Hope for Chinese Ecocities

by

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Abstract

This study focuses on the ecological and social metrics of sustainable cities in China. It presents a dialogic critique between Western scholars and local Chinese practitioners on how the ecocity concept has been framed locally in China. The dissertation consists of three papers, based on fieldwork and surveys conducted in the Sino-Singapore Tianjin Eco-City (SSTEC) project.

Chapter 2 reviews the theories and modern history of ecological planning, from which the concept of ecocity and "best practices" have evolved. My fieldwork of SSTEC concluded that in China the ecocity is a product of the local planning regime, which incorporates selective measures and principles into everyday governmental practices and city planning as a way to manage harmonious urban development.

Chapter 3 is based on a survey that introduced the concept of Ecosystem Services (ES) to urban planners. ES cover a broad range of services that human populations can receive from their surrounding ecosystems. I hypothesized that ES would be a helpful tool to help planners, particularly because increased exposure to ES would promote greater awareness of the connection between the well-being of ecosystems and that of human communities. The results show that respondents put a higher priority on ES that matched the benefits found in the existing ecocity indicators. Existing planning policy and legislation could be improved by identifying missing ES and adding these to the evaluation framework.

Chapter 4 examines neighbourly behavior and citizen participation in Tianjin, China, and explores the potential for identifying people who are likely to become local leaders i.e. individuals who are essential to the delivery of community services in China. Using a small-sample survey, I paired the participants' demographic characteristics with the participants' community involvement behaviors. This study contributes empirically to urban community research, and has practical implications for community building, particularly in the Chinese context.

Lay Summary

The idea of “Ecocity”, which originally emerged in Europe and North America during the 1960s and 1970s, is an approach to urban development that respects environmental limits. Over the past decade, China has aggressively pursued urban development. Many local governments, calling their developmental projects “ecocities”, experimented with new policies, strategies and approaches for incorporating green technology, planning and design. By 2017, nearly 300 ecocities had been developed across the country, from the eastern coast to the third-tier hinterlands. Some ecocities even boast about having partnered with wealthier countries to attract foreign investment to China.

Bei Jiang studied Chinese practices used in planning sustainable cities. She developed a set of ecological and social metrics for the Chinese ecocities. This study contributes to urban community research, presenting a dialogic critique between Western scholars and local Chinese practitioners on how the ecocity concept has been framed locally in China.

Preface

This dissertation is an original intellectual product of the author, Bei Jiang. The fieldwork reported in Chapter 2-4 was approved by the UBC Ethics Board (H16-01823).

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List of Abbreviations

CBC Community Building Campaign

ES Ecosystem Services

HOA Homeowners' Association

KPIs Key Performance Indicators

MEA The Millennium Ecosystem Assessment

MOHURD The Ministry of Housing and Urban-Rural Development

RC Residents' Committee

SSTEC The Sino-Singapore Tianjin Eco-City

Glossary

Citizen participation: Citizen participation is the local population's voluntary involvement in community political or social affairs (Zhu, 2015). "Citizen participation" can be used as an indicator to describe the degree of involvement.

Community Efficacy: Community efficacy (or neighborhood collective efficacy) refers to the ability of the collective to intervene in order to combat neighborhood problems such as crime (Craig et al., 2014).

Ecocity: An ecocity is a city that reduces environmental stress, improves living conditions and helps to achieve sustainable development through a comprehensive urban improvement system, involving the planning and management of land and other resources (Gordon, 1990).

Ecosystem Services (ES): Ecosystem Services can be described as the benefits people obtain from the environment (MEA, 2005).

Key Performance Indicators (KPIs): A key performance indicator is a performance indicator that is more important than others. In this paper, Key Performance Indicators (KPIs) refers to a set of quantitative and qualitive indicators developed to guide the planning and development of the Sino-Singapore Tianjin Eco-City. They were jointly formulated by experts from Singapore and China, and endorsed by the Ministerial-level Sino-Singapore Tianjin Eco-city Joint Working Committee, covering ecological, economic and social dimensions.

Measure and indicator: "Measures and indicators" refer to quantified information that quantifies the performance dimensions of processes, products, services, and overall organization. A "measure" *measures* something, while an "indicator" *indicates* something. For example, the number of complaints is an indicator of dissatisfaction, but not a direct measure of dissatisfaction. An indicator can be used as a proxy measure related to performance. A "performance indicator" indicates (not measures) performance.

Mutual influence: Mutual influence refers to interactional partners taking account of each other's characteristics and behavior, and modifying their behavior as a result. In this paper, "interactional partners" of mutual influence can be community group members, or neighbors.

Neighboring: Neighboring (or neighborly behavior) refers to social interactions or closeness between neighbors（Perkins & Long, 2002; Woldoff, 2002）. "Neighboring" in this paper also is used as an indicator to distinguish different levels of bonding between neighbors, i.e., friendship-oriented interactions as "strong neighboring", casual social contact as "weak neighboring". Higher scores for neighboring indicate stronger social ties and neighborly relations.

Principle: A principle is a concept or value that serves as the foundation for behaviour or evaluation. A "planning principle" refers to a list of appropriate matters to be considered in making a planning decision.

Sense of community: Sense of community refers to the quality of neighborhood bonds, a sense of belonging, mutual influence and the significance of place for individuals. It emphasizes the collective beliefs and expectations among neighbors (McMillan & Chavis, 1986).

Task: In planning management, a task is an activity that needs to be accomplished within a defined period of time and constitutes movement toward work-related goals.

Three Harmonies: "Three harmonies" is a political slogan to promote the Sino-Singapore Tianjin Eco-City. The *three harmonies* stand for:

- people living in harmony with each other, now and for future generations;
- people living in harmony with economic activities;
- people living in harmony with the environment (Baeumler et al., 2009).

The terms "harmony" and "sustainability" are used interchangeably in China's ecological urban development initiative. Similar to the three pillars of sustainability, the *three harmonies* identify ecological health, social harmony, and economy prosperity as important goals.

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Chapter 1. Introduction of this dissertation

1.1 Metrics of Ecocities

Without a clear definition and official standards of what constitutes an ecocity, Chinese ecocities have generated much critical attention in literature. Since 2005, China has initiated hundreds of ecocities. In this study, I consider the planning of Chinese ecocities as an evolving practice one that combines both Western theories and conventional Chinese planning.

This study focuses on the ecological and social metrics of Chinese ecocities through the lens of the Sino-Singapore Tianjin Eco-City (SSTEC), a single ecocity that currently on construction in China. SSTEC is commonly considered successful among the Chinese ecocities. I selected it as a single example to study the Chinese ecocities because I had worked in Tianjin's municipal planning institute, and I had access to its planning documents and policy makers.

The research used an opportunistic case study that allows for data collection and opportunity to see how this project developed over a ten-year period.

The objectives of this study are to:

- Examine the SSTEC's approach on sustainability;
- Develop the ecological and social metrics that can be used in the decision making of planning in the context of Tianjin;
- Provide recommendations to Chinese (eco)cities.

1.2 About the Tianjin Eco-City

The Sino-Singapore Tianjin Eco-City (SSTEC) is a high-profile ecocity project, co-signed by the Singaporean and Chinese governments as an example of inter-state cooperation. It is designed to leverage Singaporean expertise in integrated urban planning and water resource technologies (Baeumler, et al., 2009). This project showcases China's ambition to realize "a sustainable development model" that is "socially harmonious, environmentally friendly and resource efficient", otherwise known as the "Three Harmonies" (Joss & Molella, 2013; Baeumler et al.,

2009). Similar to the three pillars of sustainability, the *three harmonies* identify ecological health, social harmony, and economy prosperous as important goals. In order to guide the implementation and evaluation of the development process, the Sino-Singapore Tianjin Eco-City Administrative Committee formulated a set of twenty-six Key Performance Indicators (KPIs). Many of these KPIs are higher than the national standards in China (Baeumler et. al., 2009). (Content of the SSTEC KPIs, see Appendix 1)

Table 1 Project summary of SSTEC

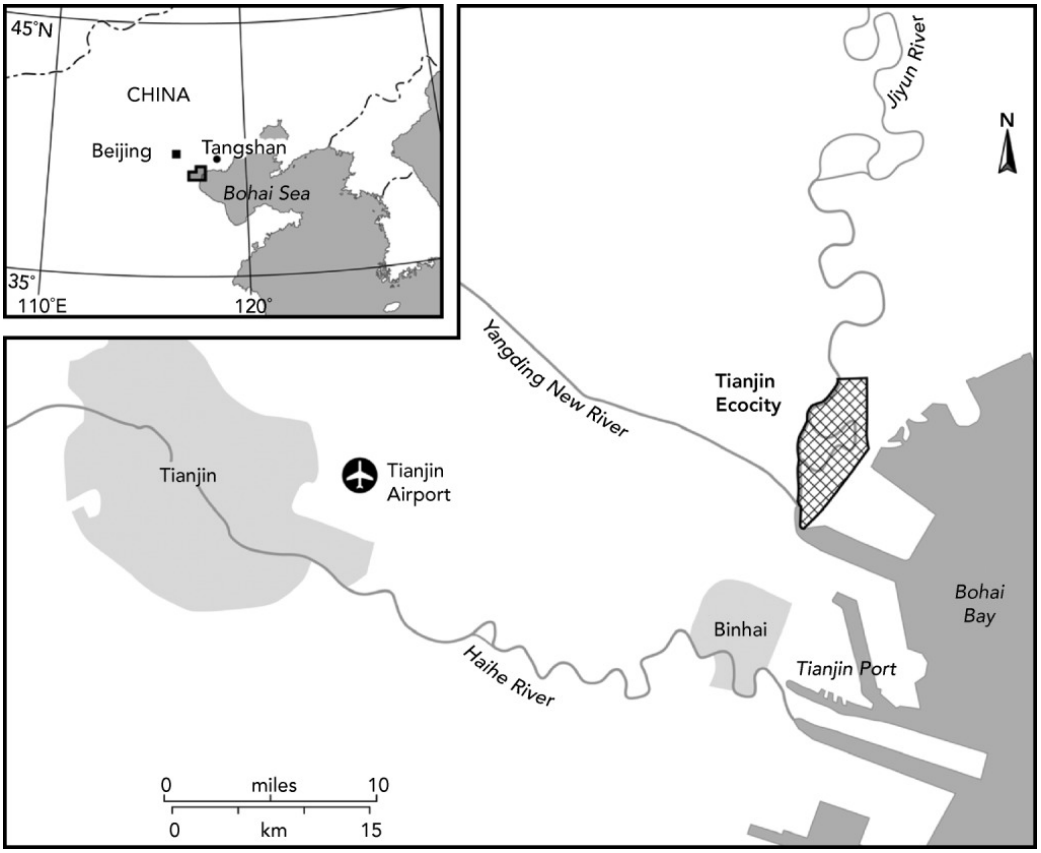
Project Name	Sino-Singapore Tianjin Eco-City
Location	45 km from the Tianjin city center, 150 km from Beijing, and 50 km from Tangshan Located in the northern part of the Tianjin Binhai New Area (TBNA)
Date Designed/Planned	Original design completed in 2007; redesigned in 2013
Construction Completed	Planned to be fully completed by 2020
Construction Cost	£24bn
Size	34.2 km^2 for the whole project, 3 km^2 has been completed by 2013
Master Plan By	China Academy of Urban Planning and Design, the Tianjin Urban Planning and Design Institute, the Singapore planning team led by the Urban Redevelopment Authority of Singapore
Client/Developer	Sino-Singapore Tianjin Eco-city Investment and Development Company Ltd, the Chinese Consortium
Managed By	Sino-Singapore Tianjin Eco-City Administrative Committee

The SSTEC was built on wasteland (see Figure 1)—consisting of saltpan, deserted beach, and wastewater pond that was transformed through the introduction of green technology, to make it suitable for human habitation. The replacement of wetlands with new urban development, however, has resulted in a loss of Tianjin's wetlands, and increase of greenhouse gas emission (Lee, 2011). The site is 40 km from Tianjin's city center and 150 km from central Beijing (see Figure 2). Designed to be "practical, replicable and scalable," the SSTEC features a number of advanced environmental technologies, such as solar energy, the practice of green building, and rainwater collection.

