		

Table 5.10 Description of Landscape Character Areas of the Yangtze River Delta Region

Source: Physiographic, hydrological/hydraulic, and agricultural land use characteristics adapted from Gong (1988, pp. 63–69); Wang (2006, pp. 33–34, 40–44); Zhu et al. (1988, pp. 21–25); contemporary characteristics of urban and industrial land use specified by the author.

No.	Landscape Character Areas	Description of Landscape Characteristics		
		Physiographic Characteristics	Hydrological/Hydraulic Characteristics	Land Use Characteristics
1	Western Taihu Basin Area	The area has the hilly part of Mountain Mao and Mountain Yili in the west and the plain part in the east.	This area is situated in the upper reaches of Lake Taihu and has a complex topography with mountains joining with polders. Floodwater of the Taihu Basin is primarily from this area and drains to Lake Taihu and the Yangtze River. The deficient drainage causes both flooding and waterlogging. Polder area constitutes 19.8 % of the whole area.	This area is less urbanized than the other sub-areas.
1.1	Low Hilly Area of Mt. Mao	Mountain Mao is around 200–300 m and has a high vegetation cover. Farms in this area are located between 15–30 m altitude. Soil erosion leads to a loss of fertile land.	This area is vulnerable to drought.	This area has rich forest resources. The piedmont area is suitable for growing cash crop trees (e.g. tea, Chinese chestnut, Tung trees, and tea oil camellia).
1.2	Northern Riverside Plain Area			
1.3	Grand Canal Drainage Area	This plain area has an elevation of more than 7 m.	This area has deficient irrigation and drainage conditions, and a few scattered streams. The south part in particular is a less productive area vulnerable to drought and waterlogging. Polder area accounts for 17.7% of the whole area.	
1.4	Taoge Lakes and Plain Area	This area has an average elevation of 5–8 m with a gently rolling landform. The eastern part, especially along Lake Taihu, has rich heat, water, and soil resources; the western part is located in a moderately piedmont plain, around 5–10 m; the southwestern part is a polder area lower than 5 m; the surrounding area of Lake Tao and Lake Ge is low-lying and	Polder area accounts for 34.9% of the whole area. The southwestern part has a large polder area and a dense water network and is vulnerable to flooding and waterlogging. The middle part surrounding Lake Tao and Lake Ge has poor irrigation and drainage conditions with a few scattered streams and is vulnerable to drought and waterlogging. The western piedmont area has few	The large water surface of this area enables the development of aquatic farming. The eastern part is a highly productive area of double cropping rice. This area also has advanced water transport, booming urbanization, and rural industrialization (township and village enterprises). The local agriculture has been significantly influenced by urban expansion and infrastructure development. The

		has an elevation of 3.5–5 m.	streams and poor hydraulic facilities: High-lying fields in this area face water shortage; low-lying polders are vulnerable to waterlogging.	western and middle parts are particularly less productive areas.
1.5	Low Hilly Area of Mt. Yili	This area has an elevation of 50–400 m, with rolling landform. This area has rich forest resources, such as bamboo, tee, and chestnuts.		The piedmont area is a productive area for cash trees (e.g. tea, Chinese chestnut, Tung trees, and tea oil camellia) as well as for rice and evergreen fruit trees (e.g. citrus and Chinese bayberry).
2	Wu-Cheng-Xi-Yu Plain Area		Polder area accounts for 19.4% of the whole area.	
2.1	Northern Riverside Shoaly Area	This new alluvial plain has been forming by shoals at the mouth of the Yangtze River. It has a flat topography, 4–6 m in elevation. This area has worse heat resource than the plain area in the east.	Most of this area is below the flood water level of the Yangtze River and is protected by the levee. This area has rich water resources and a good drainage system that ensures most farms be exempt from flooding and waterlogging.	This area has advanced modern agriculture and is a major area for cotton production. It has a highly mixed urban and polder landscapes, in which the highly urbanized city proper of Zhangjiagang as well as the industrial and port clusters superimposed on a standardized polder landscape.
2.2	Wu-Cheng-Xi Lowland Area	This area is 3–4 m in elevation and has sparsely distributed hills around 200 m. Most of this area is located in a flat lacustrine plain with a crisscross water network. The regular farms in this area are highly productive and have good irrigation and drainage conditions.	The main polder area situates in the triangle zone between the Xicheng, Xihuang and Grand Canal. The Grand Canal flows through the city proper of Changzhou and Wuxi. This area controls and prevents floods from the western hilly area that might invade via the Grand Canal.	These two sub-areas have aquatic farming, silk and pig breeding as the three main sideline production. These two areas have highly fragmented urban and industrialized rural landscape, including the city proper of Changzhou and Wuxi, a network of small and middle sizes counties and towns, and widespread township and village enterprises.
2.3	Cheng-Xi-Yu Upland Area			
3	Yang-Cheng-Dian-Mao Lakes and Plain Area	The northeastern riverside part is an upland area, 6–8 m in elevation; middle part is around 4–5 m; and the southeastern part is lowland, around 2.8–3.5 m.	This area is sprinkled with numerous lakes and water surface, accounting for 19% of the whole area. The Yangcheng and Dianmao Plain areas function as a flood corridor of the Taihu Basin. Polder area composes 45.5% of the whole area, in which polder mergence and standardization were firstly conducted among all sub-areas. The waterlogging issue of the low-lying plain limits the advantages of rich climate and soil resources for agricultural production.	Rich heat and water resources make this area an important grain production area. The southern part is an ideal area for double or triple cropping.

3.1	Yangcheng Lakes and Plain Area	This area is very low-lying with an average elevation of 2 m, which is below the flood water level. This area has a large water area consisting of dense canals and lakes. Most of this area is polder area, 3–4 m in elevation.	The streams and canals connecting to the Yangtze River were dredged and controlled by sluices. Run off in this area could drain efficiently to the Yangtze River. Polder area accounts for 49.7%.	Lake Yangcheng is a major area for fish and crab farming. The areas adjacent to Kunshan city and the Sino-Singapore Industrial Park are one of the most rapidly expanding metropolitan areas in the Taihu Basin.
3.2	Dianmao Lakes and Plain Area		This area has 24.7% of water surface and 39.3% polder area. Rivers and canals in this sub-area discharge into two directions: eastward into the Wusong River and southeastward into the Huangpu River via Lake Dianshan.	This area is relatively less populated and has a sparse road network because of the large water area. Due to the lagging urbanization and industrialization process, this area still has a high quality polder landscape.
3.3	Eastern Riverside-Coastal Plain Area		This area has rich water resources and good drainage. This area has a dense water network consisting of tide-influenced shallow, narrow canals.	This area has moderately high-lying fields that are suitable both for paddy and non-irrigated fields. It has an intensive and efficient farming system and is a major cotton and linen production area. In the meanwhile, this area has intensive urban and industrial land uses and is under high pressure of future development.
4	West Huangpu River Drainage Area	This area is located in a riverside, coastal plain, 4–5 m in elevation, increasing from north to south. This location is vulnerable to typhoon, and its proximity to large water body influences the climate of this area. This area has good heat conditions and abundant sunshine.	Almost 95.8% of this area is polder area. Floods from Lake Taihu and tides from the Huangpu River influence this drainage area, and tide prevention is more pressing than flood prevention.	The historic city proper of Shanghai is situated in the northeastern part of this area. Now this area is almost fully urbanized as the metropolitan area of Shanghai.
5	East Huangpu River Drainage Area		This area is 100% polder area. The Chuangyang and Dazhi River drain water into the Huangpu River and the East China Sea from east to west; the Jinhui *Gang* discharges water into the Huangpu River and the Hangzhou Bay from north to south. This area is under the threat from floods and tides, especially costal storm surges.	This area used to be mainly farmland, while currently one of the fastest-growing metropolitan areas since the establishment of the special economic zone—Pudong New Area in the 1990s. The coastal area has poor water quality and drainage and is a less productive area for cotton and wheat.
6	Hang-Jia-Hu Plain Area	This area is located in a flat plain. It has a large proportion of water area and a crisscross water network. The elevation decreases from southwest to northeast: The area along the Hangzhou Bay is 5–7 m in elevation; the central plain is about 3.5–4.5	The main water flow direction is from west to east, and the Grand Canal crosses this area in a north-south direction. This area has the worst drainage conditions among all eight hydraulic units as the west-east drainage route (more than 100 km) is inefficient. Thus, the	The mixed paddy and non-irrigated fields as well as the dense water network form a stereoscopic agriculture production of grain, cash crops, silk, and aquaculture.

		m; the eastern part is about 3.2 m; and the area neighboring the Dian-Mao Plain and the upper reach of the Huangpu River is below 3.0 m.	southward canal connecting the Hangzhou Bay was built to be the primary one for drainage.	
6.1	West Grand Canal Drainage Area	This sub-area is at a relatively higher elevation. The most low-lying part—Linghu area is 2.8–3.5 m.	Large areas of lakes were reclaimed and turned into polder areas (68.3 %). This area has a dense water network and is under threat of waterlogging.	This area is relatively less populated and has a sparse road network because of the distribution of numerous lakes and a dense water network. This area has rich agricultural production resources and few rural industries. Due to the lagging urbanization and industrialization process, this area still has high quality polder landscape based on a stereoscopic farming system of the mulberry dike-fish pond complex.
6.2	East Grand Canal Drainage Area	This sub-area is situated in a netted river plain, at a relatively lower elevation and has fertile soil.	This area has good drainage conditions and a dense water network. The polder area makes up 84.4 % of the whole area.	This area has mixed paddy fields of around 4 m and non-irrigated fields growing primarily mulberry as well as the other cash crops such as linen, wheat, tobacco, chrysanthemum, and vegetables.
6.3	South Drainage Area		The polder area accounts for 62.2 % of the whole area.	
6.4	Shangtang River Plain Area	The Qiantang River shore area has higher elevation of around 4.5–7.5 m.		This area is in between the old and new coastal dikes and has a short history of farming, mainly cotton and linen.
7	Zhexi Hilly Area	This area is mainly hilly area, of which the plain area accounts only 22.3 %. It is mainly situated in the middle and lower reaches of the Dongtiao and Xitiao Stream and the Changxing Valley Plain.	Floods coming from this hilly area primarily flow into Lake Taihu and secondarily into the Hang-Jia-Hu Plain. This area has poor drainage.	
7.1	Valley Plain Area	This area is situated in the valley plain of the Xitiao Stream with an elevation of 3–7 m.	This valley area has crisscross streams and canals. The lowlands of the valley were reclaimed as polders (30.8 %) to prevent floods from the mountains. The polder area is vulnerable to flooding and waterlogging. The gentle slopes have terraced fields with poor irrigation and drainage, mainly growing single cereal crop.	This area has a combined agriculture of grain, cash crops, animal husbandry, and aquatic farming. The fertile soil enables the production of both grain and cash crops (e.g. oil-yielding crops and mulberry).