Figure 1 The Tianjin Ecocity site's previous condition

Source: Archived document of Tianjin salt factory, photo taken in the 1990s

Figure 2 Illustrated map of SSTEC



Source: Plymouth University cartography office, based on SSTEC maps

Since the project started, an exhibition house has been open to visitors seven days a week for a year, like a political showcase for this state-of-art green building. The "green" or ecological label fuels home sales. At its peak, homebuyers had to bid in order to get on the waiting list to buy properties in the SSTEC (according to an interview source). The SSTEC is set to relax its rules for *hukou*, the household registration, to attract labour and homebuyers, especially people from Tianjin and Beijing who are keen to buy new subsidized homes.

1.3 Structure of the Study

The concepts of "Ecological Civilization" and "Ecocity" have been broadly interpreted in China. Given the lack of transparent information about China's ecocities, I attempted to introduce the concept of "Ecosystem Services" (ES) to urban planners in Tianjin in the hope that ES might be incorporated into the local planning practices of Tianjin. In addition, I studied the social interaction of residents involvement in specific neighborhoods as neighborhood involvement indicates a variety of Cultural Services at neighborhood scale.

Following the Introduction, the main body of this study includes three papers, from Chapter 2 to Chapter 4.

Chapter 2 provides an overview of the evolving "ecocity" concept by reviewing the relevant modern history of ecological planning. The paper then discusses the possible interpretation of "Ecological Civilization" and "Ecocity", in the Chinese context, drawing on fieldwork of the Sino-Singapore Tianjin Eco-City (SSTEC). By analysing the SSTEC's effort to exemplify a successful ecocity, this paper shows how the ecocity concept has been framed locally in China.

Chapter 3 introduces an experimental approach to introduce ES to urban planners with the aim of identifying omissions and oversights existing in the planning structure linked to specific outcomes. I started with a policy review of current planning documents to understand the SSTEC's scope on environmental sustainability. Then I conduct a survey among local planners, using the ES metrics, to find out what ES are prioritized and undervalued, as well as a correlation analysis between ES and benefits.

Chapter 4, as a separate study, examines neighbourly behaviour and citizen participation in Tianjin, China. Although community action was not the focus of my dissertation, I am reluctant to ignore the impacts of local residents' involvement on a series of Cultural Services, such as sense of community, residents' wellbeing etc. This paper explores the potential for identifying people who are likely to become local leaders i.e. individuals who are essential to the delivery of community services in Chinese society.

Chapter 5 concludes the key findings of this dissertation and indicates the direction for future research on Chinese ecocities, to help them improve their ecological and social performance.

Chapter 2. Revisiting the concept of ecocity in China: An investigation of current practice

2.1 Introduction

The concept of the "Ecocity", which originally emerged in Europe and North America during the 1960s and 1970s, is an approach to urban development that respects environmental limits (Rapoport, 2014). Richard Register first coined the term "Ecocity" in 1987, setting up a self-sustaining model that attempted to minimize the inputs and outputs of the city while preserving biodiversity. Register's Ecocity, modelled after Berkeley modelled in the 1980s, supports the long-term ecological balance of urban environments.

Chinese scholars started to pay attention to the subject of ecocities when Shenzhen hosted the Fifth International Conference on Ecocities in 2002. That same year, China signed the Kyoto Protocol, committing to reduce fossil fuel emissions. China's 11th Five-Year Plan (2006-2010) strengthened the leadership for addressing climate change and for conserving energy and reducing emissions, a milestone in China's transition to a low-carbon economy (Zhang, 2010). Carbon reduction was an essential task for many of China's early ecocities (Shepard, 2017; World Bank, 2012; Wu, 2014).[1]

"Ecocity", much like "Green City"[2] or "Ecological City", is an attempt at sustainable city building[3]. These models play a valuable role in testing new ideas of how to manage urbanism. However, there is a lack of consistency in measuring "sustainability" of China's policy structure.

[1] The first Chinese ecocity, Dongtan, was initiated in 2006. This city was to be nearly carbon neutral and as close to zero waste as possible. Even though this ecocity was never actually built, Dongtan has had an unprecedented impact.

[2] Green City refers to cities like Curitiba (Brazil), Reykjavik (Iceland), and Portland (U.S.) that strive to minimize resource and energy consumption, while taking advantage of the ecosystem services of the blue-green natural components within the city and its surrounding region. It is a concept of urban planning that relies on the ecosystem services that green infrastructure can supply.

[3] A sustainable city strives to balance ecological, economic, and social needs to ensure a clean, healthy and safe environment for all members of society and for generations to come (Robert, Parris & Leiserowitz, 2005). The 1987, Brundtland Report defines "sustainable development" as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Chinese ecocity research frequently pairs "ecocity" with "Ecological Civilization", a political slogan introduced during the Chinese Communist Party's 17th Congress meeting in 2007. On one hand, the phrase reflects China's ambition to become a leader in global climate change; on the other hand, Chinese leaders used the expression to mobilize new sources of value and expertise to formulate certain aesthetic environmental practices. Pow (2018) interprets it as "eco-aesthetic normativity that perpetuates the aestheticization of urban environmental politics in China" (p.877). "Ecological Civilization" has also become a projection of Chinese state power and the *zhongguomeng* (the Chinese Dream) for Chinese people (Yel, 2009).

Compared to their "Western" counterparts, Chinese ecocities are still at an early stage, both in theory and in methodology. However, aggressive development has taken place in China over the past decade. A recent report shows that as of 2017, 285 ecocities had been developed across the country, from the eastern coast to the third-tier hinterlands (Shepard, 2017). Some ecocities even boast of having partnered with wealthier countries to attract foreign investment to China (Caprotti, 2014; Joss & Molella, 2013; Pow & Neo, 2010; 2015). Without a clear definition and official standards of what an ecocity is assumed to be, "ecocity" is an ecologically friendly city with Chinese characteristics (Williams, 2017). This is a vague definition that has generated much critical attention in literature (see Caprotti, 2014; Pow & Neo, 2015; Wu, 2012). In this study, I consider the planning of Chinese ecocities as an evolving practice, one that combines both Western theories and conventional Chinese planning.

This paper addresses the following questions:

1) How have the theories and methodologies of ecological planning been adapted and applied in China's ecocities? and
2) How does the concept of "Ecological Civilization" direct the planning actions in ecocities?

To answer these questions, this paper draws on fieldwork conducted in the Tianjin Eco-City (SSTEC) from 2012 to 2017, during which period I made repeated visits to the site. In addition, I attended planning workshops, and official meetings, where planners shared their experiences and views on knowledge transfer in the SSTEC.

2.2 The Origins of Ecocities: Western Theories of Ecology and Planning

Ecology and planning have many areas of shared concern. Ecology is engaged with understanding the functioning of resources, while planning focuses on the appropriate use of resources for the benefit of humanity (Botequilha Leitão & Ahern, 2002). The concept of ecocity has the potential to combine the goals and issues of ecology and planning. This section reviews literature on ecological planning as it relates to ecocities, in a search for relevant contemporary Western perspectives on the relationship between humans and nature.

2.2.1 The Beginning of Ecological Planning: Bringing Nature to Cities

The beginning of ecological planning offers up utopian ideas about how to use the tools of architecture, engineering, planning and design for the betterment of society as a whole. Many of the visionaries' plans were intended to reverse the negative consequences of economic development in the Industrial Revolution, making cities healthier, cleaner, and more productive (Larson, 2013).

Howard's (1898) Garden City in Britain is an example of using landscape to shape urban form. Howard argued for the importance of preserving agriculture close to cities and for using large green spaces (known as "greenbelts") to provide physical boundaries between communities. In Howard's plan, each greenbelt community was a self-contained unit, encompassing residences, industry, and agriculture. Self-sufficiency was the priority upon which Register created his Berkeley ecocity in 1987. This mode of organization promotes harmony between people and their environment.

Urban parks, which began in Europe and Britain, spread throughout North America after the completion of Central Park in New York in 1873. The new parks were presented to the public as a means to improve the health, welfare, and character of citizens as well as the tax base of the municipal government (Schuyler 1986). Frederick Law Olmsted, designer of Central Park and many of the later city parks and park systems in North America, regarded his parks as works of art whose purposes were to serve as antidotes for the detrimental effects of city life (Jordan, 1994).

After Central Park in New York, Olmsted went on to design major parks and park systems in many of America's major cities (e.g., Boston's Franklin Park and Emerald Necklace, and Brooklyn's Prospect Park). This spate of park building increased taxation revenues, fostered development and changed the standards of city living for urbanites. Such was their success that today parks have become a necessary part of any form of urban planning.

Greenways were fundamental infrastructure for solving urban problems such as congestion and sanitation in the U.S. The early greenways were a source of recreation for cities, such as Boston's Emerald Necklace and the Minneapolis' parkway. Early twentieth century Greenways provided the full range of possibilities in landscape design, from aesthetic to recreational, from ecological to social, from economic to ethical. For example, the removal of the Embarcadero freeway in the 1960s proved successful for downtown San Francisco. The miles of public space as well as walking and bike paths that were built subsequently have stimulated the growth of numerous businesses and cultural events, transforming the city's vitality and atmosphere for the better. During the 1990s, the concept of greenways was further woven into the urban fabric, fueling urban growth toward the city's fringes (Ahern, 1996). As such, greenways have become useful for smart conservation and smart growth (Walmsley, 2006).

Many of the visionaries in the urban planning canon such as Patrick Geddes, Ebenezer Howard and Frederick Law Olmsted were in favour of a comprehensive transformation of the urban environment (Fishman, 1977). A review of their work demonstrates their concern for the preservation of nature and ecological functions (Hall, 1996; Lye & Gang, 2010). Before the 1900s, when ecological ideas were still rudimentary, cities were studied separately from their surroundings. The study of ecological functions within cities was rare.

2.2.2 Ecological Planning as an Accepted Paradigm: "Design with Nature"

Breakthroughs in ecological theory and methodology emerged in the United States during the mid-twentieth century. Perhaps the most influential was the work of American landscape architect Ian McHarg. His "suitability approach", introduced in 1969, consists of three components, which, when combined together, create a robust paradigm. These three components are human ecology, regional planning theory, and the overlay mapping technique. Although

McHarg was not the first to develop these concepts, he recognized the advantages of their synthesis.

McHarg was influenced by Benton MacKaye and Lewis Mumford, particularly their earlier contributions to regional planning theory and analysis (Ndubisi, 2002). MacKaye (1940) argued in favor of applying human ecology to regional planning. He asserted that the tasks of revealing and visualizing physical and human aspects can be used in the context of regional planning. He defined "region" as a unit of environment, and regional planning as "applied human ecology" (p. 351). In line with MacKaye, Lewis Mumford (1938) introduced a cultural dimension into ecological planning. For Mumford, "region" was a unit of cultural and natural heritage. Instead of focusing on ecological or biological features, Mumford's regional planning approach focuses on analyzing human activities and human beings' active relationships with the environment.

The overlay mapping technique is a powerful tool for systematically documenting and evaluating natural and cultural data. Prior to McHarg, similar techniques had been adopted in numerous large-scale projects (Collins, Steiner & Rushman, 2001; McHarg, 1997). The advantage in using the overlay mapping technique is that it brings together information from across disciplines and translates abstract natural and cultural data into a visual aid that non-specialists can understand. Its application involves both quantitative and qualitative methods. McHarg's suitability analysis marks a paradigmatic shift in ecological planning, moving the focus from the well-being of specific ecosystems toward the concerns of human survival in relation to geography (Ndubisi, 2002; 2014).