7.2	Hilly Area of Mt. Tianmu	This hilly area has the Longwangshan Peak of 1587 m, and the elevation decreases from southwestern to northeast. The hilly area has good water and heat conditions, vegetation cover, and rich mountain resources.		Mountain Tianmu is protected as a nature reserve. The Moganshan National Park and the hilly areas of Hangzhou and Yixing have well-developed tourism.
8	Lake Taihu Area			
8.1	Lake Area	Lake Taihu has an area of 2427 km^2 and the lakeshore is 405 km long. Lake Taihu has shallow water with an average depth of around 1 m.	The floods in Taihu lake area mainly come from the Western Taihu Basin Area and the Zhexi Hilly Area. The run off discharges northwards into the Yangtze River via the Wangyu River and eastwards into the Huangpu River via the Taipu River. The water flow could be controlled by the sluices in the mouths of water outlets in the east Taihu lakeshore.	The lake area has rich aquatic resources and has a long fishery history.
8.2	Lakeside Hilly Area	The hilly area is situated in the north and east lakeshore. This area has dispersed hills at an elevation of 100–300 m and has a piedmont plain area of around 5 m.	The piedmont area has relatively high-lying fields with sparse streams, whereas the plain area has a dense water network. This area has good irrigation and drainage conditions.	The plain part is a highly productive area with intensive farming. The piedmont area has high vegetation cover and is a major production area of sub-tropical fruit trees (e.g. citrus, Chinese bayberry, and loquat). This area is close to the city proper of Suzhou, which is heavily populated and has advanced infrastructure for urban and industrial developments.

Table 5.11 Classification of Historic Cultural Landscape Elements by Function Types

The names of the function types, cultural landscape complexes and functional groups are adapted from (Bastian, Walz, & Decker, 2013; Bayerisches Landesamt für Umwelt, Bayerisches Landesamt für Denkmalpflege, & Bayerischer Landesverein für Heimatpflege e.V., 2013; Kopp, 2012; Kulturlandschaftsportal Thüringen, 2015).

Level I Functional Types	Level II Cultural Landscape Complexes	Level III Functional Groups	Level IV Cultural Landscape Elements	Chinese Names
Water Use and Hydraulic Engineering *水利用与水利工程*	Hydraulic engineering	Flood protection	dikes	*堤*
			polder embankments	*圩岸*
			reservoirs	*水库*
			sluices	*水闸*
		Drainage and irrigation	ditches	*沟渠*
			drainage channels	*排水渠*
			irrigation ponds	*灌溉池*
			weirs	*拦河坝*
		Hydropower	water power stations	*水力发电站*
	Water use	Water supply and control	dams	*水坝*
			sluices	*水闸*
			weirs	*拦河坝*
		Water collection and production	ponds	*水池*
			reservoirs	*水库*
			water towers	*水塔*
Agriculture and Fishery *农业与渔业*	Arable land	Field	cropland	*耕地*
			paddy fields	*水稻田*
			lotus ponds	*藕田*
		Field boundary	field paths	*田间小路*
			ridges	*田埂*
	Fishery and aquaculture		fishponds	*鱼塘*
			fishpond embankments	*塘基*
			huts on fishpond embankments	*塘基上的棚屋*
			other aquaculture ponds	*其他水产养殖池塘*
	Livestock	Pasture	meadows/grasslands	*草甸，草地*
	Orchard		orchards	*果园*
	Plantation		tee plantations	*茶园*
			mulberry plantations	*桑树园*

			nurseries	苗圃
Forestry 林业	Wood		*Feng Shui* woodland	风水林
			shelter forests	防护林
	Linear tree belt		avenue trees	行道树
			trees along canals	沿运河林带
			trees along dikes	沿堤林带
			trees along lakeshores	沿湖岸林带
			trees along polder embankments	沿圩岸林带
			trees along railways	沿铁轨林带
			trees along riverbanks	沿河岸林带
			trees along roads	沿公路林带
	Single tree		ancient trees	古树
Settlement 聚落	Urban and town's historic settlement	Neighbourhood, district	blocks of residences	街区住宅
			colonnades	檐廊
		Commerce and trade	merchant houses	商铺
			markets	市集
		Fortress	city walls	城墙
			gates	城门
			moats	护城河
		Other buildings	bell towers, drum towers	钟鼓楼
			memorial archways	牌坊，牌楼
			pagodas	塔
		Urban green/open space	traditional gardens	传统园林
			parks	公园
	Rural historic settlement	Homestead	barns	牲口棚
			courtyards	院子
			farmhouses	农舍
			fences	篱笆
			patios	天井
			silos	谷仓
			vegetable gardens	菜园
			walls	墙
		Other buildings	ancestral temples	祠堂
			gatehouses	门楼，巷门
			memorial archways	牌坊，牌楼

			pagodas	塔
			pavilions	亭子
			theatrical or opera stages	戏台
			village schools	乡村私塾
			wells	水井
		Rural green/open space	cottage gardens	乡村园林
			spaces near docks	河埠头周围空间
			stone tables and benches	石桌，石凳
			village ponds	乡村池塘
Religion, Funeral and Memorial Site *宗教，殡葬与纪念地*	Religion		Buddhist pagodas	佛塔
			Buddhist temples	寺庙
			churches and churchyards	教堂,教堂庭院
			mosques	清真寺
	Funeral and memorial site		mausoleums	陵园
			public cemeteries	公墓
			rural private graves	坟墓
Industry and Mining *工业与采矿*	Industrial complex		brickyards	砖厂
			cement mills	水泥厂
			shipyards	造船厂
			textile mills	纺织厂
			industrial relics	工业遗址
	Mining	Mining	mines	矿区
			mining relics	矿区遗址
		Quarry	quarry relics	采石场遗址
			sand quarries	采砂场
			stone quarries	采石场
Transportation *交通*	Waterways	Port facility	boats	船
			boat houses	船坞
			docks	河埠头
			ports, harbors	港口
		Waterway	canals	运河
			ferry crossings	渡口
			water lanes	水巷
		Other	towpaths	纤道
	Roads and	National and regional	national highways	国道

	alleys/Paths	road	provincial highways	*省道*
		Local road and path	alleys	*巷子*
			county roads	*县道*
			field paths	*田间小路*
			flagstone walks	*石板路*
			paths	*小径*
			pavement lanes	*铺装路*
			stone embankments	*石驳岸*
			streets	*街*
			village roads	*乡村道路*
		Crossing water	bridges	*桥*
	Railway		train tracks	*铁轨*
			railway stations	*火车站*

Table 5.12 Classification of Historic Cultural Landscape Elements by Form Types

The names of the three form types are adapted from Hallmann and Pabst (1993).

Form Types	Historic Cultural Landscape Elements	Chinese Names
Single Elements *点状元素*	water power stations	*水力发电站*
	sluices	*水闸*
	weirs	*拦河坝*
	dams	*水坝*
	ponds	*水池*
	water towers	*水塔*
	huts on fishpond embankments	*塘基上的棚屋*
	ancient trees	*古树*
	bell towers, drum towers	*钟鼓楼*
	gates	*城门*
	merchant houses	*商铺*
	pagodas	*塔*
	memorial archways	*牌坊，牌楼*
	ancestral temples	*祠堂*
	barns	*牲口棚*
	courtyards	*院子*
	farmhouses	*农舍*
	gatehouses	*门楼，巷门*
	patios	*天井*
	pavilions	*亭子*
	silos	*谷仓*
	stone tables and benches	*石桌，石凳*
	theatrical or opera stages	*戏台*
	vegetable gardens	*菜园*
	village schools	*乡村私塾*
	wells	*水井*
	Buddhist pagodas	*佛塔*
	Buddhist temples	*寺庙*
	churches and churchyards	*教堂, 教堂庭院*
	mosques	*清真寺*
	rural private graves	*坟墓*

	brickyards	*砖厂*
	cement mills	*水泥厂*
	industrial relics	*工业遗址*
	shipyards	*造船厂*
	textile mills	*纺织厂*
	boats	*船*
	boat houses	*船坞*
	docks	*河埠头*
	ferry crossings	*渡口*
	port, harbors	*港口*
	bridges	*桥*
	railway stations	*火车站*
Linear Elements *线性元素*	dikes	*堤*
	ditches	*沟渠*
	drainage channels	*排水渠*
	polder embankments	*圩岸*
	field paths	*田间小路*
	ridges	*田埂*
	fishpond embankments	*塘基*
	avenue trees	*行道树*
	trees along canals	*沿运河林带*
	trees along dikes	*沿堤林带*
	trees along lakeshores	*沿湖岸林带*
	trees along polder embankments	*沿圩岸林带*
	trees along railways	*沿铁轨林带*
	trees along riverbanks	*沿河岸林带*
	trees along roads	*沿公路林带*
	city walls	*城墙*
	colonnades	*檐廊*
	moats	*护城河*
	fences	*篱笆*
	walls	*墙*
	canals	*运河*
	towpaths	*纤道*
	water lanes	*水巷*
	alleys	*巷子*
	county roads	*县道*

	flagstone walks	*石板路*
	national highways	*国道*
	paths	*小径*
	pavement lanes	*铺装路*
	provincial highways	*省道*
	stone embankments	*石驳岸*
	streets	*街*
	village roads	*乡村道路*
	train tracks	*铁轨*
	irrigation ponds	*灌溉池*
	reservoirs	*水库*
	cropland	*耕地*
	lotus ponds	*藕田*
	paddy fields	*水稻田*
	fishponds	*鱼塘*
	other aquaculture ponds	*其他水产养殖塘*
	meadows/grasslands	*草甸，草地*
	orchards	*果园*
	mulberry plantations	*桑树园*
	nurseries	*苗圃*
	tee plantations	*茶园*
	Feng Shui woodland	*风水林*
Spatially Continuous Elements *面状元素*	shelter forests	*防护林*
	blocks of residences	*街区住宅*
	markets	*市集*
	parks	*公园*
	traditional gardens	*传统园林*
	cottage gardens	*乡村园林*
	spaces near docks	*河埠头周围空间*
	village ponds	*乡村池塘*
	mausoleums	*陵园*
	public cemeteries	*公墓*
	mines	*矿区*
	mining relics	*矿区遗址*
	quarry relics	*采石场遗址*
	sand quarries	*采砂场*
	stone quarries	*采石场*

APPENDIX C GLOSSARY OF CHINESE TERMS

English	***Pinyin***	***Hanzi***
big polder system	*dawei tixi*	大圩体系
canal-road	*tanglu*	塘路
chenier	*gangshen*	冈身
city	*cheng*	城
	cheng shi	城市
county	*xian*	县
county-level city	*xian ji shi*	县级市
country market	*shi*	市
cultural landscape	*wenhua jingguan*	文化景观
cultural relics protection unit	*wenwu baohu danwei*	文化保护单位
designated city	*jian zhi shi*	建制市
designated town	*jian zhi zhen*	建制镇
everyday landscape	*richang jingguan*	日常景观
fish scale polder	*yulin wei*	鱼鳞圩
gardening	*zaoyuan*	造园
Hu-Dang polder	*hudang weitian*	湖荡圩田
hydraulic	*shuili de*	水利的
hydrological	*shuiwen de*	水文的
lake field	*hutian* *dangtian*	湖田 荡田
Jiangnan region	*Jiangnan diqu*	江南地区
	Jiang Zhe Hu	江浙沪
Jiang Zhe region	*Jiang Zhe diqu*	江浙地区
	jingbang	泾浜
Jing-Bang polder	*jingbang weitian*	泾浜圩田
landscape	*fengjing* *jingguan*	风景 景观
landscape architecture	*fengjing yuanlin* *jingguan sheji xue* *jingguan jianzhu* *yuanlin*	风景园林 景观设计学 景观建筑 园林
landscape character/characteristics/features	*jingguan tezheng*	景观特征

landscape characterization	*jingguan tezheng miaoshu*	*景观特征描述*
landscape element	*jingguan yuansu*	*景观元素*
landscape planning	*fengjing yuanlin guihua* *jingguan guihua*	*风景园林规划* *景观规划*
landscape structure	*jingguan jiegou*	*景观结构*
local authority scale	*difang dangju chidu*	*地方当局尺度*
local chronicle	*difangzhi*	*地方志*
local/site scale	*bendi/changdi chidu*	*本地/场地尺度*
longitudinal *Pu*	*zongpu*	*纵浦*
lougang	*lougang*	*溇港*
Lou-Gang polder	*lougang weitian*	*溇港圩田*
municipality	*zizhi shi*	*自治市*
national park	*fengjing mingshengqu*	*风景名胜区*
ordinary landscape	*xunchang jingguan*	*寻常景观*
polder	*weitian* *weizi*	*圩田* *圩子*
polder mergence	*lianwei* *bingwei*	*联圩* *并圩*
polder standardization	*weitian biaozhunhua*	*圩田标准化*
prefecture-level city	*di ji shi*	*地级市*
region	*diqu* *diyu*	*地区* *地域*
regional character	*diyu tezheng*	*地域特征*
regional scale	*quyu chidu*	*区域尺度*
rural landscape	*xiangcun jingguan*	*乡村景观*
small polder system	*xiaowei tixi*	*小圩体系*
suburban landscape	*chengjiao Jingguan*	*城郊景观*
Tang-Pu polder	*tangpu weitian*	*塘浦圩田*
town	*zhen*	*镇*
transverse *Tang*	*hengtang*	*横塘*
tuntian system	*tuntian zhi*	*屯田制*
urban district	*chengqu*	*城区*
urban landscape	*chengshi jingguan*	*城市景观*
urban population	*chengzhen renkou*	*城镇人口*
vernacular landscape	*xiangtu jingguan*	*乡土景观*
water conservancy annal	*shuilizhi*	*水利志*

Hierarchical Water System in the Yangtze River Delta (Table 4.1)

English	***Pinyin***	***Hanzi***
Lake	*Hu*	湖
	Dang	荡
	Dian	淀
	Yang	漾
River	*Jiang*, e.g. *Wusong Jiang, Huangpu Jiang*, *Lou Jiang*	江, 吴淞江,黄浦江,娄江
	He, e.g. *Taipu He*, *Wangyu He*	河, 太浦河, 望虞河
Canal and Creek	*Tang*, e.g. *Di Tang*, *Shuanglin Tang*	塘, 頔塘,双林塘
	Pu	浦
	Gang, e.g. 72 *Gangs* in Zhenze, *36 Gangs* in Wujiang	港, 震泽七十二港, 吴江三十六港
	Lou, e.g. *38 Lous* in Wuxing	溇, 吴兴三十八溇
	Jing	泾
	Bang	浜

Physiographic Units of the Yangtze River Delta Region (Figure 5.2)

No.	**English**	***Pinyin***	***Hanzi***
1	Western Hilly Area	*Xibu Shandi Qiuling Qu*	*西部山地丘陵地区*
1.1	Low Hilly Area of Mt. Mao	*Maoshan Dishan Qiulinggang Diqu*	*茅山低山丘陵岗地区*
1.2	Low Hilly Area of Mt. Yili	*Yili Dishan Qiuling Qu*	*宜溧低山丘陵区*
1.3	Xitiao Stream Valley Plain Area	*Xitiaoxi Hegu Pingyuan Qu*	*西苕溪河谷平原区*
1.4	Hilly Area of Mt. Tianmu	*Tianmushan Shandi Qiuling Qu*	*天目山山地丘陵区*
2	Taihu Plain Area	*Taihu Pingyuan Diqu*	*太湖平原地区*
2.1	Northern Riverside Plain Area	*Beibu Yanjiang Pingyuan Qu*	*北部沿江平原区*
2.2	Western Taihu Plain Area	*Huxi Pingyuan Qu*	*湖西平原区*
2.3	Suxi Plain Area	*Suxi Pingyuan Qu*	*苏锡平原区*
2.4	Yang-Cheng-Dian-Mao Lakes and Plain Area	*Yang-Cheng-Dian-Mao Hudang Pingyuan Qu*	*阳澄淀泖湖荡平原区*
2.5	Eastern Riverside-Coastal Plain Area	*Dongbu Yanjiang Yanhai Pingyuan Qu*	*东部沿江沿海平原区*
2.6	Lake Taihu and Lakeside Hilly Area	*Taihu Ji Hubin Qiuling Qu*	*太湖及湖滨丘陵区*
2.7	Hang-Jia-Hu Plain Area	*Hang-Jia-Hu Pingyuan Qu*	*杭嘉湖平原区*

Hydraulic Units of the Yangtze River Delta Region (Figure 5.3)

No.	English	*Pinyin*	*Hanzi*
1	Western Taihu Basin Area	*Huxi Qu*	湖西区
1.1	Hilly Area of Mt. Mao and Yili	*Maoshan he Yili Shanqu*	茅山和宜溧山区
1.2	Riverside Self-draining Area	*Binjiang Zipai Qu*	滨江自排区
1.3	Grand Canal Drainage Area	*Yunhe Pian*	运河片
1.4	Taoge Lakes and Plain Area	*Taoge Pian*	洮滆片
2	Wu-Cheng-Xi-Yu Plain Area	*Wu-Cheng-Xi-Yu Qu*	武澄锡虞区
2.1	Self-draining Shoaly Area	*Shazhou Zipai Pian*	沙洲自排区
2.2	Wu-Cheng-Xi Lowland Area	*Wu-Cheng-Xi Dipian*	武澄锡低片
2.3	Cheng-Xi-Yu Upland Area	*Cheng-Xi-Yu Gaopian*	澄锡虞高片
3	Yang-Cheng-Dian-Mao Plain Area	*Yang-Cheng-Dian-Mao Qu*	阳澄淀泖区
3.1	Yangcheng Plain Area	*Yangcheng Pian*	阳澄片
3.2	Dianmao Plain Area	*Dianmao Pian*	淀泖片
4	West Huangpu River Drainage Area	*Puxi Qu*	浦西区
5	East Huangpu River Drainage Area	*Pudong Qu*	浦东区
6	Hang-Jia-Hu Plain Area	*Hang-Jia-Hu Qu*	杭嘉湖区
6.1	West Grand Canal Drainage Area	*Yunxi Pian*	运西片
6.2	East Grand Canal Drainage Area	*Yundong Pian*	运东片
6.3	South Drainage Area	*Nanpai Pian*	南排片
6.4	Shangtang River Self-draining Area	*Shangtang Zipai Pian*	上塘河自排片
7	Zhexi Hilly Area	*Zhexi Qu*	浙西区
7.1	Changxing Valley Area	*Changxing Pian*	长兴片
7.2	Xitiao Stream Basin Area	*Xitiaoxi Pian*	西苕溪片
7.3	Dongtiao Stream Basin Area	*Dongtiaoxi Pian*	东苕溪片
8	Lake Taihu Area	*Taihu Qu*	太湖区
8.1	Lake Area and Islands	*Humian yu Daoyu*	湖面与岛屿
8.2	Lake Shore	*Yan'an*	沿岸

Landscape Character Areas of the Yangtze River Delta Region (Figure 5.4)