2.2.3 Advances in Ecology: Understanding Urban Environments as Ecosystems

Early twentieth-century advances in ecological science led to ecological interaction between humans and the non-biological components of cities. A city is understood as an ecosystem, consisting of both biological and physical features. The idea of considering a city as an urban ecosystem changes the way cities are studied. Firstly, cities are no longer considered as separate from nature. Ecologists have shifted their focus from ecological sites to ecological processes and functions (Wiens, 1989). Secondly, city functions are studied as a whole, rather than examined as individual separate parts (such as the transportation systems, networks, or parks).

Urban planners have been attracted by the evolving concept of "region". Region is a scale for successful management of ecosystems (Ndubisi, 2008). It is also a territorial community, distinguished by its common history and cultural system of meaning (Ndubisi, 2002). Patrick Geddes (1915) highlighted the interrelationship between the regional landscape, people's economic activities, and their cultures. He (1905) also proposed a regional survey method with the focus on "folk-work-place" analysis (p.71) analysis for understanding the complexities between human action and the environment. Such an approach stimulates systematic thinking about our living environment and expands the theoretical foundation for regional planning.

2.2.4 A Quantitative Research Direction: Reducing the Impact of Humans

During the second half of the twentieth century, regional planning in the U.S. relied heavily on spatial analysis accompanying the development of computer and information systems (Erickson, 1979). From the 1970s onwards, Environmental Impact Assessments (EIA) were generally applied before large development designs could be carried out (Wolfe & Larry Wolfe Associates, 1987). Existing EIA frameworks concern ecological limits, and often use an index-based approach to evaluate ecosystem performance. The original ecocity concept proposed by Register (1987) was based on the bioregion's carrying capacity. The priority of his design was to reduce the city's carbon footprint, or, in other words, achieve large reductions in urban energy consumption and carbon dioxide emissions (Rees, 1996). The ecological footprint approach reflects a closer link between consumption and its impact on the site (Rees, 1992; Wackernagel & Rees, 1996). Other prevailing composite indices include the well-being index and the environmental sustainability index (Mori, K., & Christodoulou, 2012).

The emerging concept of "Ecosystem Services" provides a value basis for selecting indicators (Huang, Wu & Yan, 2015). Ecosystem Services can be broadly defined as the contribution of ecosystems to human well-being (Haines-Young & Potschin, 2009; TEEB, 2012). The Ecosystem Services approach stimulates communication and mutual understanding about the goods and services shared across groups. For example, access to green space has been shown to contribute to human well-being, physically, mentally, and spiritually (Kuo, 2010). These cultural ecosystem services hold the potential of integrating multiple resources and interests in decision

making. The aesthetic and spiritual gains from nature, therefore, have been recommended in numerous developments (Chan et al., 2012; Martin-Lopez et al., 2014; Soy-Massoni et al., 2016).

For policymakers, indicators, adapted for large-scale development programs, that integrate infrastructure, landscape change, urban design, and ecosystem services management, provide useful information concerning environmental impact and mechanisms. Planning institutions independently decide which indicators to use. Through the use of indicators, these integrated programs can address environmental challenges. Various indicators are selected and applied by planning institutions as an autonomous practice (Shen et al., 2011). However, it is usually a complicated, indirect attribution between an environmental intervention and the result. For example, air quality can be impacted by both local and non-local sources of pollution. It is hard to tell if a change in the air quality of an area has been triggered by the implementation of local or non-local environmental policies, or a combination of both. Also, the impact of a policy on the ecological performance of a particular area can be gradual and intangible, taking years for policymakers to become aware of (Lye & Gang, 2010).

2.2.5 Sustainability as a Practice of Ecological Planning in Europe and North America

Since the 1970s, the concept of sustainability has become a significant influence on planning and policy, at the local level. The sustainability of urban areas is essential to the sustainability of regions, nations, and the world as a whole (Huang, Wu & Yan, 2015). In the U.S., the concept of sustainability is practiced as a framework, and it includes four thematic subsystems for possible solutions to certain kinds of problems: Smart Growth, New Urbanism, Renewable Energy, and Green Development. Planning practice and policies related to sustainability, in North America, are based on consensus building, and their enforcement is shared by the courts and regulatory systems (Freilich & Popowitz, 2010). In such a context, planners act like mediators, aiming to build coalitions between different stakeholder groups (Innes & Booher, 2003).

Sustainability in Europe is practiced in a very different way from North America. The European Union has a centralized policy structure, and employs a political sustainability framework that is based on spatial and regional planning. Sustainability objectives are transformed into action plans on specific topics, and these action plans are carried out by European Union cities and member states (James, 2014).

Currently, there are no universal criteria or methods for measuring the sustainability of urban areas (Alberti, 1996; Huang, Wu & Yan, 2015; James, 2014; Maclaren, 1996; McManus, 2012). There are rating programs, such as LEED (Leadership in Energy and Environmental Design), and China's "Three Star" system, which measures an individual building against the criteria of green and low-carbon standards (Geng et al., 2012). In the U.S., Urban Sustainability Indicators (USIs) are widely applied in large planning projects. Rather than being a rigid standard, USIs can be continually developed, flexibly integrating participatory policy input (Innes & Booher, 2003; Huang, Wu & Yan, 2015; Newig & Fritsch, 2009). USIs are used to predict the outcomes of various development scenarios (e.g. determining the best location for a park). Planners can choose among various indicators of different sustainability goals, depending on the drivers and goals of each practice (Liu, Ness, & Huang, 2011; Qiu, 2009; Yu, Li, & Ji, 2001; Zhang, 2007).

2.3 Integrating Ecological Planning into Chinese Ecocities

Drawing on the fieldwork of the flagship Sino-Singapore Tianjin Eco-City (SSTEC) project, this section highlights the shifting planning politics that increasingly incorporates local agendas into governmental practices and urban planning as a way to manage emerging situations.

2.3.1 Why Ecocity?

"Eco" and "city" sound like contradictory terms. However, when "eco-desires", combined with green technological wizardry, meet profitable urban land development, the move to build more ecocities seems understandable.

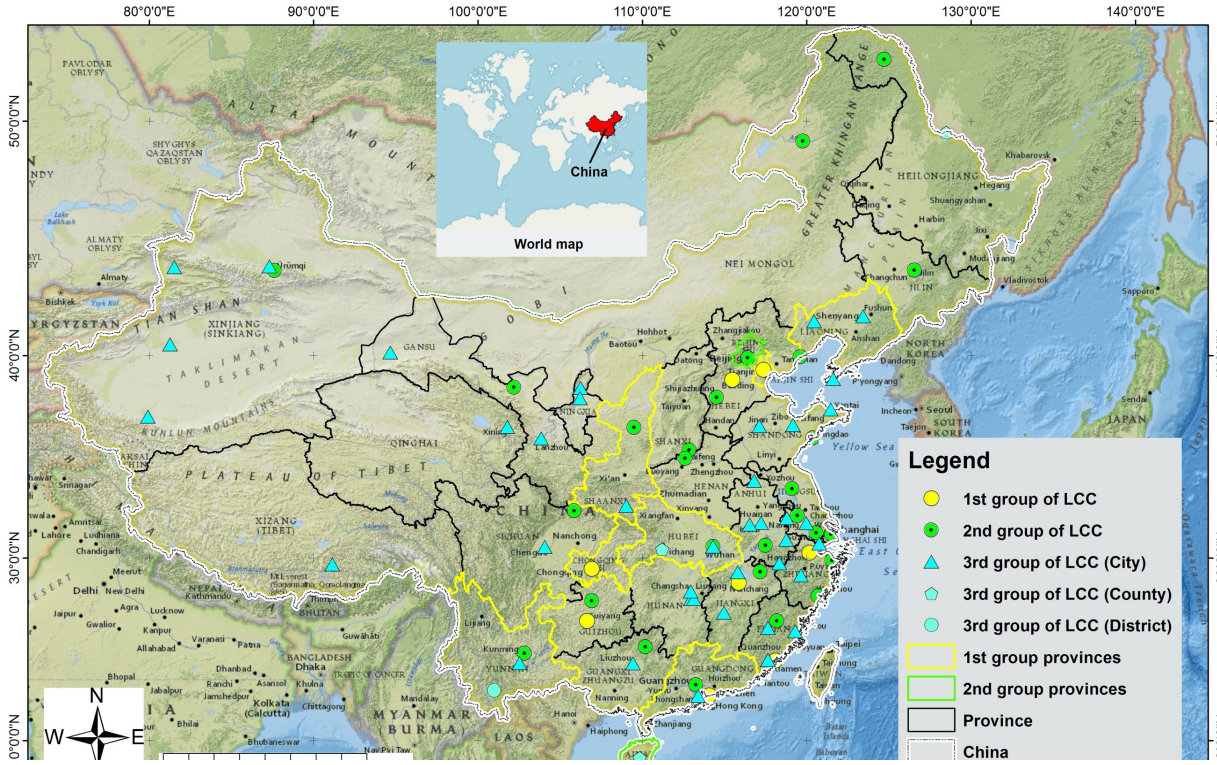
The development and successful functioning of Chinese cities depends heavily on a strong performance by the real estate market (CSUS, 2015; Li & Liu, 2011). The lease of land-use rights provides city governments with an incentive to sell land to generate revenue. On average, 70% of the municipality's revenue is generated through land leasing, and this revenue is used to finance urban development (World Bank & Development Research Center of the State Council of People's Republic of China, 2014). While most ecocities are in China's wealthier regions, the underdeveloped western regions also use ecocities to generate a more "civilized" urban scene

that will to stand out in inter-city competition (Yeh, 2015). An ecocity is considered to be successful when the created urban design leads investment and new jobs (Liu & Salzberg, 2012).

Other factors that drive local governments to build ecocities are environmental objectives (Rapoport, 2014), and environmental tasks are regularly mandated at the local level by the local government. As "environmental governance" becomes a more important part of officials' performance evaluations, the completion of such tasks will have a significant impact on the officials' careers (Shiuh-Shen, 2013). For example, since 2006 the weight assigned to "sustainable development" in the municipalities of Fujian Province increased to 32% (Zhou, 2010). In some regions, achievements in the field of environmental protection is considered more "politically" provocative than "technologically" provocative (Turiel, Ding & Chung-En Liu, 2017). This is due, in part, to the lack of a unified technological method for describing environmental protection. Taking Guangzhou Province as an example, a comprehensive index system for assessing the "Level of Scientific Development" has been employed since 2008 to evaluate the performance of officials at the municipality and bureau levels. The evaluation of "Scientific Development" picked two indices: Per Capita Green Space, and Synthetic Energy Consuming Per 10,000 RMB of GDP. However, both indices are questionable in terms of accountability and their use as a measurement for representing ecosystem services (Chi & Yang, 2009; Yu et al., 1999). This, in turn, forces performance evaluations to focus even more on the technological solutions. Very often, ecocities are used by local governments as a tool for experimenting with policies and technological innovations.

Constructing ecocities is an effective way of attracting educated young talent to the field of eco-technologies. For example, the Dezhou "Solar Valley" is estimated to have employed 800,000 people in the solar panel industry. China's subsidization of the solar industry is an example of the strong incentives given to this type of high-tech business park project. Another example is the Shenzhen Sino-Dutch Low Carbon City. In its "Open Innovation Campus", space is organized to stimulate communication between universities, research and development centers, and high-end services (de Jong et al., 2013). In such cases, local politicians see ecocities as a catalyst for promoting both large-scale new commercial developments and high-tech solutions for resolving environmental concerns (Sze, 2015, p. 54).