No.	**English**	***Pinyin***	***Hanzi***
1	Western Taihu Basin Area	*Huxi Qu*	*湖西区*
1.1	Low Hilly Area of Mt. Mao	*Maoshan Dishan Qiuling Qu*	*茅山低山丘陵区*
1.2	Northern Riverside Plain Area	*Beibu Yanjiang Pingyuan Qu*	*北部沿江平原区*
1.3	Grand Canal Drainage Area	*Yunhe Qu*	*运河区*
1.4	Taoge Lakes and Plain Area	*Taoge Huqu*	*洮滆湖区*
1.5	Low Hilly Area of Mt. Yili	*Yili Dishan Qiuling Qu*	*宜溧低山丘陵区*
2	Wu-Cheng-Xi-Yu Plain Area	*Wu-Cheng-Xi-Yu Qu*	*武澄锡虞区*
2.1	Northern Riverside Shoaly Area	*Beibu Yanjiang Shazhou Qu*	*北部沿江沙洲区*
2.2	Wu-Cheng-Xi Lowland Area	*Wu-Cheng-Xi Didi Qu*	*武澄锡低地区*
2.3	Cheng-Xi-Yu Upland Area	*Cheng-Xi-Yu Gaodi Qu*	*澄锡虞高地区*
3	Yang-Cheng-Dian-Mao Lakes and Plain Area	*Yang-Cheng-Dian-Mao Hudang Pingyuan Qu*	*阳澄淀泖湖荡平原区*
3.1	Yangcheng Lakes and Plain Area	*Yangcheng Huqu*	*阳澄湖区*
3.2	Dianmao Lakes and Plain Area	*Dianmao Huqu*	*淀泖湖区*
3.3	Eastern Riverside-Coastal Plain Area	*Dongbu Yanjiang Yanhai Pingyuan Qu*	*东部沿江沿海平原区*
4	West Huangpu River Drainage Area	*Puxi Qu*	*浦西区*
5	East Huangpu River Drainage Area	*Pudong Qu*	*浦东区*
6	Hang-Jia-Hu Plain Area	*Hang-Jia-Hu Pingyuan Qu*	*杭嘉湖平原区*
6.1	West Grand Canal Drainage Area	*Yunxi Qu*	*运西区*
6.2	East Grand Canal Drainage Area	*Yundong Qu*	*运东区*
6.3	South Drainage Area	*Nanpai Qu*	*南排区*
6.4	Shangtang River Plain Area	*Shangtanghe Qu*	*上塘河区*
7	Zhexi Hilly Area	*Zhexi Qu*	*浙西区*
7.1	Valley Plain Area	*Hegu Pingyuan Qu*	*河谷平原区*
7.2	Hilly Area of Mt. Tianmu	*Tianmushan Shandi Qiuling Qu*	*天目山山地丘陵区*
8	Lake Taihu Area	*Taihu Qu*	*太湖区*
8.1	Lake Area	*Hu Qu*	*湖区*
8.2	Lakeside Hilly Area	*Hubin Qiuling Qu*	*湖滨丘陵区*

Landscape Character Areas of Suzhou (Figure 5.9)

No.	English	Pinyin	*Hanzi*
1	Suzhou Old Town Area	*Suzhou laocheng qu*	苏州老城区
2	Fragmented Polder and Fishery Area	*Jingbang weitian yuye qu*	泾浜圩田渔业区
3	Dispersed Lakes and Polders Area	*Hudang weitian qu*	湖荡圩田区
4	Lakeside Polder Area	*Hubin lougang weitian qu*	湖滨溇港圩田区
5	Lakeside Polder and Fishery Area	*Hubin lougang weitian yuye qu*	湖滨溇港圩田渔业区
6	Fragmented Polder and Plantation Area	*Jingbang weitian zhongzhiyuan qu*	泾浜圩田种植园区
7	Lakeside Fragmented Polder Area	*Hubin jingbang weitian qu*	湖滨泾浜圩田区
8	Lakeside Fragmented Polder and Plantation Area	*Hubin jingbang weitian zhongzhiyuan qu*	湖滨泾浜圩田种植园区
9	Lakeside Hilly Area	*Hubin qiuling qu*	湖滨丘陵区
10	Riverside-Coastal Fragmented Polder Area	*Yanjiang yanhai jingbang weitian qu*	沿江沿海泾浜圩田区
11	Riverside-Coastal Highly Fragmented Polder Area	*Yanjiang yanhai jinglou weitian qu*	沿江沿海泾溇圩田区
12	Riverside Standardized Polder Area	*Yanjiang biaozhunhua weitian qu*	沿江标准化圩田区
13	Upland Fragmented Polder Area	*Gaodi jingbang weitian qu*	高地泾浜圩田区

BIBLIOGRAPHY

American Society of Landscape Architects. (n.d.-a). Glossary: Landscape architecture terms. Retrieved from http://www.asla.org/nonmembers/publicrelations/glossary.htm

American Society of Landscape Architects. (n.d.-b). What do landscape architects do?. Retrieved from https://www.asla.org/FAQAnswer.aspx?CategoryTitle= About the Profession&Category=3150 - DispID3130

American Society of Landscape Architects. (n.d.-c). What is Landscape Architecture?. Retrieved from http://www.asla.org/aboutjoin.aspx

Antrop, M. (2000). Changing patterns in the urbanized countryside of Western Europe. *Landscape Ecology, 15*(3), 257-270.

Antrop, M. (2004). Landscape change and the urbanization process in Europe. *Landscape and Urban Planning, 67*(1), 9-26.

Antrop, M. (2005). Why landscapes of the past are important for the future. *Landscape and Urban Planning, 70*(1), 21-34.

Antrop, M. (2006). From holistic landscape synthesis to transdisciplinary landscape management. In B. Tress, G. Tress, G. Fry, & P. Opdam (Eds.), *From landscape research to landscape planning: Aspects of integration, education and application* (pp. 27-50). Dordrecht: Springer

Argan, G. C. (1996). On the typology of architecture. In K. Nesbitt (Ed.), *Theorizing a new agenda for architecture* (pp. 242-246). New York: Princeton Architectural Press.

Army Map Service. Corps of Engineers. U.S. Army. (1950). *Army Map Service Series L500 of China*. Retrieved from: http://hcl.harvard.edu/libraries/maps/collections/series_indices/China_Index.html

Atelier Groenblauw. (n.d.). Urban green-blue grids: For sustainable and resilient cities. Retrieved from http://www.urbangreenbluegrids.com/

Atsutoshi, H. (1982). *Mindai Komnan nomson shakai no kenkyum [A Study of Ming period farming society in Jiangnan]*. Tokyo: Tomkyom daigaku shuppankai.

Bao, Z., & Zhou, J. (2015). *Yingguo jingguan tezheng pinggu gaishu—Guanli jingguan bianhua de xin gongju* [Landscape Character Assessment in UK—A new tool to manage landscape change]. *Journal of Chinese Landscape Architecture*(3), 46-50.

Bastian, O., Walz, U., & Decker, A. (2013). Historical landscape elements: Part of our cultural heritage—A methodological study from Saxony. In J. Kozak, K. Ostapowicz, A. Bytnerowicz, & B. Wyżga (Eds.), *The carpathians: Integrating nature and society towards sustainability* (pp. 441-459). Berlin: Springer Berlin Heidelberg.

Bayerisches Landesamt für Umwelt, Bayerisches Landesamt für Denkmalpflege, & Bayerischer Landesverein für Heimatpflege e.V. (Eds.). (2013). *Handbuch der historischen Kulturlandschaftselemente in Bayern [Handbook of historical cultural landscape elements in Bavaria]*. Munich: Bayerischer Landesverein für Heimatpflege.

Berry, B. J. (1964). Approaches to regional analysis: A synthesis. *Annals of the Association of American Geographers, 54*(1), 2-11.

Birnbaum, C. A. (1994). *Preservation Brief 36. Protecting cultural landscapes: Planning, treatment and management of historic landscapes*. Washington, D.C.: Technical Preservation Service, National Park Service, U.S. Dept. of the Interior.

Bodenschatz, H., & Polinna, C. (2010). *Learning from IBA-die IBA 1987 in Berlin*. Berlin: Zentral- und Landesbibliothek Berlin.

Breuste, J. H. (2004). Decision making, planning and design for the conservation of indigenous vegetation within urban development. *Landscape and Urban Planning, 68*(4), 439-452.

Bucx, T., Marchand, M., Makaske, A., & Van de Guchte, C. (2010). *Comparative assessment of the vulnerability and resilience of 10 deltas–Synthesis report* (Delta Alliance Report Number 1). Retrieved from http://www.delta-alliance.org/projects/Comparative-assessment-of-the-vulnerability-and-resilience-of-deltas

Campanella, T. J. (2007). *The concrete dragon: China's urban revolution and what it means for the world*. New York: Princeton Architectural Press.

Changsanjiao dituwang [Atlas of the Yangtze River Delta]. (n.d.). Retrieved from http://www.csjmap.com

Che, S., Xie, C., Chen, D., & Yu, B. (2015). *Haimian chengshi lilun yu jishu fazhan yange ji goujian tujing* [Development and constructive approaches for theories and technologies of Sponge City System]. *Journal of Chinese Landscape Architecture*(6), 11-15.

China's Agricultural Heritage Research. (1990). *Taihu diqu nongye shigao [History of agriculture in the Taihu region]*. Beijing: Agriculture Press.

Chinese Society of Landscape Architecture. (n.d.). A brief introduction to Chinese Society of Landscape Architecture. Retrieved from http://w2.chsla.org.cn/en/

Christaller, W. (1966). *Central places in southern Germany*. Englewood Cliffs, N.J. : Prentice-Hall.

Clark, J., Darlington, J., & Fairclough, G. J. (2004). *Using Historic Landscape Characterisation: English Heritage's review of HLC applications 2002-03*. English Heritage, Lancashire County Council. Retrieved from https://historicengland.org.uk/images-books/publications/using-historic-landscape-characterisation/

Clark, J., Darlington, J., & Fairclough, G. J. (Eds.). (2003). *Pathways to Europe's landscape: European pathways to the cultural landscape, 2000-2003*. Loir: EPLC.

Claval, P. (2007). Regional geography: Past and present. *Geographia Polonica, 80*(1), 25-42.

Corboz, A. (1983). The land as palimpsest. *Diogenes, 31*(121), 12-34.

Cosgrove, D., & Daniels, S. (1988). Introduction: Iconography and landscape. In S. Daniels & D. Cosgrove (Eds.), *The iconography of landscape: Essays on the symbolic representation, design and use of past environments*. Cambridge: Cambridge University Press.

Council of Europe. (2000). *European Landscape Convention*. (CETS No.176). Florence Retrieved from http://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/176.

Council of Europe. (2006). *Spatial development glossary: European Conference of Ministers responsible for Spatial/Regional Planning(CEMAT)* (Territory and landscape, No. 2). Retrieved from http://www.coe.int/t/dgap/localdemocracy/cemat/VersionGlossaire/Default_en.asp

Council of Europe, & European Landscape Convention. (2013). *Glossary of the Council of Europe information system of the European Landscape Convention*. Retrieved from https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId=09000016802fc144

Cressey, G. B. (1934). *China's geographic foundations: A survey of the land and its people*. New York: McGraw-Hill Book Company.

Crowther, S., & Clarke, V. (2012). *Worcestershire Historic Landscape Characterisation*. (Report 1936). Worcester: Worcestershire Archive and Archaeology Service, Worcestershire County Council. Retrieved from http://gis.worcestershire.gov.uk/website/hlcpublishing/documents/SWR21534.pdf

Darlington, J. (2002). Mapping Lancashire's historic landscape: The Lancashire Historic Landscape Characterisation programme. In G. Fairclough, S. Rippon, & D. Bull (Eds.), *Europe's cultural landscape: Archaeologists and the management of change* (pp. 97-105). Belgium: Royal Library legal.