Figure 3 Geographical location of China of low-carbon ecocities and provinces



Source: Garfield et al., 2019, p.4342

Table 2 shows evolving ecocities around the world in chronological order. European and American ecocities are the earliest neighborhood-scale experiments, and these ecocities have been focusing primarily on devising solutions to reduce human impact on the environment. These projects have showcased sustainability models, such as green development, new urbanism, and renewable energy. In 2006, Abu Dhabi undertook the first large-scale ecocity project in the Middle East, taking on the challenge of finding eco-friendly solutions for an unlivable environment. In more recent years, various ecocities have been established in other geographic territories, and many are in developing countries. This demonstrates the power of knowledge sharing, which facilitates the advancement of multiple solutions for the sake of human civilization. A closer look at the Chinese ecocities that have thrived since the late 2000s shows that their scale is both promising and challenging. Also, the large number of ecocities in China has resulted in a streamlining of paths to all types of sustainability goals. Consequently, China has succeeded in generating plenty of design schemes, models, strategies, and scientific evidence for researchers and planners to use in dealing with the challenges posed by complex urbanization.

Undeniably, the practice of ecocities also helps form a strong alliance between local government and investors, and enables them to stand out amid the intense competition among regions and cities.

Table 2 Examples of the ecocities planned and constructed worldwide

Geographic Area	Project Name	Scale and timeline	Ecological Planning Themes	Ref.
North America	Berkeley, California, U.S.	Late 1970s, 10 acres	New urbanism; human impact on the environment (e.g., promotion of holistic living, restoring creeks)	Register (1987; 2002)
Europe	EVA Lanxmeer, Netherlands	1994-2009, 240 houses	Human impact on the environment (e.g., reduce household energy consumption)	Roggema (2017)
Europe	Hammarby-Sjöstad, Stockholm, Sweden	Designed in 1990 for the Olympic 2012, realization 2004-2016, 1.5 km^2 with 26,000 residents	Integrated urban systems	Ignatieva & Berg (2014); Pandis Iverot & Brandt (2011)
East Asia	Kawasaki Eco-town, Japan	1997, 28 km^2	Human impact on the environment	Low (2013)
Europe	Hannover-Kronsberg, Germany	Drafted in 2000, 3200 units, 70 ha	Eco-friendly urban development (e.g., a design that adapts local weather)	Shashua-Bar, Tsiros, & Hoffman (2012)
Europe	Solar District Schlierberg, Germany	Completed in 2002, 59 homes	Green development; reduce human impact on the environment (e.g., carbon-neutral homes)	Heinze & Voss (2009)
Europe	BedZED, UK	Finished in 2002, 82 homes	Renewable energy (e.g., zero-carbon homes); human impact on the environment (e.g., sustainable lifestyles)	Chance (2009)
Middle East	Masdar, Abu Dhabi	2006, 6 km^2 45 -50K residents	"Green living": Using energy solutions to transform a non-liveable place into a city (e.g., clean power, desalinization plant that runs on solar power, transportation)	Cugurullo (2015)
Europe	Eco-towns, UK	2007 initial planning proposal; 2012, approved with no completion	Political sustainability framework based on spatial and regional planning (e.g., affordable housing, lifestyle changes)	BBC News (2007; 2009)
Austria	SolarCity, Linz	Planned in 1992 and completed in 2006, aims to accommodate 35 ha 4,000 people	Integrated urban systems; human impact on the environment (e.g., energy-saving residential district);	Breuste (2012); Breuste & Riepel (2008)
South America	SymbioCity, Sao Paulo, Brazil	2009	Smart growth (e.g., mobility, a mixed land use urban structure)	Chiariotti et al. (2016)
East Asia	Shanghai Dongtan Ecocity, China	Drafted in 2005, 86 km^2, 50K residents	Green development; renewable energy; human impact on the environment	Castle (2008); Sze (2015)
Southeast Asia	KL Eco City, Kuala Lumpur, Malaysia	2007, 0.1 km^2	Smart growth (e.g., downtown mixed-use development)	Tan (2012)
East Asia	Solar Valley, Dezhou, China	2007, 3 km^2	Green development; renewable energy	Nusca (2010)
East Asia	Sino-Singapore Tianjin Eco-City, China	First plan drafted in 2007 of 35 km^2, 350K residents; Revised in 2016 as 120 km^2	Renewable energy; human impact on the environment; integrated urban systems	Baeumler et al. (2009)
East Asia	Tangshan Caofeidian International Ecocity, China	2007, 60 km^2, 1.2 million residents	Green development; renewable energy; integrated urban systems	Following "The Hammarby model"
East Asia	Suzhou Western Eco-City	Construction began in 2010, 6 km^2, 1.2 million residents	Integrated urban systems	Wang, Ding & Zhuang (2015)
East Asia	Sino-Swedish Wuxi Low-Carbon Eco-city	Construction began in 2010	Integrated urban systems	de Jong et al. (2013)

Reference: Zhou & Williams, 2013

2.3.2 The Undefined Chinese Ecocity and its Evolving Agenda: From the Case of the Sino-Singapore Tianjin Eco-City

2.3.2.1 The revised masterplan for an eco-friendly future

Prior to development, the SSTEC site comprised mainly salt pans, aquaculture ponds and waste land. The site is situated in Northern China with a low precipitation and high evaporation rate. The site is in an area that was reclaimed from tidal flats that were used for salt farming for centuries. The soil is highly saline and alkaline, making it unsuitable for plant growth (Green Building Index, 2010).

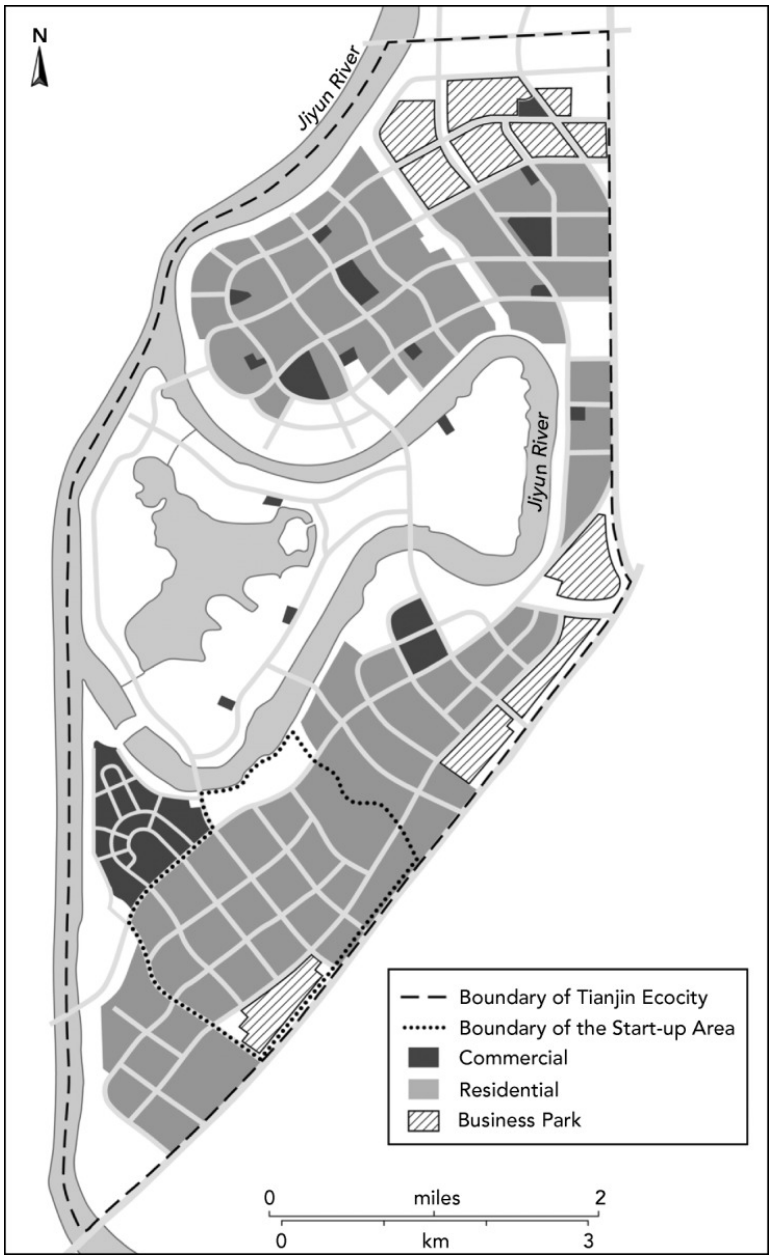
The site is close to several designated Important Bird Areas, including the Qilihai Nature Reserve and the Beidagang Wetland Nature Reserve. The mudflats around the SSTEC are part of the greater Yellow Sea/Bohai Bay coastal wetlands. A good number of migratory coastal birds have come to the site along Bohai Bay.

The SSTEC masterplan is a blueprint that started from scratch (See Figure 4). It proposes a green "spine", with a main axis road that runs through the entire ecocity and links three city hubs with four subcenters. The proposed spine is 500 meters wide, connecting residential neighborhoods, social amenities, and workplaces with tram networks, as well as scenic trails for pedestrians and cyclists. By the time the project is completed in 2030, it is expected to accommodate 350,000 permanent residents in an area of over 30 km^2.

Phase one was completed in 2011, but it had failed to reach the projected population targets. No residents had moved in as of October 2011 (Chang et al., 2016). Several international media outlets, showing pictures of dusty construction sites, housing developments, high-rise office buildings, and empty streets, warned that the city may become another ghost town—an overbuilt city with few inhabitants (see Kaiman 2014). The green spine idea was also revised, becoming an 8-lane-wide road surrounded by commercial and office buildings, just like any other Chinese new town development. Caprotti (2014) questioned whether the SSTEC would be ecologically healthy. He stated that it would be impossible to finance the city's development at such a speed. Those dusty, empty homes represented a misalignment of interests between citizens, the government, and urban planners. As for the governments, the urgent issue was to formulate

actions to turn the ecocity into a place to live and stay, rather than a place to visit (the source is from personal communication, anonymous public official).

Figure 4 Original masterplan made in 2008



Source: Plymouth University cartography office, based on the 2008 masterplan

By late 2015, the situation started to improve. A boom in home and condominium sales was triggered by the thousand-family relocation in the wake of the Tianjin warehouse explosions on August 12, 2015. (This disaster is commonly known as “the Port of Tianjin 8.12 explosions”)

(The Guardian, 2017). On that day, a series of massive industrial explosions occurred in the nearby Port of Tianjin, taking the lives of more than 150 people and polluting the Binhai New Area with hazardous chemicals. The SSTEC was reported to have been slightly impacted. The municipality offered settlement subsidies to the affected families to facilitate their resettlement. By the end of 2015, more than 75% of the housing units had been occupied (source from an interview). Soon afterwards, a revision to the SSTEC masterplan increased residential land by 10%. The 10% increase in residential land saved the SSTEC project substantial costs associated with the maintenance of high-rise towers. The Binhai government hesitated to lease more land for offices and commercial purposes as "it was more urgent to put the empty towers and malls to use in order to serve those who have been newly relocated in the ecocity," an official of the Administration Committee admitted during an interview.

The Tianjin-Binhai government continued to report that SSTEC was making good progress in terms of physical development and public services. Free bus transportation was provided for all residents. Top-notch schools and discounted rates for medical care were introduced as part of premier deals offered to new homeowners. By the end of 2015, the number of residents had reached 30,000. This was still insufficient, considering that the target population was 350,000 by 2030, but at least residential neighborhoods were no longer empty.