De Wit, S. (2009). *Dutch lowlands: Morphogenesis of a cultural landscape*. Amsterdam: Uitgeverij SUN.

Dear, M. J. (1986). Postmodernism and planning. *Environment and Planning D: Society and Space, 4*(3), 367-384.

Delta Interventions Studio. (n.d.). Retrieved from http://www.tudelft.nl/en/study/master-of-science/master-programmes/architecture-urbanism-and-building-sciences/architecture/programme/specialisations/delta-interventions/

Delta Urbanism TU Delft. (n.d.). Retrieved from https://deltaurbanismtudelft.org/

Deming, M. E., & Swaffield, S. R. (2011). *Landscape architecture research: Inquiry, strategy, design*. Hoboken, N.J.: Wiley.

Deng, J., Tan, X., Li, Y., Wan, J., Liu, J., & Zhou, B. (2016). *The protection and development of historic Lougang water resource features along Lake Tai.* Paper presented at the International Conference on Water Resource and Environment, Shanghai.

Duan, J., Ji, S., & Wang, H. (2002). *Chengzhen kongjian jiexi: Taihu liuyu guzhen kongjian jiegou yu xingtai [Spatial analysis of cities and towns: Spatial form and structure of ancient towns in the Taihu Basin]*. Beijing: China Architecture & Building Press.

E, E. (Qing Dynasty). *Shoushi tongkao [A general investigation into agricultural time]*.

Energy Smart Communities Initiative. (2014, April 11). Guangming New District. Retrieved from http://esci-ksp.org/project/guangming-new-district/

Ermischer, G. (2005). *Pathways to cultural landscapes: How to gain European understanding of the cultural landscape*. Paper presented at the Landscapes as Cultural Heritage in the European Research: Proceedings of the Open Workshop, Madrid.

European Council of Landscape Architecture Schools. (n.d.). Landscape architecture—The European dimension. Retrieved from http://www.eclas.org/index.php/about/landscape-architecture

European Landscape Character Assessment Initiative. (2005). *European landscape character areas—Typologies, cartography and indicators for the assessment of sustainable landscapes* (Alterra Report No. 1254). Retrieved from http://www.paesaggiopocollina.it/paesaggio/dwd/lineeguida/elcai_projectreport.pdf

Fairclough, G., Lambrick, G., & Hopkins, D. (2002). Historic Landscape Characterisation in England and a Hampshire case study. In G. Fairclough, S. Rippon, & D. Bull (Eds.), *Europe's cultural landscape: Archaeologists and the management of change* (pp. 69-83). Belgium: Royal Library legal.

Fang, J., Wang, X., & Xue, G. (Eds.). (1997). *Suzhou Shuilizhi [Water conservancy annals of Suzhou]*. Shanghai: Shanghai Academy of Social Sciences Press.

Fei, H.-T. (1939). *Peasant life in China: A field study of country life in the Yangtze Valley* (1980 ed.). London: Routledge & Kegan Paul.

Finch, V. C., & Trewartha, G. T. (1942). *Elements of geography: Physical and cultural* (2 ed.). New York: McGraw-Hill.

Fowler, P. J. (2003). *World heritage cultural landscapes 1992–2002*. (Paper 6). UNESCO World Heritage Centre. Retrieved from http://whc.unesco.org/documents/publi_wh_papers_06_en.pdf

Frampton, K. (1985). Towards a critical regionalism: Six points for an architecture of resistance. In H. Foster (Ed.), *Postmodern culture* (pp. 16-30). London: Pluto Press.

Frampton, K. (1999). *Megaform as urban landscape*. Ann Arbor, Mich.: University of Michigan.

Gang. (1999). In *Cihai [Encyclopedic Dictionary]*. Shanghai: Shanghai Lexicographical Publishing House.

Gao, J. (2004). Impact of land use changes on runoff of the Taihu Basin, China. In Y. Chen, K. Takara, I. Cluckie, & F. H. De Smedt (Eds.), *GIS and remote sensing in hydrology, water resources and environment* (pp. 219-226). Wallingford, Oxfordshire: IAHS Publication.

Gao, J., & Han, C. (1999). *Taihu diqu de wei jiqi dui honglao de yingxiang* [Polders in Taihu Lake Region and Its Effects on Floods]. *Journal of Lake Sciences, 11*(2), 105-109.

Gao, J., & Jiang, T. (1997). *Sunan diqu honglao weixianqu de huading jiqi zhili duice* [Definition of flood risk region in south Jiangsu and flood control countermeasures]. *Journal of Natural Disasters, 6*(3), 56-62.

Ge, J. (2000). *Zhonguo renkoushi [History of the population of China]* (Vol. 4, 5). Shanghai: Fudan University Press.

Geographical Section, & General Staff [Cartographer]. (1927). Shanghai and Hangchow [map]. 1: 250,000. Retrieved from http://www.virtualshanghai.net/Maps/Collection?ID=80

Gilbert, A. (1988). The new regional geography in English and French-speaking countries. *Progress in human geography, 12*(2), 208-228.

Ginsburg, N. (1991). Extended metropolitan regions in Asia: A new spatial paradigm. In N. Ginsburg, B. Koppel, & T. G. McGee (Eds.), *The extended metropolis: Settlement transition in Asia* (pp. 27-46). Honolulu: University of Hawaii.

Gong, C. (1988). *Taihu diqu tudi leixing tezheng* [Characteristics of land types in Taihu Lake Region]. In Nanjing Institute of Geography and Limnology & Chinese Academy of Sciences (Eds.), *Taihu liuyu shuitu ziyuan ji nongye fazhan yuanjing [Long-range prospect of water-land resources and agricultural development in Taihu Lake Region]*. Beijing: Science Press.

Gottmann, J. (1957). Megalopolis or the urbanization of the northeastern seaboard. *Economic geography, 33*(3), 189-200.

Gottmann, J. (1961). *Megalopolis: The urbanized northeastern seaboard of the United States*. New York: The Twentieth Century Fund.

Gottmann, J. (1976). Megalopolitan systems around the world. *Ekistics, 41*(243), 109-113.

Groth, P. (1997). Frameworks for cultural landscape study. In P. E. Groth & T. W. Bressi (Eds.), *Understanding ordinary landscapes* (pp. 1-21). New Haven: Yale University Press.

Gu, C., Hu, L., Zhang, X., Wang, X., & Guo, J. (2011). Climate change and urbanization in the Yangtze River Delta. *Habitat International, 35*(4), 544-552.

Guralnik, D. B. (Ed.) (1984). Webster's new world dictionary of the American language (2nd college ed.). Cleveland: Simon and Schuster.

Hallmann, H. W., & Pabst, J. (1993). *Kulturhistorische Landschaftselemente in Brandenburg: eine Untersuchung am Institut für Landschaftsbau der Technischen Universität Berlin [Historical cultural landscape elements in Brandenburg: A study at the Institute of Landscape Engineering of Technical University Berlin]*. Berlin-Friedrichshagen: Lucie Großer Verlag.

Han, F. (2007). *Shijie yichan wenhua jingguan jiqi guoji xin dongxiang* [World heritage cultural landscapes and new international trends]. *Journal of Chinese Landscape Architecture,* *23*(11), 18-21.

Hard, G. (1970). *Die "Landschaft" der Sprache und die "Landschaft" der Geographen. Semantische und forschungslogische Studien [The "landscape" of the language and the "landscape" of geographers. Studies in semantics and the logics underlying research]*. Bonn: Dümmler.

Hartz, A., & Kestermann, R. (2004). New planning concepts and regional cooperation: Responding to the challenges of new urban landscapes. In G. Tress, B. Tress, B. Harms, P. Smeets, & A. v. d. Valk (Eds.), *Planning metropolitan landscapes: Concepts, demands, approaches* (Vol. Delta series 4, pp. 178-198). Wageningen Delta Program, Alterra.

Harvard Yenching Institute, & Fudan Center for Historical Geography. (2007). *China Historical Geographic Information System Dataset*. Retrieved from: http://www.fas.harvard.edu/~chgis/data/chgis/v4/

Herrle, P., Fokdal, J., & Ipsen, D. (2014). *Beyond urbanism: Urban (izing) villages and the mega-urban landscape in the Pearl River Delta in China*. Berlin: LIT Verlag.

Höfer, W., & Trepl, L. (2010). Jackson's concluding with landscapes—full circle. *Journal of Landscape Architecture, 5*(2), 40-51.

Hooimeijer, F., Meyer, H., & Nienhuis, A. (2005). *Atlas of Dutch water cities*. Amsterdam: Uitgeverij SUN.

Howe, C., & Mitchell, C. (Eds.). (2012). *Water sensitive cities*. London: IWA Publishing.

Hoyer, J., Dickhaut, W., Kronawitter, L., & Weber, B. (2011). *Water sensitive urban design: Principles and inspiration for sustainable stormwater management in the city of the future*. Hamburg: Jovis.

Hu, H., & Tang, D. (2006). *Wenhua jingguan yanjiu huigu yu zhanwang* [Review and prospect of the cultural landscape study]. *Geography and Geo-Information Science, 22*(5), 95-100.

Huang, P. C. (1990). *The peasant family and rural development in the Yangzi Delta,1350–1988*. Stanford, Calif.: Stanford University Press.

Huang, Y., & Li, Q. (2011). *Jiangnan shuiwang xiaochengzhen kongjiangeju de shengtaihua fazhan yanjiu* [South China watertown spatial layout ecological development]. *Planners*(11), 112-116.

International Commission on Irrigation and Drainage. (2017). Lougang irrigation and drainage system of Taihu Lake Basin. Retrieved from http://www.icid.org/HisMore.php?ID=53

Ipsen, D. (2005). Urban landscape and landscape urbanism. In D. Ipsen, Y. Li, & H. Weichler (Eds.), *The genesis of urban landscape: The Pearl River Delta in South China* (pp. 7-13). Kassel: University of Kassel.

Jackson, J. B. (1984). *Discovering the vernacular landscape*. New Haven: Yale University Press.

Jain, P., & Clancy, G. (2008). Preserving cultural landscapes: A cross-cultural analysis. In C. Goetcheus & E. MacDonald (Eds.), Preserving the boundaries of historic landscape preservation (pp. 15-29). Clemson, SC: Clemson University Digital Press.

Jessel, B. (2006). Elements, characteristics and character–Information functions of landscapes in terms of indicators. *Ecological Indicators, 6*(1), 153-167.

Jiang, Z. (1981). *Songdai guantian de yanbian* [The evolution of state-owned land in the Song Dynasty]. *Journal of Hangzhou University, 11*(3), 69-80.