Figure 5 Construction of residential buildings in SSTEC

Source: The Guardian, photographed by Bloomberg via Getty Images

In addition to actively promoting physical construction, the SSTEC initiated the Community Building Campaign (CBC) as an innovation to improve social services. The goal of the CBC is to encourage the non-governmental sectors to establish facilities and provide services that will improve the quality of community life.

The establishment of a community center system is part of the program to support the daily lives of local residents. Similar to Singapore's neighborhood center, each community center provides a "meeting point" for residents within a 1 km radius, where they can go to socialize outside of their homes. The community center offers a variety of services, including job hunting support services, legal services, a gym, a library, art classrooms, and other social amenities, as well as retail and healthcare facilities (See Figures 6 and 7). During my visit in early 2017, a few residents said that in their daily lives they were quite "dependent on their nearby community center". Meanwhile, some residents still felt that their social lives had become more limited since moving into the SSTEC, especially for people who did not drive. "Most bus lines are free, but the buses are infrequent. It is tough to stand for 30 minutes on winter days, waiting for a bus," one community manager told me, adding, "all the bus lines stop before 8:30 p.m., so you have to have a backup plan to get home if you and your family decide to go for dinner somewhere outside the Ecocity."

Figure 6 An activity room in the community center

Note: Photo taken by the author in 2017

Figure 7 Inside the community center

Note: The left poster says “Cultivate good habits for a healthy life.” The right poster says “A non-smoking life starts from saying ‘no’ to the first cigarette. Keep air fresh and maintain sanitation indoors”.

2.3.2.2 A dead-end path for Chinese ecocities

Local officials’ eagerness to make the ecocity a liveable place is understandable, given that the city had already made massive investments in social amenities. However, further actions are required to effectively deal with the existing environmental problems. For example, residents in the SSTEC have been encouraged to sort and recycle waste to cultivate a healthier lifestyle. Each neighborhood is equipped with waste disposal and recycling bins that come with detailed instructions. Many residents, after discovering that all the sorted-out items would eventually be put into the same garbage truck, refused to use the recycling bins. “I feel like a fool, doing whatever they tell us to do,” said an interviewee. He added, “If the lifestyle tip is just to make us feel good, I am not interested in being part of the show.” One SSTEC official explained to me in an interview that the city uses advanced German technology to sort waste refuse by density. “It takes time to cultivate the habit to sort and recycle garbage. I cannot force residents to do it, but can only educate them about how to do it…Waste treatment [currently undertaken in the SSTEC]

does not require households to sort their refuse and recycling," she said. "The separated bins in neighborhoods are more for educational purposes. It is important for residents and visitors to see for themselves that I take seriously the spirit of cultivating a 'green' lifestyle, so that others can follow our example."

Looking closely at the language the SSTEC uses to describe its "Three harmonies", "ecocity" means to provide a decent quality of urban living. Terms like "economic growth", "improved living conditions", "better mobility", and "social progress" are simply intended to be much-needed improvements and infrastructural development with an "Eco" prefix.

Table 3 highlights the characteristics of Western and Chinese ecocities, comparing their goals, processes, and outcomes. Nearly all ecocities make energy-related objectives a top priority, and an essential goal. The earlier ecocities of wealthy countries are, in general, small-scale suburban initiatives, focusing on household and community lifestyles. Their primary aim is to reduce their impact on the environment. In contrast, the emerging ecocities of developing (Asian) countries are mostly ambitious urban projects, driven by local and national pride, and a promise for a decent quality of urban environment (Shepard, 2015).

Some European ecocities have developed a "transaction-oriented" planning framework, based on structural cooperation among different levels of government. Issues like climate change and affordable housing win strong political support, as well as the integration of infrastructural systems. For example, in Stockholm, "The Hammarby Model" exemplifies advances in the integration of infrastructural systems (i.e., technical infrastructures, mobility, communications, building, and blue-green infrastructures. This methodology is also applicable to other processes of environmental management (Svane, 2008). There have been ecocities such as Tangshan Caofeidian (China) and SymbioCity (Brazil), which followed this model to achieve extensive environmental objectives. The development of ecocities in these countries allows the integration of the state-of-the-art technologies and the latest advancements in architecture, planning and design.

Table 3 A comparison of ecocities from West and China

Project	Goals	Processes	Outcomes
Berkeley, California, U.S.	Livability, healthy communities	Led by environmental activists. Residents are involved in the early depaving and creek restoration efforts	A case to represent New Urbanism; Re-naturalization of the Bay Area creeks; Wake up the global-wide climate change campaign led by community leaders
BedZED, UK	New energy, zero-carbon homes, sustainable community and sustainable lifestyles	Two years to complete the project. Designed by architect Bill Dunster, with consulting supports on engineering and marketing.	Energy efficient design for high-income households; Housing policies and household variety of the residential development in Brighton (Chance, 2009)
Eco-towns, UK	Zero carbon, affordable housing, sustainable living	More like a policy proposal, sponsored by government, sites were approved but never been completed	"Eco Town" standards as criteria for vision, construction and urban management (e.g., social inclusion)
Hammarby-Sjöstad, Stockholm, Sweden	Interdisciplinary planning of physical flows of energy, water and waste	Integrate systems in planning at the beginning of the project	"The Hammarby model"−an exemplary residential case for sustainable neighborhood. Caofeidian Ecocity in China and the SymbioCity in Brazil imitated the Hammarby model
Solar District Schlierberg, Germany	PlusEnergy addresses climate change issue, carbon neutral	A framework for local action in key areas identified for effective GHG emissions reduction	Freiburg Climate Protection Strategy 2030─an action plan supported by current implementation
Hannover-Kronsberg, Germany	Reduce carbon emission; reduce household energy consumption	Close cooperation between the City and public utilities resulting in the establishment of an Energy Agency	Suburb of Kronsberg was built as part of the World Exhibition 2000 as an example of sustainable city planning (City of Hannover, 2004)
Shanghai Dongtan, China	Carbon neutral, new energy, eco-tourism,	2002-Distinguished international partners involved in the scoping stage 2005-Project was scrapped after political scandal	The Dongtan project stalled. Nonetheless, it drew much attention from the media.
Sino-Singapore Tianjin Eco-City, China	Pollution; public transportation; Creating abundant jobs and housing; Clean energy resources; High-tech development parks; Eco-tourism	Start from integrated infrastructural systems, with massive investment in green technologies From 2015 onward, a real-estate development breakthrough; investment in transportation and community facilities; and eco-tourism	A hub for Greentech; Key Performance Indicators (KPIs) as a criteria system to guide the SSTEC development
Solar Valley, Dezhou, China	Building the biggest solar energy production base in the world	Build upon experimental venture in the solar industry, situated on reclaimed farmland.	A hub for clean energy technology launched by Himin Solar Energy.
Suzhou Western Eco-City	Applying relatively low ecological footprint urban settlement, with the strong financial incentives to businesses for urban development	Settlement extension initiated by Suzhou New District government. A masterplan informed by "agro-urbanism"-connecting urban areas to agricultural land	Walkable neighborhoods with a main town center providing services for the local community. An environmentally-based design code to govern development

2.3.3 The Resultant Ecocities Embody Diverse Interpretations of "Ecological Civilization"

Historically, Chinese cities were ecological by default. They were built based on Chinese environmental philosophies such as Taoism and *feng shui,* which have always given priority to patterns inherent in nature (Shiuh-Shen, 2013; Skinner, 1982; Yu, 1994). However, few of the above traditions have been applied in Chinese ecocities. China, a country once known for its more holistic approach to urban planning, currently runs the risk of missing out on some of its own historical practices.

After reviewing more than fifty Chinese ecocities that have been built over the past decade, it is my impression that the concept of "Ecological Civilization" is being interpreted in many different ways, depending on the objectives or the policies in the spotlight at the time of project implementation. Local leaders and planners usually use the opportunity of building ecocities to deliver local political agendas. I outline four themes as "local interpretations" of what local leaders envisioned when they refer to a project as an "Ecocity":

- High-tech development parks: Using the "eco" brand to build research and development centers and promote an entrepreneurial environment with the aim of attracting high-tech companies and talent from all over the world. For example, the National Animation Industry Park has been set up in the SSTEC, and the Dezhou "Solar Valley" is now the home of China's solar panel industry. In general, such projects occupy large areas of land, and have costly infrastructure requirements. For this model to succeed, the city needs to generate a lot of jobs and attract young workers, and it requires converting rural land to urban uses to finance urban expansion. Heavy debts have become a serious issue as local governments continue investing in such infrastructure. The "eco" is a catchphrase that helps authorities to market projects of superior urban planning and design.

- Abundant housing: Ecocities provide a variety of housing options for China's growing middle class, enabling people to live on the outskirts of the city in more spacious residential units, while still allowing them to benefit from access to urban facilities and services. Ecocities exemplify a compact development model that preserves farmland. This type of ecocity is supposed to accommodate a huge population. For cities that have an expanding population and growing homebuying power, the promise of a better quality of life on the

edge of urban centers sounds appealing. However, this model may not be suitable for cities that already face a shrinking population and a loss of jobs.

- Public transit: Most ecocities are built outside of city centers. The promotion of public transit affords the dual benefits of greater ease of mobility and energy efficiency. Considering the extensive investments required over numerous years, and the small populations that actually live in the district undergoing new development, it is hard, in the planning stages, to predict whether the ecocity will reach a population size that is large enough to support extensive infrastructure investment. The Caofeidian Eco-City and the SSTEC are both expecting the provision of convenient public transit services to be the key to success. Caofeidian is within a one-hour commute to the urban center of Beijing, and the SSTEC is within a one-hour commute to both the Tianjin and Beijing city centers. Such a model provides businesses the incentive to relocate outside the city, where leases will be cheaper. The employees of these companies could then choose to commute or buy a second home in the ecocity.

- Pollution remediation and eco-tourism: Reducing the negative impact on the environment is essential for the success of an ecocity. Many ecocities' promises of a better quality of life for residents have a lot to do with pollution remediation. Ecocities that can provide access to nature are able to attract new homebuyers. The way to do this is by developing eco-tourism and creating commercial spaces for gardens or cultural venues.[4] The continual provision of clean water and reliable food resources is heavily subsidized, which begs the question of whether such subsidies are economically sustainable.

2.3.4 Advice Given to Chinese Ecocities

Williams (2017) suggests that "ecocity" is a vaguely defined concept open to interpretation. While Westerners consider urban living issues relating to air pollution and water quality as the cost of growth, "China hangs on to the idea that environmental concerns should be addressed in order to revamp productive growth" (Williams, 2007, p.68). As a result, many ecocities provide misleading commentaries about their environmental achievements, offering data that demonstrates growth in business involving new technologies. Cultural commentaries question the extent to which green technology can actually improve environmental performance. An

[4] The SSTEC has invested massively in tourism, primarily in a nature sanctuary featuring wetlands for migratory birds and an ocean-themed tourist destination.

important study by Sze (2015) concluded that such ecocities do not allocate sufficient resources to truly address China's environmental emergency. She points out that the planning of Dongtan was based on the commodification of ecosystem services, such as eco-tourism. Similar critiques can be found in other ecocities (see de Jong, Wang & Yu, 2013; Joss & Molella, 2013).

What advice can be given to Chinese ecocities? Clearly, looking at building performance or green technology alone is not sufficient. Instead, I looked at how our cities are designed, and consider which values are appreciated by the leadership, especially the mayors and planning directors in the municipalities. Considering the scale and speed of China's urbanization, the country would benefit greatly from reliable guidance at the planning stage (e.g., holistic design strategies, and development plans that consider locally accessible resources). Such guidance could lead China on a new path toward urbanization.