Jiangsu Department of Water Resources (Ed.) (1976). *Jiangsusheng jin liangqiannian honglaohanchao zaihai nianbiao [Flooding, waterlogging and droughts occurred in Jiangsu Province in the past two thousand years]*. Nanjing: Jiangsu Department of Water Resources.

Johnston, R. J., Gregory, D., Pratt, G., & Watts, M. (Eds.). (2000) The dictionary of human geography (4 ed.). Malden, MA: Blackwell.

KLEKs—Das Kulturlandschafts-Wiki. (n.d.). Retrieved from https://www.kleks-online.de/

Kopp, P. (2012). *Das Kulturlandschaftskataster Rhein-Main - Spuren suchen im Ballungsraum* [The Rhine-Main cultural landscape register - Searching for traces in the agglomeration]. In W. Schenk, M. Kühn, M. Leibenath, & S. Tzschaschel (Eds.), *Suburbane Räume als Kulturlandschaften [Suburban spaces as cultural landscapes]* (pp. 325-339). Hannover: Verl. d. ARL.

Kulturlandschaftsportal Thüringen. (2015). *Register der Kulturlandschaftselemente* [Register of cultural landscape elements]. Retrieved from http://www.kulturlandschaft.fh-erfurt.de/index.php?id=11

Kunshan Studio. (n.d.). Kunshan Studio. Retrieved from http://www.kunshanstudio.com.au/

Laing, C. R. (2012). Viewing China: Observations of China's cultural landscapes. *Education About Asia, 17*(3), 1-13.

Lake-Watershed Science Data Center—National Earth System Science Data Sharing Infrastructure. (2002). *National Science & Technology Infrastructure of China*. Retrieved from: http://lake.geodata.cn

Land Use Consultants. (1999). *South Peninnes Landscape Character Assessment*. Bradford.

Lawson, E. (2014). *Managing urban flood risk: The blue-green approach*. Retrieved from http://www.bluegreencities.ac.uk/bluegreencities/documents/publicsciencelecture-dec2014-bgc.pdf

Lawson, E., Thorne, C., Ahilan, S., Allen, D., Arthur, S., Everett, G., . . . Hoang, L. (2014). Delivering and evaluating the multiple flood risk benefits in blue-green cities: An interdisciplinary approach. *Flood Recovery, Innovation and Response IV, 184*, 113-124.

Lefaivre, L., & Tzonis, A. (2003). *Critical regionalism: Architecture and identity in a globalized world*. Munich: Prestel.

Lefèbvre, H. (2003). *The urban revolution*. Minneapolis: University of Minnesota Press.

Lewis, P. F. (1979). Axioms for reading the landscape: Some guides to the American scene. In D.

W. Meinig (Ed.), *The interpretation of ordinary landscapes: Geographical essays* (pp. 11-32). New York: Oxford University Press.

Li, B. (1991). *Jianlun "Jiangnan diqu" de jieding* [A Brief study on the defination of "Jiangnan region"]. *The Journal of Chinese Social and Economic History*(1), 100-105.

Li, H., Shan, Y., & Feng, X. (2012). *Yingguo lishi jingguan tezheng pinggu ji yingyong* [Historic Landscape Characterisation and application in England]. *Architectural Journal*(6), 40-43.

Lin, G. (2006). *Jiangguan ciyi de yanbian yu bianxi* (1) [Evolution and distinction of the definition of landscape (I)]. *Journal of Chinese Landscape Architecture, 22*(6), 42-45.

Lin, J., & Wang, X. (2005). *Diyu tezheng yu jingguan xingshi* [Regional features and landscape forms]. *Journal of Chinese Landscape Architecture, 21*(6), 16-24.

Lister, G. (1987). *Postmodernism and landscape architecture.* (Post-graduate Diploma), Lincoln University. Retrieved from https://researcharchive.lincoln.ac.nz/bitstream/handle/10182/2059/lister_dipla.pdf?sequence=5

Liu, J. (2004). *Landscape Architecture yiming tantao* [The discussion of the translated term for landscape architecture]. *Journal of Chinese Landscape Architecture, 20*(5), 10-12.

Liu, S. (2009). *Jiangnan yu Jiangnan wenhua de jieding ji dangdai xingtai* [South of the Yangtze River and the definition of the culture of south of the river and the form today]. *Jiangsu Social Sciences*(5), 228-233.

Liu, X., Fan, J., & Zou, Z. (2012). *Xiangtu jingguan yuansu de biaoda fangfa yanjiu* [The research on expression skill of vernacular landscape elements]. *Journal of Chinese Landscape Architecture, 28*(2), 49-52.

Lu, D., & Wang, X. (2005). *Huzhou ruhu lougang he tangpu (lougang) weitian xitong de yanjiu [The research on the Lougang and Tangpu (Lougang) Polder system in Huzhou].* Paper presented at the *Huzhou ruhu lougang he tangpu (lougang) weitian xitong de yanjiu chengguo ziliao huibian* [The research outcome and summery of the Lougang and Tangpu (Lougang) Polder system in Huzhou], Huzhou.

Lu, X. (2006a). *Mingqing jiangnan chengzhen—Jiyu kongjian guandian de zhengti yanjiu [Jiangnan cities in Ming and Qing China—A Spatial-based integrated study]* (Doctoral dissertation). Tongji University, Shanghai.

Lu, X. (2006b). *Mingqing shiqi Jiangnan chengzhen de kongjian fenbu* [Spatial distribution of cities in Jiangnan of Ming and Qing Dynasties]. *Urban Planning Forum*(3), 89-94.

Lu, Y., & Dong, P. (2005). *Mingqing shiqi taihu liuyu de zhongxindi jiegou* [Central Place System of Taihu Basin during the Ming and Qing Dynasties]. *Acta Geographica Sinica, 60*(4), 587-596.

Luijendijk, J., Schultz, E., & Segeren, W. A. (1988). Polders. In P. Novak (Ed.), *Developments in hydraulic engineering–5* (pp. 178-208). London: Elsevier Applied Science.

Luo, J., Gu, X., & Gong, R. (2011). *Suzhou weiqu xianzhuang jiqi zhili duice* [The status quo of polder areas in Suzhou and management strategies]. *Water Resources Development Research, 11*(1), 55-58.

Manchester City Council. (2015). *Manchester's great outdoors: A green and blue infrastructure strategy for Manchester*. Manchester. Retrieved from http://www.manchester.gov.uk/downloads/download/6314/manchester_green_and_blue_strategy

Map of the country around Shanghai. (1864). Retrieved from http://www.virtualshanghai.net/Maps/Collection?ID=571

Marston, S. A., Knox, P. L., & Liverman, D. M. (2002). *World regions in global context: Peoples, places, and environments* (3 ed.). Upper Saddle River, N.J.: Prentice Hall.

McGee, T. G. (1989). Urbanisasi or kotadesasi? Evolving patterns of urbanization in Asia. In F. J. Costa, A. K. Dutt, L. J. C. Ma, & A. G. Noble (Eds.), *Urbanization in Asia: Spatial dimensions and policy issues* (pp. 93-108). Honolulu: University of Hawaii Press.

McGee, T. G. (1991). The emergence of *Desakota* regions in Asia: Expanding a hypothesis. In N. Ginsburg, B. Koppel, & T. G. McGee (Eds.), *The extended metropolis: Settlement transition in Asia* (pp. 3-26). Honolulu: University of Hawaii Press.

Meinig, D. W. (1979a). Introduction In D. W. Meinig (Ed.), *The interpretation of ordinary landscapes: Geographical essays* (pp. 1-7). New York: Oxford University Press.

Meinig, D. W. (Ed.) (1979b). *The interpretation of ordinary landscapes: geographical essays*. New York: Oxford University Press.

Meyer, H., Morris, D., & Waggonner, D. (Eds.). (2009). *Dutch Dialogues: New Orleans, Netherlands: Common challenges in urbanized deltas*. Amsterdam: SUN.

Meyer, H., & Nijhuis, S. (2013). Delta urbanism: Planning and design in urbanized deltas–comparing the Dutch delta with the Mississippi River delta. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability, 6*(2), 160-191.

Miao, Q. (1982). *Taihu diqu tangpu weitian de xingcheng he fazhan* [The Formation and development of Tangpu Polders in the Taihu region]. *Agricultural History of China*(1), 12-32.

Ministry of Construction of the P.R. China. (1994). *Zhongguo fengjing mingshengqu xingshi yu zhanwang [Situation and prospects of China's scenic areas].* Beijing.

Ministry of Housing and Urban-Rural Development of the P.R. China. (2014). *Haimian chengshi jianshe jishu zhinan—Diyingxiang kaifa yushui xitong goujian* [Technical guideline for the construction of "sponge city"—Construction of storm water system with the concept of low impact development]. Beijing.

Mitin, I. (2010). Palimpsest. In B. Warf (Ed.), *Encyclopedia of Geography* (pp. 2112-2113). Thousand Oaks, CA: SAGE Publications, Inc.

Mumford, L. (1941). *The south in architecture*. New York: Harcourt, Brace and Company.

National Earth System Science Data Sharing Infrastructure. (2012). *Taihu liuyu 1:100,000 tudi liyong shujuji (1980s, 1995, 2000, 2005) [Dataset of land use in the Taihu Basin (1980s, 1995, 2000, 2005)]*. Retrieved from http://nnu.geodata.cn:8008/featured_data.html

National Park Service. (n.d.-a). Cultural landscapes. Retrieved from http://www.nps.gov/cultural_landscapes/

National Park Service. (n.d.-b). Guidelines for the treatment of cultural landscapes: Defining landscape. Retrieved from https://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/terminology.htm

Natural England. (2012). *An approach to Seascape Character Assessment* (NECR105). Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/396177/seascape-character-assessment.pdf

Olwig, K. R. (1996). Recovering the substantive nature of landscape. *Annals of the Association of American Geographers, 86*(4), 630-653.

Page, R. R., Gilbert, C. A., & Dolan, S. A. (1998). *A guide to cultural landscape reports: Contents, process, and techniques*. Retrieved from Washington, DC: http://www.nps.gov/cultural_landscapes/Documents/Guide_to_Cultural_Landscapes.pdf

Page, R. R., Killion, J., & Hilyard, G. (2009). *National Park Service cultural landscapes inventory professional procedures guide*. Washington, DC: US Department of the Interior, National Park Service, Cultural Resource Stewardship and Partnerships, Park Historic Structures and Cultural Landscapes Program. Retrieved from http://www.nps.gov/oclp/CLI PPG_January2009_small.pdf

Palimpsest. (2015). *Oxford English Dictionary Online.* Retrieved from http://www.oxforddictionaries.com/definition/english/palimpsest

Pan, P., Yang, G., Su, W., & Wang, X. (2015). *Taihu liuyu tudi liyong bianhua dui gengdi shengchanli de yingxiang yanjiu* [Impact of land use change on cultivated land productivity in Taihu Lake Basin]. *Scientia Geographica Sinica, 35*(8), 990-998.

Pei, D. (2014). *Taihu xiayou pingyuan honglao shiyingxing jingguan yanbian ji jili [Evolution and mechanism of flood-adaptive landscape in downstream of Taihu Lake Basin]* (Doctoral dissertation). Peking University, Beijing.

Planning Department of HKSAR Government. (2005). *Landscape value mapping of Hong Kong– Final repoort (Appendix 3).* Hong Kong. Retrieved from http://www.pland.gov.hk/pland_en/p_study/prog_s/landscape/landscape_final/app3.htm

Polder. (2015). *Oxford English Dictionary Online.* Retrieved from https://en.oxforddictionaries.com/definition/polder

Prince George's County. (1999). *Low-impact development design strategies: An integrated design* *approach*. Department of Environmental Resources, Programs and Planning Division, Prince George's County, Maryland. Retrieved from http://water.epa.gov/polwaste/green/upload/lidnatl.pdf

Rossi, A. (1984). *The architecture of the city*. Cambridge, MA: MIT Press.

Sasaki Associates. (2014). South Taihu Lake. Retrieved from http://www.sasaki.com/project/352/south-taihu-lake/

Sasaki Associates. (2015). Zhangjiabang Park. Retrieved from http://www.sasaki.com/project/380/zhangjiabang-park/

Sauer, C. O. (1925). The morphology of landscape. *Geography, 2*(2), 19-54.

Schöbel, S. (2016). Restructuring the urban landscape: A "critical reconstruction" of permanent structures in historic cultural and urban landscapes. In F. Wang & M. Prominski (Eds.), *Urbanization and locality: Strengthening identity and sustainability by site-specific planning and design* (pp. 215-225). Berlin, Heidelberg: Springer.

Schöbel-Rutschmann, S. (2012). *Landschaftsarchitektur regionaler Freiräume* [Landscape architecture and regional open space]. In Lehrstühle der Fakultät für Architektur & Dekannat und Studendekanat (Eds.), *Jahrbuch - Yearbook 2012 Fakultät für Architektur Technische Universität München* (pp. 207-213). Munich: Technische Universität München.

Scottish Natural Heritage. (2017, April 11). Landscape glossary of terms. Retrieved from http://www.snh.gov.uk/protecting-scotlands-nature/looking-after-landscapes/landscape-resource-library/glossary-of-terms/

Seavitt, C. (2013). Yangtze River Delta Project. *Scenario,* (3). Retrieved from http://scenariojournal.com/article/yangtze-river-delta-project/

Seavitt, C. (2014). Poldering the Yangtze River Delta. *Topos*(87), 98-103.

Shan, J. (2010). *Zoujin wenhua jingguan yichan de shijie [Step in the world of cultural landscape heritage]*. Tianjin: Tianjin University press.

Shanghaishi ziyuan puchadui songjiangdui [Songjiang resources census team of Shanghai]. (1958). Jing-Bang polder system in Songjiang County of Shanghai. *The overview of resources census of people's commune in the Chengdong area*. Shanghai: Songjiang County Archives.

Shannon, K. (2006). From theory to resistance: Landscape urbanism in Europe. In C. Waldheim (Ed.), *The landscape urbanism reader* (pp. 141-162). New York: Princeton Architectural Press.

Simpson, J., & Weiner, E. (Eds.). (1989) The Oxford English Dictionary (2 ed.). Oxford: Clarendon Press.

Skinner, G. W. (1964). Marketing and social structure in rural China, Part I. *The Journal of Asian Studies, 24*(1), 3-43.

Skinner, G. W. (1965). Marketing and Social Structure in Rural China Part II. *The Journal of Asian Studies, 24*(2), 195-228.

Skinner, G. W., & Baker, H. D. R. (1977). *The City in late imperial China*. Stanford, Calif.: Stanford University Press.

Sokuryobu, R. (1986). *Chugoku tairiku gomanbun no ichi chizu shusei* I [Map Collection of Mainland China, Vol.1]. Tokyo: Kagaku Shoin.

Sorensen, A. (2003). Megalopolitan development and the transformation of rural Japan: Sustainability implications of extended metropolitan regions in Asia. In S. Sassen (Ed.), *Human settlement development section, Encyclopedia of Life Support Systems (EOLSS)*. Paris: UNESCO.

Spirn, A. W. (1998). *The language of landscape*. New Haven, Conn.: Yale University Press.

Stanners, D., & Bourdeau, P. (Eds.). (1995). *Europe's environment: The Dobris assessment*. Copenhagen: European Environment Agency.

Steenbergen, C. M. (2008). *Composing landscapes: Analysis, typology and experiments for design*. Basel; Boston: Birkhäuse.

Sui, D. Z., & Zeng, H. (2001). Modeling the dynamics of landscape structure in Asia's emerging desakota regions: A case study in Shenzhen. *Landscape and Urban Planning, 53*(1), 37-52.

Sun, X. (2002). *Fengjing yuanlin (Landscape Architecture): Cong zaoyuanshu, zaoyuan yishu, fengjing zaoyuan—zhi fengjing yuanlin, diqiu biaoceng guihua* [Landscape architecture from garden craft, garden art, landscape gardening—to landscape architecture, earthscape planning]. *Journal of Chinese Landscape Architecture, 18*(4), 7-12.

Sun, X. (2005). A "correction" on the discipline title of modern landscape architecture and landscape planning. *Landscape Architecture*(3), 12-14.

Sun, X., Wang, H., & Li, X. (2008). *Xiangtu yu yuanlin—Xiangtu jingguan yuansu zai yuanlin zhong de yunyong* [Vernacular and landscape architecture—Application of vernacular landscape elements in landscape architecture]. *Journal of Chinese Landscape Architecture*(8), 37-40.

SWA Group. (n.d.). Nanhu New Country Village. Retrieved from http://www.swagroup.com/projects/nanhu-new-country-village/

Swanwick, C. (2002). *Topic Paper 1: Recent practice and the evolution of Landscape Character Assessment*. Retrieved from http://publications.naturalengland.org.uk/file/6522413248413696

Swanwick, C. (2006). *Yingguo jingguan tezheng pingjia* [Landscape Character Assessment in Britain]. *World Architecture*(7), 23-27.

Swanwick, C., & Land Use Consultants. (2002). *Landscape Character Assessment: Guidance for England and Scotland*. (CAX 84). Cheltenham: The Countryside Agency; Edinburgh:

Scottish Natural Heritage. Retrieved from http://www.heritagecouncil.ie/fileadmin/user_upload/Planning/LCA_CPD/LCA_CPD_Sep_2011/Reports/LCA_Guidance_for_England_and_Scotland.pdf

Tan, Q. (1973). *Shanghaishi dalu bufen de hailu bianqian he kaifa guocheng* [The process of landing formation and development in Shanghai]. *Archaeology*(1), 2-10.

Tan, Q. (1982). *Zhongguo lishi ditu ji [The historical atlas of China]*. Shanghai: China Cartographic Publishing House.

Tan, Y. (Song Dynasty). *(Jiatai) Wuxing zhi [The local chronicles of Wuxing]* (Vol. 19).

Tang, M. (2000). *Wenhua jingguan de neihan jiqi yanjiu jinzhan* [The inventory and progress of cultural landscape study]. *Progress in Geography, 19*(1), 70-79.

The Countryside Agency, & Scottish Natural Heritage. (2002). *Topic Paper 4: Use of Geographical Information Systems and other computer methods*. Retrieved from http://publications.naturalengland.org.uk/file/6703877629935616

The Cultural Landscape Foundation. (2013). A new focus on Postmodernist landscapes. Retrieved from https://tclf.org/news/features/new-focus-postmodernist-landscapes

The State Council of the P.R. China. (2005). *Guowuyuan 2005 chexian jianshi (xianji shi) jianyi biaozhun* [Suggestion of the State Council on the standards for upgrading counties to county-level cities 2005].

The State Council of the P.R. China. (2015, October 16). Guideline to promote building sponge cities. Retrieved from http://english.gov.cn/policies/latest_releases/2015/10/16/content_281475212984264.htm

The State Council of the P.R. China. (2016). *Changjiang sanjiaozhou chengshiqun fazhan guihua [The development plan of Yangtze River Delta Urban Agglomeration]* Retrieved from http://ghs.ndrc.gov.cn/zcfg/201606/W020160715547156103759.pdf

Thiis-Evensen, T. (1987). *Archetypes in architecture*. Oslo: Norwegian University Press.

Treib, M. (2002). Must landscapes mean? In S. Swaffield (Ed.), *Theory in landscape architecture: A reader* (pp. 89-101). Philadelphia: University of Pennsylvania Press. (Original work published 1995).

Tudor, C., & Natural England. (2014). *An approach to Landscape Character Assessment*. (NE579). Natural England. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/396192/landscape-character-assessment.pdf

Turenscape. (2011, August 25). Qunli Stormwater Park: A green sponge for a water-resilient city. Retrieved from https://www.turenscape.com/en/project/detail/435.html

Turenscape. (2014, December 19). A resilient landscape: Yanweizhou Park in Jinhua city. Retrieved from https://www.turenscape.com/en/project/detail/4629.html

Typology. (2017). *Merriam-Webster Online.* Retrieved from https://www.merriam-webster.com/dictionary/typology

Tzonis, A., & Lefaivre, L. (1996). Why critical regionalism today? In K. Nesbitt (Ed.), *Theorizing a new agenda for architecture: An anthology of architectural theory 1965–1995* (pp. 484-492). New York: Princeton Architectural Press.

U.S. Army Map Service. (1927). Shanghai [map]. 1: 50,000. China city plans series, map N3108-E12118/19. Washington, D.C.: U.S. Army Map Service.

Umitsu, M. (1990). *中国江南デルタの地形形成* [Landform evolution of the southern Chang Jian River Delta]. *The Journal of the Faculty of Letters, Nagoya University. History*(107), 231-245.