Project teams are required to function at a high level, with coordination between the planning and environmental offices, if environmental objectives are to be realized. Many of these objectives, however, are in conflict with other objectives (i.e., transport and aesthetic objectives). For example, the energy efficiency of industry has significantly improved. However, the way this improvement has been achieved is problematic. After the 2012 smoggy Beijing winter, SSTEC closed down hundreds of factories as a move to combat air pollution (CSUS, 2012). The municipality of Tianjin also started to limit the number of new car license plate registrations. Estimates suggested that if 90% of commuters chose not to drive a private car, transportation-related greenhouse gas emissions could be reduced by 50% when compared to 2005 levels (Tianjin Capital Environmental Protection Group, 2016). However, the masterplan in 2008 did not support such a transit solution. The number of private cars has been increasing every year. According to the local Environmental Protection Bureau report, the improvements seen in air quality within the SSTEC since 2014 have been attributed to the closure or relocation of factories.

2.4 Conclusion

An ecocity is a city that reduces environmental stress, improves living conditions and helps to achieve sustainable development through a comprehensive urban improvement system, involving the planning and management of land and other resources (Gordon, 1990). Ecocities should further develop both a design and an economic basis for cities and regions organized around a fundamental respect for inherited natural environmental and economic systems that support human activity (Register, 2016a; 2016b).

A comparison of ecocities from five continents suggests that ecocities have shifted from small-scale, grassroots environmental activism in the 1970s, to the ambitious, large-scale projects of today. A review of ecocity literature indicates that the early literature on ecocities has failed to address the incremental, bottom-up reforms required. This paper contributes to a dialogue between Western and Chinese planners on the subject of ecocities.

In recent years, China's local governments have begun embracing ecological objectives, and seem eager to believe in the ability of "green technology" to solve many environmental problems. Municipalities have promoted compliance with advanced standards for transaction value in the tech market, the number of patents granted, and expenditures on R&D funding to attract media attention and investments amid intense competition. Such a strategy puts ecocities in a problematic situation, as the main priority becomes the achievement of environmental objectives that are somewhat dependent on the marketing of an "eco" brand. In such a situation, maintaining a holistic focus on environmental protection becomes a much lower priority. Some municipalities have gone deeply in debt, while providing their inhabitants with clean water, a high quota of green spaces, top-notch schools and hospitals. Each city is competing with other cities by creating jobs to generate tax revenue and attract homebuyers.

One undeniable fact is that the quality of urban living has been greatly enhanced all over China in the past few decades, a development which is not limited to the ecocities. Such an improvement is seen as a success derived from a housing market that features competition and cities that compete for labor. But tax revenue drawn from property investment is insufficient to help the country to achieve healthy growth (Ding, 2003). Meanwhile, the situation brings with it more challenges for managing the public's desire for "greener," "healthier," and "balanced" urban living.

In this chapter, “Ecological Civilization” impacts planning actions for much-needed infrastructural development and improvement. Driven by economic and environmental objectives, Chinese ecocities have selectively applied theories and approaches to support local political agendas. Chinese ecocities exemplify a model for developing countries that combines advances in new technologies and accommodating a growing urban population.

This paper concludes that the following planning guidance should be given to China.

- Build cost efficient, multi-functional green infrastructure. The ecocities that have been developed in China are large-scale, high-profile projects aimed at attracting investment. More consideration must be given to the economic health. The current problem with nearly all of China’s ecocities is the tendency to promise investors too much, and be overly focused on “expansion” and “development”. In addition, local leaders are not making a sufficient commitment to solving real environmental problems. The development of multi-functional green infrastructure that can mitigate environmental problems, like flooding and pollution, while delivering cultural ecosystem services should become an accepted component of ecocities. Curbing the scale of ecocities, or phasing them over longer time frames, would reduce the pressure on project developers to achieve impressive-looking results, and allow them to make economic feasibility and long-term sustainability higher priorities.

- Learn from tradition for both urban design and the economic basis for cities. The current approach to ecocity development in China brings together a cumulative body of knowledge relating to resource circulation, environmental performance, and the adaptation of ecological principles in planning. This knowledge, however, has yet to be integrated with the vernacular city building wisdom that has long been practiced in Chinese cities. Advances have been made with regard to integrating input from various fields in the development of urban systems in some of China’s ecocities, particularly in the case of collaborations with foreign partners. Future ecocities, however, should not focus solely on the “best practices” of the West or rely entirely on green technologies and land reclamation. China’s ecocities should draw on the principles of *feng shui*, incorporate locally available materials, and adopt concepts and designs that suit the local ecologies and people.

- Use cross-section collaboration to address climate change and sea-level raising challenges. Strong political support for ecocities in China enables an interdisciplinary approach to

solving the challenges of urban living. Given the recent effects of climate change, ecocities slated for development in populated urban areas, along the coast, should address climate change and rising sea levels as special concerns, and seek holistic solutions.

- Ecocities need to supply ease of mobility. Many ecocities are averse to low-carbon living, primarily because residents keep buying new cars and making driving a priority. Ecocities should be designed to ensure the safety of pedestrians. Ease of mobility should be among the highest priorities for the urban design and transportation planning teams, and non-motorized transportation networks are a necessary part of transportation networks.

Like other ecocities, the attribute of "Ecological Civilization" led SSTEC to address housing affordability, cleaner energy, eco-tourism, and a high-tech development park. However, Tianjin did not deliver what it originally promised, and is nothing like what Register's Ecocity proposed. In this regard, Tianjin is more akin to a Chinese conventional planning product.

Chapter 3. Is lack of ecological knowledge a barrier for urban planners? Evidence from Chinese urban communities

3.1 Introduction

3.1.1 Ecosystem Services: A Useful Concept for Understanding how Ecosystems work to Contribute to Human Welfare

Cities present a host of sustainability challenges (Grimm et al., 2008; Solecki et al., 2010). As cities become more populous and more consumptive, environmental problems increase. Scholarly literature is uncovering major adverse health effects in urban residents that are caused by the stresses on the natural environment, including those caused by increased pollution and flood risk, rising temperatures, and decreased biodiversity (Butler et al., 2005; Northridge, Sclar, & Biswas, 2003).

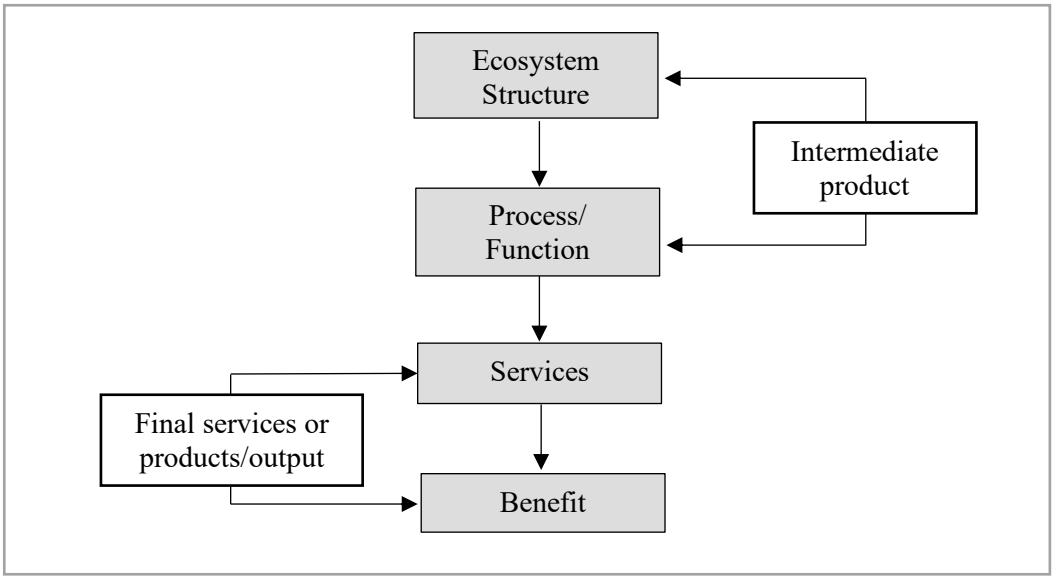
As previously mentioned, the promise of a green healthy environment is a big attractor to the new residents of Chinese ecocities. The Chinese populace is increasingly aware of the negative health impacts of air and water pollution and many will seek the opportunity to live in a healthier environment. In order to plan actions to counteract negative environmental effects, the interactions between the ecosystems, ecosystem management, and human well-being need to be examined in a holistic way.

Ecosystem Services (ES) can be described as the benefits people obtain from ecosystem. In 2000, the United Nations initiated a worldwide assessment of the condition of global ecosystems, known as the Millennium Ecosystem Assessment (MEA, 2005). The scientists who conducted this work used ES to assess the health of the global ecosystems. They divided ES into four broad categories: material or *provisioning* services such as food, water, and fiber; *regulating* services that affect environmental processes of regulating climate, floods, disease, wastes and water quality; *supporting* services that lay the foundation for all other services by providing processes/functions such as soil formation, photosynthesis, and nutrient cycling; and *cultural* services that meet the recreational and spiritual needs of people. Their report stated that the net

gains in human well-being and economic development in recent years had been achieved at the cost of degradation of many ecosystem services (MEA, 2005).

The MEA provided a scientific framework to guide policy and planning toward the sustainable use of ecosystems. The approach seeks to put human needs at the centre of ecosystem management, and considers the needs of different stakeholders in the decision-making process. It is now widely used among research and policy communities to enhance communication regarding human welfare (Costanza & Kubiszewski, 2012; Plant & Ryan, 2013; MEA, 2005). Yet challenges to this approach remain, including predicting how human actions will affect ecosystems, how landscape changes will affect the provision of ES, and how changes in the provision of different ES will affect different groups in society (Granek et al., 2010).

Figure 8 A cascade diagram showing the understanding of ecosystem features



Note: The relationship between the ecosystem structure, process/functions, services and benefits (adapted from Haines-Young and Potschin, 2010)

The MEA used the terms “ecosystem structure”, “ecosystem function”, “ecosystem services” and “benefits” interchangeably, which confused and frustrated planners. Haines-Young and Potschin (2010) clarified the relationship between these concepts by developing the Cascade Diagram (see Figure 8). They correctly expressed the understanding that the structure or physical make up of an ecosystem gives rise to ecosystem processes (sometimes called functions). Ecosystem processes yield the ES, and the services produce the benefits received by humans. Thus, the

ecosystem structure provides a biophysical space for ecological processes and functions, and services produce the benefits that people enjoy.

The distinctions between services and benefits, however, is debatable, and, depending on one's point of view, both may be the final outcomes of ecosystems. Wallace (2007) argues that "service" should only be defined as a benefit that people can consume or experience, while the rest are part of ecological structures and processes that help create the benefit. Following Wallace's logic, a service can be described as a benefit only if people can directly enjoy it. Because the benefits of intangible and intermediate ES are not immediately apparent, they can be overlooked (e.g., soil formation, nutrient cycling, and disease regulation). By contrast, Fisher and Turner (2008), and Costanza (2008) disagree with limiting the definition of "service" as a final product to be utilized directly by people. In many cases these undervalued services that contribute to biodiversity also enhance human well-being. ES therefore provides a vehicle to help people re-access whether the structure, function, and services currently being provided are optimum.

3.1.2 The Problematic Assessment of Ecocities

From the 1970s onwards, environmental and urban planning promoted new frameworks for tackling urban sprawl, biodiversity loss, and associated social problems (Imura, 2010; Jongman, Külvik, & Kristiansen, 2004; Luederitz, Lang, & Von Wehrden, 2013; Margules & Sarkar, 2007; Termorshuizen, Opdam, & van den Brink, 2007). Later, the idea of the ecocity emerged from grassroots environmental movements that sought to respect environmental limits in urban development (Rapoport, 2014).

Richard Register (1987), in his book *Ecocity Berkeley: Building cities for a healthy future*, expressed his idea that the primary goal of an ecocity was to conserve, recycle, and preserve biodiversity. For Register, the design and planning of an ecocity needed to be grounded in self-sustaining resilient structures and a properly functioning ecosystem (Chang & Sheppard, 2013). In subsequent years, new planning principles that include a reduction in the use of automobiles, wetland restoration, and affordable housing have all become part of an ecocity framework (Kenworthy, 2006; Roseland, 1997). Meanwhile, many indicators have been developed to assess ecocities, such as Urban Sustainability Indicators, Ecocity Standards, and Ecocity Builders used in the North America, and Key Performance Indicators for Ecocities in the Asia-Pacific Region

(Zhou & Williams, 2013). However, the planning literature did not fully explain some of the critical connections between planning actions and their outcomes (e.g., how the principles and the assessment systems actually play a role in helping an ecocity achieve its goals). In this study, I attempt to link assessment systems and the desired outcomes, drawing on the burgeoning literature on ecocities.

The problems with the current indicators that planners use have been well analysed in literature. One common problem is the way that indicators are selected (Joss & Molella, 2013). Current methodology has relied heavily on statistical data and on expert opinion regarding which indicators can be used to best track progress (Voß & Bornemann, 2011). However, there is little consensus on how to set priorities for issues that are to be evaluated (Zhou & Williams, 2012). Another critique is the adaption of indicators at different stages of the planning process. Indicators selected in the initial planning stage are fixed, and then handed down from the top as assigned targets (Berrini & Bono, 2011; Zhou & Williams, 2012). These indicators are not responsive to changing agendas or emerging situations. For example, urban sustainability indicators have frequently omitted "social identity" and "social cohesion," which are important issues pertaining to the influx of new ecocity residents (Maclaren, 1996). Many indicators are dependent upon complicated data described in abstract economic terms. For example, carbon reduction is measured according to GDP, and water consumption is measured per capita. It is unclear what planning practices would need to be applied in order to achieve these appropriate goals for these parameters. Lastly, planning scholars have not fully elaborated the direct impact and role of these indicators in the planning process.

3.1.3 A Potential Solution: Integrate Ecosystem Services into Urban Planning

In this study, I propose the use of Ecosystem Services (ES) as a response to these assessment problems. This research intends to show that ES can be adapted in different phases of the planning and decision-making process, as well as being included as indicators of new requirements that are relevant for the formulation of decisions, in later phases of the planning process.

The concept of service does not exist in isolation from people's needs. Hauck et al. (2013) pointed out that it is important to include the beneficiaries in the context of analysing ES. Without demand and an interest group, certain ES would not be identified as being important in

ecosystem management. Brown and Mooney (2013) developed a simplified method that can be applied by planners and researchers to investigate the relationship between landscape change and ES. Their approach was used to assess the ES of more than 100 designed landscapes of varying scales in North America. Ahern et al. (2014) and Hauck et al. (2016) decided to use the ES tool because the beneficiaries (i.e., members of the local community) would be involved, and because they found it useful for responding to changes in monitoring data and feedback from these important stakeholders.

In this study, planners were used to test the ES method because planners combined two roles that are important for ES analysis: First, as ES beneficiaries (i.e., the end users who will benefit from the ES as residents) and second, as ES decision-makers, those who identify specific questions that will be tackled by the ES assessment (Hauck et al., 2013; Wissen Hayet al., 2015). With this study, I used the survey method to investigate how local planners identify key values of their living environment. More specifically, I would like to discover, for planners and environmental experts, what ES related to the SSTEC were considered most valuable.

Hansen et al. (2015) summarized six human-nature relationships closely related to ES: *Benefits* that represent an outcome provided by an urban ecosystem; *dependence*, in which humans are depending on ecosystems (e.g., photosynthesis and fresh water); *interdependence*, where humans and urban ecosystems are closely interrelated and depending on each other (e.g., national park habitats, not just as human experience, but as the sum of the interconnection of all living things that shape the ecosystem); *impact*, representing environmental problems caused by humans (e.g., emissions); *conservation*, where humans have the responsibility to preserve the ecosystem; and *vulnerability*, which describes humans' need to be protected from the environment (e.g., extreme weather conditions).

These six relationships explain how each ES category plays a role in triggering certain planning actions. *Provisioning* services provide the material outputs of ecosystems; *cultural* services cover all the non-material benefits of human contact with ecosystems. Both categories can be consumed or experienced by people, therefore beneficiaries are willing to pay for these services (Boyd & Banzhaf, 2006; Wallace, 2007). *Regulating* services serve humans by providing ecosystem resilience and protecting people from natural hazards and climate change; *supporting* services are intermediate services that are necessary for the other categories of ES to be sustained (Haines-Young & Potschin, 2010). As regulating services and supporting services represents

indirect, long-term benefits humans obtain from nature, they have been undervalued in some cases (Díaz et al., 2011)

These six relationships also help planners to create links between planning goals and ES. In our survey, I used language familiar to planners (e.g., conserve, reduce risks) with planning action examples to introduce the output of the ES. The research questions are: “Would urban planners prioritize certain Ecosystem Services based solely on their immediate benefits, or would they look beyond the immediate benefits to include long-term or intangible benefits?”, and “How does translating ES into planning terminology impact the results?”

The chapter is structured as follows: Section 3.2 describes the methodology; Section 3.3 and 3.4 present the results and discuss their relevance; and Section 3.5 provides the concluding remarks with suggestions for ES study to improve decision-making in urban planning.

3.2 Methodology

3.2.1 Review Planning Documents and Undertake Site Observation

The design of the research began with a small-sample interview survey involving ten municipal planning employees operating at different levels in the planning bureaucracy. Each interviewee was asked to describe their educational background, and if they understood, or had even heard of, ES. Because the targeted subjects were unfamiliar with the ES concept, I translated the original ES into terms that the planners would be familiar with, that were taken from the existing Tianjin Ecocity planning documents, and I provided examples of planning actions that contribute to each ES item.

I then created a list of ES that were mentioned in the current planning bylaws and regulations released during the period 2012-2017 (see Table 4). Some regulations suggest important ecosystem types, locations, and conservation areas within the study area. I also included the environmental regulations that local government has updated. The 14 documents analysed delineate the many ES considered. This was followed with an online survey of 107 planning professionals (see section 3.2.2). Appendix 2 presents which types of ES had already been

considered and determine how broad the overall thematic scope was concerning each ES (findings are in the third column, and policy examples are in the last column).

Table 4 List of all analyzed planning documents

Tianjin/Binhai	Tianjin Ecocity (SSTEC)
Comprehensive planning	
TJ_1 City of Tianjin Comprehensive Plan 2008	**SSTEC_1** Master plan of SSTEC 2008 (original)
TJ_2 Binhai New Area masterplan 2012	**SSTEC_2** Key Performance Indicators 2009
TJ_3 Strategic planning of Tianjin Binhai New Area 2015	**SSTEC_3** District 04 masterplan 2016
Green space/landscape planning	
TJ_4 Tianjin Green space planning 2010, revised in 2016	**SSTEC_4** Landscape guideline SSTEC 2014
TJ_5 Vision a sustainable Tianjin	**SSTEC_5** Eco-community SSTEC 2010, revised in 2015
Environmental/Gray infrastructure planning	
TJ_6 Tianjin Transportation Planning 2010	**SSTEC_6** Vision 2020: Community hubs
TJ_7 Sponge City Tianjin 2012	**SSTEC_7** Sponge City infrastructure planning SSTEC 2015

There are many different ways to categorize ES. In this study, I used Mooney's (2014) ES Evaluation Matrix and the MEA (2005) as references to create an ES checklist with which to review current policies related to the Tianjin Ecocity (see Appendix 2). The policies found in the 14 planning documents were reviewed to pick out the essential issues that planners had identified as being essential components of the ecocity. The rule used to identify local concerns was simple: If an ES, or the benefits drawn from this ES, was mentioned in more than one of the 14 reviewed documents, I considered it to be of local concern.

The combination of Mooney's (2014) ES Evaluation Matrix and MEA (2005) mention 35 ecosystem services. I found policy items that matched only 20 ES and missed 15 ES in the 14 planning documents reviewed (see Appendix 2, missing ES are coloured). This large portion of unaddressed ES indicates that planners have failed to address some important issues.

Our field research was conducted in the core residential area, which was central to the first phase of the Sino-Singapore Tianjin Eco-City (SSTEC) project in Tianjin, China. Figure 9 shows the site I have focused on. Figures 10 and 11 show photographs taken of the site by the author in 2016.

Figure 9 The site map of the Mangrove Bay Subdistrict in 2015

Source: Google map (the red line encloses the studied residential area)

Figure 10 Photos taken from northwest of the site

Figure 11 Photo taken on the Heyun Road

I chose this site because SSTEC started its early real estate development here. Therefore, this is now the most populous area within the SSTEC. I spent a few days walking along the streets, taking buses and taxis, and visiting the community center. During our field research, I wandered around the core residential area to observe the daily-life experiences of the local residents. In addition, I contacted the Ecocity Administration Office to get permission to conduct a survey. With the support of the local officials, I uploaded a survey to my research website, and shared the link under the planning section of the Tianjin Ecocity official website in early 2017. I collected data over six months, during which the online questionnaire was open, and the voluntary participants were able to submit their questionnaire.

3.2.2 The Survey

I conducted a survey with 107 planning-related professionals from Tianjin to examine their perception of ES (see Appendix 3). The purpose of this survey was to explore the potential use of ES tools in planning practices. The researcher created an online survey that was administered through the local planning association website as well as the researchers' blog. Visitors of these websites who responded to the study were given a three-page informative booklet with ES descriptions and examples of how to enhance each ES (see Appendix 4). Respondents comprised urban planners, administrators and researchers who were involved in the planning work for the Tianjin Ecocity project. Many of our subjects knew the SSTEC KPIs but had not necessarily

heard about ES. In order to help them understand ES, I attached a three-page booklet with information from "The Economics of Ecosystems and Biodiversity", or TEEB (2011), translated into Chinese. (Appendix 4 shows the contents of the booklet that was attached to the survey.)

The survey asked for the respondent's age, education level, profession, and general knowledge in sustainability research. After deleting invalid sets of responses (including those that were more than 20% empty), we retained 107 valid submissions (143 submissions in total, 75% response rate). A breakdown of total respondents shows that 72 were urban planners; 8 were environmental scientists; 15 were official administrators; and 12 were community staff and social workers.

In this survey, two questions were asked. The first was: "What ecosystem *services* do you consider important for your living environment?" This was followed by the question: "What *benefits* would you consider important when choosing a neighbourhood?" Both questions provided 20 options, and respondents were allowed to choose multiple answers.

The 20 options of the first question were based on the ES used in literature (see Boyd et al., 2016; Hansen et al., 2015; Brown & Mooney, 2013; La Notte et al., 2017). The 20 options for the second question included benefits that were expressed in terms familiar to planners as planning outcomes. I sourced the planners' terminology from the planning documents I had reviewed. Based on the respondents' answers to these two questions, I created the following hypotheses:

Hypothesis 1: The perception of ES and their benefits are correlated. Hypothesis 1 would be supported in this study if respondents who considered an individual ES to be important to their living environment were more likely to pick the associated benefits as important.

Hypothesis 2: The perception of ES and their benefits are not correlated. Hypothesis 2 would be supported in this study if respondents selected an ES as important but not a correlating benefit, or vice versa.