UNESCO World Heritage Centre. (2015). *Operational guidelines for the implementation of the World Heritage Convention* (WHC.15/01). Paris: World Heritage Centre. Retrieved from http://whc.unesco.org/en/guidelines/

UNESCO World Heritage Centre. (n.d.). Cultural landscapes. Retrieved from http://whc.unesco.org/en/culturallandscape/

Van Slyke, L. (1988). *Yangtze: Nature, history, and the river*. Reading, Mass. u.a.: Addison-Wesley.

Vos, W., & Meekes, H. (1999). Trends in European cultural landscape development: Perspectives for a sustainable future. *Landscape and Urban Planning, 46*(1), 3-14.

Waggonner, D., Dolman, N., Hoeferlin, D., Meyer, H., Schengenga, P., Thomaesz, S., . . . Van Der Zwet, C. (2014). New Orleans after Katrina: Building America's water city. *Built Environment, 40*(2), 281-299.

Walz, U., Schauer, P., Ueberfuhr, F., & Halke, E. (2012). *Historische Kulturlandschaften Sachsens [Historic cultural landscape Saxony]*. (Heft 33/2012). Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie. Retrieved from https://publikationen.sachsen.de/bdb/artikel/15690/documents/19367

Walz, U., Ueberfuhr, F., Schauer, P., & Halke, E. (2010). *Ableitung und Bewertung von Kulturlandschaftsgebieten für das Landschaftsprogramm Sachsen* [Derivation and assessment of cultural landscape areas for the Saxony landscape program]. *Natur und Landschaft, 85*(1), 17-23.

Wang, G. (Ed.) (1995). *Kunshanshi chengbeizhen zhi [The local chronicles of Chengbei Town in Kunshan]*. Shanghai: Shanghai Science and Technological Literature Press.

Wang, J. (1989). *Dongwu tuntian yu nongtianshuili de kaifa* [The *tuntian* system in the Wu Dynasty and the development of agriculture and water conservancy]. *Agricultural History of China*(1), 57-64.

Wang, J. (2009). *Jingbang fazhan yu Wusongjiang liuyu de weitianshuili (9–15 shiji)* [The development of Jing-Bang and the Wei-field irrigation in Wusong River valley 9th-15th century]. *Journal of Chinese Historical Geography, 24*(2), 30-42.

Wang, J. (2010). *Tangmo Jiangnan nongtian jingguan de xingcheng* [The formation of Jiangnan agricultural landscape in the late Tang Dynasty]. *Historical Review*(4), 58-69.

Wang, J. (2012). *Taihu dongbu de hutian shengtai* (15–20 shiji) [The ecology of lake-farmlands along East Tai-lake (15–20th century)]. *Journal of Social Sciences*(1), 142-151.

Wang, J. (2013). *Shuixiang shengtai yu jiangnan shehui (9–20 shiji) [Ecology in watery regions and society in south of the lower reaches of the Yangtze River (9th–20th Century)]*. Beijing: Peking University Press.

Wang, S. (1994). *Lun LA de zhongyiming wenti* [The discussion of the translated Chinese term for LA]. *Journal of Chinese Landscape Architecture, 10*(2), 58-59.

Wang, T. (2006). *Taihu liuyu fanghong yu shuiziyuan guanli [Flood protection and water resources management of the Taihu Basin]*. Beijing: China Water & Power Press.

Warnock, S., & Parker, A. (1999). *Sefton Landscape Assessment*. Sefton: Sefton Borough Council.

Wittfogel, K. A. (1981). *Oriental despotism: A comparative study of total power*. New York: Vintage Books.

Worcestershire County Council. (2012). *Landscape Character Assessment: Supplementary Guidance*. Retrieved from http://www.worcestershire.gov.uk/download/downloads/id/4788/landscape_character_assessment_supplementary_guidance.pdf

Worcestershire County Council. (2013). *Landscape Character Assessment. Supplementary Guidance. Technical Handbook*. Retrieved from http://www.worcestershire.gov.uk/downloads/file/4789/landscape_character_assessment_technical_handbook

Worcestershire County Council. (n.d.). Glossary of terms used in Landscape Character Assessment. Retrieved from http://www.worcestershire.gov.uk/info/20014/planning/1006/landscape_character_assessment/8

Wu, D. (2011). *Yi wenhua jingguan yichan jiqi jingguan wenhua de baohu* [Discussing on cultural landscape heritage and its landscape culture's conservation]. *Journal of Chinese Landscape Architecture*(4), 1-3.

Wu, J. (2007). *Chengshi kongjian kuozhan shiyexia de jindai Shanghai hebang ziyuan liyong yu huanjing wenti* [The creek-utilizing manner and concerning environmental problems with Shanghai modernization from an urban-space-expanding angle]. *Journal of Chinese Historical Geography, 22*(3), 67-77.

Wu, W., & Yang, J. (2008). *Sugelan he Yinggelan jingguan tese pingjia daoze jieshu* [Introduction to Landscape Character Assessment Guidance for England and Scotland]. *Urban Planning International*(5), 97-101.

Xie, S. (2010). *Shiyi shiji Taihu diqu nongtian shuili geju de xingcheng* [The structuring of agricultural water conservation network in the Tai Hu Lake Area in the 11th century]. *Journal of Sun Yat-Sen University (Social Science Edition), 50*(5), 94-106.

Xie, Y., & Schöbel-Rutschmann, S. (2015). *Identifying and reactivating historic cultural landscape elements as green-blue infrastructure for polder urbanization—A case study of Suzhou, Yangtze River Delta region.* Paper presented at the History of the Future: the 52nd World Congress of the International Federation of Landscape Architects, Saint-Petersburg, Russia.

Xu, M. (2002). *Jiangnan de lishi neihan yu quyu bianqian* [Historical meaning and regional changes of Jiangnan]. *Historical Review*(3), 52-56.

Yang, L., Scheffran, J., Qin, H., & You, Q. (2015). Climate-related flood risks and urban responses in the Pearl River Delta, China. *Regional Environmental Change, 15*(2), 379-391.

Yu, F., & Zhang, X. (2010). *"Dadushi lianmianqu" yu "chengxiang hudongqu"—Guanyu Geteman yu Maiji chengshi lilun de fenxi bijiao* [Megalopolis and desakota: The comparative analysis of urban theory between Gottmann and McGee]. *Urban Studies, 17*(1), 46-53.

Yu, K. (2002). *Jingguan de hanyi* [Meanings of landscape]. *Time + Architecture, 1*, 14-17.

Yu, K. (2004). *Huan tudi he jingguan yi wanzheng de yiyi: Zailun "Jingguan sheji xue" zhiyu "fengjing yuanlin"* [Landscape architecture in terms of the wholeness of land]. *Journal of Chinese Landscape Architecture, 7*, 37-40.

Yu, K. (2005). *Xunchang jingguan de shiyi* [The poetic ordinary landscape]. *Journal of Chinese Landscape Architecture, 20*(12), 25-28.

Yu, K., & Li, D. (2004). *Jingguan sheji: Zhuanye xueke yu jiaoyu daodu* [An introduction to landscape architecture: The profession and education]. *Journal of Chinese Landscape Architecture, 20*(5), 7-8.

Yu, K., Li, D., Li, H., & Zhang, L. (2012). *Jinghang dayunhe guojia yichan yu shengtai langdao [The Grand Canal heritage and ecological corridor of China]*. Beijing: Peking University Press.

Yu, K., Wang, Z., & Huang, G. (2005). Discussion about the vernacular landscapes and their implications to modern landscape architecture. *Huazhong Architecture, 23*(4), 123-126.

Zhan, Y., Li, J., Zhang, Z., Chen, J., & Yu, Z. (Eds.). (1994). *Wuxian Zhi [The local chronicles of Wu County]*. Shanghai: Shanghai Classics Publishing House.

Zhang, G. (Ming Dynasty-a). *Wuzhong shuili quanshu [Complete record of hydraulic management in the Wu Region]* (Vol. 2).

Zhang, G. (Ming Dynasty-b). *Wuzhong shuili quanshu [Complete record of hydraulic management in the Wu Region]* (Vol. 1).

Zhang, G., & Wu, Y. (2012). *Su zhe bianjie de shuili jiufen yu zhengfu yunzuo—yi 20 shiji 50–60 niandai Wujiang xian lianwei yinqi de shengji jiufen weili* [Irrigation dispute and government operation at the border between Jiangsu and Zhejiang: Take provincial dispute caused by Wujiang county's joint polders in the 1950s–1960s as an example]. *Zhejiang Social Sciences*(9), 91-96.

Zhang, Q., Gemmer, M., & Chen, J. (2008). Climate changes and flood / drought risk in the Yangtze Delta, China, during the past millennium. *Quaternary International, 176*, 62-69.

Zhao, C., & Liu, X. (2003). *Jin bange shiji yilai zhongguo gudai weitian yanjiu zongshu* [Review of studies on Chinese ancient polders in the recent post half century]. *Ancient and Modern Agriculture, 3*, 58-69.

Zheng, Z. (1987). *Taihu shuili jishu shi [The history of hydraulic technology in the Lake Taihu region]*. Beijing: China Agriculture Press.

Zhou, N., Yu, K., & Huang, Z. (2006). *Guanzhu yichan baohu de xindongxiang* [New challenges of world heritage conservation: Cultural landscape]. *Human Geography, 5*, 61-65.

Zhou, W. (1990). *Zhongguo gudian yuanlinshi [Chinese traditional gardening history]*. Beijing: Qinghua University Press.

Zhou, Y. (1991). The metropolitan interlocking region in China: A preliminary hypothesis. In N. Ginsburg, B. Koppel, & T. G. McGee (Eds.), *The extended metropolis: Settlement transition in Asia* (pp. 89-112). Honolulu: University of Hawaii Press.

Zhu, J., Jiang, Z., Ji, Z., & Liang, H. (1988). *Taihu diqu nongye ziran tiaojian de zonghe pingjia* [Integrated assessment of agricultural natural conditions in Taihu Lake region]. In Nanjing Institute of Geography and Limnology & Chinese Academy of Sciences (Eds.), *Taihu liuyu shuitu ziyuan ji nongye fazhan yuanjing [Long-range prospect of water-land resources and agricultural development in Taihu Lake region]*. Beijing: Science Press.

Zonneveld, I. S. (1995). *Land ecology: An introduction to landscape ecology as a base for land evaluation, land management and conservation*. Amsterdam: SPB Academic Publishing.

Zube, E. H. (1986). Landscape planning education in America: Retrospect and prospect. *Landscape and Urban Planning, 13*, 367-378.