Table 5 The 20 options of ES and their paired benefits as stated in the survey questionnaire

	Question 1: What **services** do you consider important for your living environment? (Multiple options applied)	Question 2: What **benefits** would you consider important when choosing a neighborhood?
Code	**Options (ES)**	**Options (Benefits with planning action examples)**
1	**Food**: Agriculture, crops, grain/vegetables produced, fishery	More reliable food provision (e.g., Locally-grown food)
2	**Fresh water**: Freshwater, drinking water, water supply, groundwater, water infiltration, water suspension, water storage	Improved water quality and availability (e.g., Maintain the carrying capacity of river channels)
3	**Ornamental plants**: Local plants, invasive plants, all-season greenery, flowers and fruit trees	Access to plants and greenery (e.g., Patio gardening)
4	**Carbon sequestration & storage**: Gas cycles, biomass/soils as carbon sinks	Provide renewed energy (e.g., Recycled heating in buildings)
5	**Hazard regulation**: Noise reduction, stormwater regulation, reducing stormwater runoff, disease control	Reduced disaster risk (e.g., Build rain gardens in neighbourhoods)
6	**Pollution mitigation**: Quality of water, soil, and air	Better quality of air, water and soil (e.g., Remove impurities from air, water and soil)
7	**Local climate & air quality regulation**: Microclimate regulation, mitigating heat island effect, shading, reflecting solar radiation, wind blocking	More resilient to climate change (e.g., Launch "sponge city" projects to reduce the effect of a flood)
8	**Moderate impacts of weather extremes**: Buffering from damage through storms/floods/waves	Reduce the negative consequences of extreme climates (e.g., Emergency preparedness for disasters)
9	**Seasonal drought mitigation**: Alternative water resource	Improve the efficiency of water use (e.g., Rainfall harvesting)
10	**Wastewater treatment**: Filtering wastewater, sewage	Hazardous wastewater removal (e.g., 100% wastewater treated)
11	**Maintenance of soil fertility**: Crop rotations, manure management, compost, soil acidity and liming, fertilizer applications	Sustain plant growth and optimize crop yield while minimizing the environmental impact (e.g., Enrich humus content of soils to allow soils to regenerate quicker)
12	**Preservation and generation of soil**: Erosion prevention, maintaining nutrient content	Cultivating soils in the city (e.g. Build urban farms)
13	**Nutrient cycling**: Biogeochemical cycles, carbon, nitrogen, and oxygen	Regulating the flow of substances in different organisms in forms that are usable to them (e.g., Compost collecting and reuse)
14	**Water cycling**: Stormwater regulation/retention, balancing stormwater peaks, reducing stormwater runoff	Produce potable water (e.g., Water management to reduce water demand, lower construction cost, and minimise future maintenance needs)
15	**Social cohesion**: Trust, a sense of belonging, participation, inclusion, recognition and legitimacy[5]	Strong, socially cohesive community that make one feel safe, secure and supported in social life (e.g., Community events)
16	**Sense of identity**: Identity, spiritual experiences, neighbourhood experience, sense of place, experience in nature	Recognize the resources that makes one feel connected to the community (A physical place such as the community center)
17	**Mental & physical well-being**: Mental and physical health, tranquilizing effects	Cultivate health by having healthy lifestyles options (Provide pedestrian friendly experience)
18	**Recreation**: Outdoor recreation, sports, walking, fishing, gardening	Plenty of dining, shopping and leisure choices
19	**Tourism**: Tourism sights	Places to spend quality time for visits
20	**Aesthetic & spiritual sensibility**: Aesthetic appreciation, cultural sensibility, art and design	Therapeutic, feeling connected and calm (Access to historical heritage sites)

Note: Subjects of this survey did not receive any extensive training on ecological knowledge.

[5] http://www.unesco.org/most/besseng.htm

3.3 Results

3.3.1 Profile of Respondents

The data consisted of 107 respondents recruited online. Background questions included age, education, and profession. The results show that the subjects are highly educated (103 were degree holders) young professionals (98 out of 107 are between 25 to 44 years old). Most subjects had been involved in the planning and management of Tianjin Ecocity projects. Respondents included urban planners (72/107), environmental researchers (8/107), administrators (15/107), and community staff (12/107).

3.3.2 Perceived Significant Individual Ecosystem Services

Figure 12 The options checked off from the two survey questions

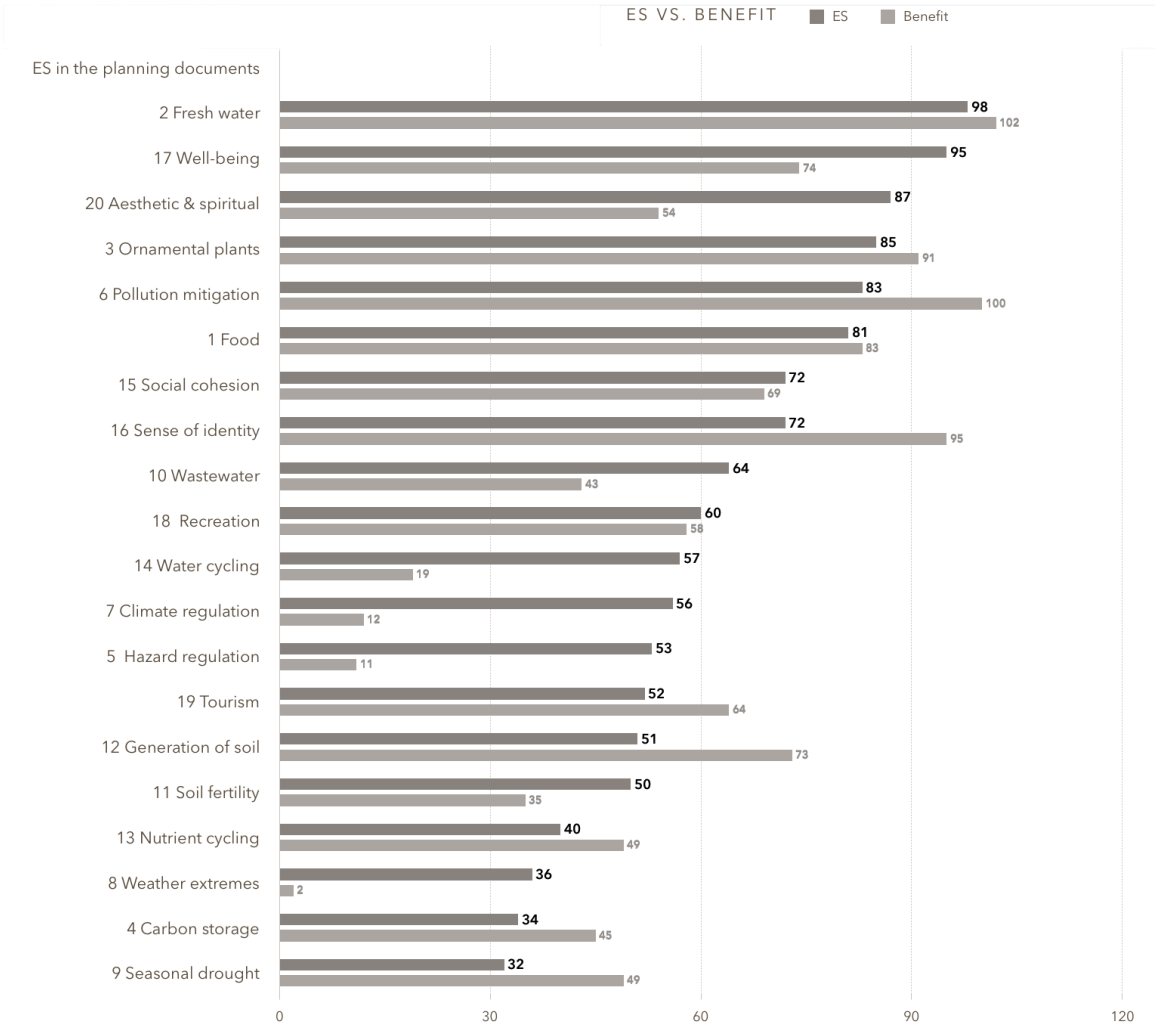


Figure 12 and Table 6 shows the result of the options checked off from the two survey questions. *Provisioning services* and some *cultural services* were rated significantly higher by planners than regulating or supporting ES. Unexpectedly, the ES of carbon sequestration was rated extremely low even though the planning documents of the Tianjin Ecocity listed cutting carbon emissions as an essential planning goal.

Table 6 Number of respondents that selected each item

ES Category	ES items	Number of subjects that chose this ES (and %)	Number of subjects that chose this benefit (and %)
Provisioning Services	Food	81 (75.70%)	83 (77.57%)
	Fresh water	98 (91.59%)	102 (95.33%)
	Ornamental plants	85 (79.44%)	91 (85.05%)
Regulating Services	Carbon sequestration & storage	34 (31.78%)	45 (42.05%)
	Hazard regulation	53 (49.53%)	11 (10.28%)
	Pollution mitigation	83 (77.57%)	100 (93.45%)
	Local climate & air quality regulation	56 (52.34%)	12 (11.21%)
	Moderate impacts of weather extremes	36 (33.64%)	2 (1.87%)
	Seasonal drought mitigation	32 (29.90%)	49 (45.79%)
	Wastewater treatment	64 (59.81%)	43 (40.19%)
	Maintenance of soil fertility	50 (46.73%)	35 (32.71%)
Supporting Services	Preservation and generation of soil	51 (47.66%)	73 (68.22%)
	Nutrient cycling	40 (37.38%)	49 (45.79%)
	Water cycling	57 (53.27%)	19 (17.76%)
Cultural Services	Social cohesion	72 (67.29%)	69 (64.49%)
	Sense of identity	72 (67.29%)	95 ((88.79%)
	Mental & physical well-being	95 (88.79%)	74 (69.16%)
	Recreation	60 (56.07%)	58 (54.21%)
	Tourism	52 (48.60%)	64 (59.81%)
	Aesthetic & spiritual sensibility	87 (81.31%)	54 (50.47%)

Note: The top-rated ES items were fresh water, aesthetic & spiritual sensibility, ornamental plants, well-being, pollution mitigation, and food.

3.3.3 Correlation Analysis between ES and Benefits

A correlation analysis was run to assess the 20 ES options and their paired benefits. For the two to be considered as correlated, the respondent had to check both the ES and the planning action or goal supported by that ES. I then divided the number of correlated answers by the number of subjects that chose the ES. The result is shown in the fourth to last column in Table 7. I refer to the resulting correlation as high when the result is .75 or higher, moderate when the result is .5 to .74, and low when the result is below .5. The results show that a total of 5 items are highly correlated, 7 items are moderately correlated, and 8 items are poorly correlated.

I found a high correlation between ES and the associated benefits for all the items under the *provisioning* services, and a moderate correlation between ES and the benefits for all ES in the *cultural* services (except number 16, sense of identity). Items under the *regulating* services and *supporting* services had, in general, lower degrees of correlation (except number 6, pollution mitigation).

Table 7 Correlation analysis

ES categories		ES	Number of subjects that chose this benefit	Number of subjects that chose this ES	Number of correlated answers	Correlated/ Benefit	Correlated/ ES	Correlation level
Provisioning services	1	Food	83	81	66	0.80	0.81	High
	2	Fresh water	102	98	93	0.91	0.95	High
	3	Ornamental plants	91	85	77	0.85	0.91	High
Regulating services	4	Carbon sequestration & storage	45	34	22	0.49	0.645	Moderate
	5	Hazard regulation	11	53	8	0.73	0.15	Low
	6	Pollution mitigation	100	83	80	0.8	0.96	High
	7	Local climate & air quality regulation	12	56	8	0.67	0.14	Low
	8	Moderate impacts of weather extremes	2	36	2	1	0.06	Low
	9	Seasonal drought mitigation	49	32	17	0.35	0.53	Moderate
	10	Wastewater treatment	43	64	30	0.70	0.47	Low
	11	Maintenance of soil fertility	35	50	17	0.49	0.34	Low
Supporting services	12	Preservation and generation of soil	73	51	23	0.32	0.45	Low
	13	Nutrient cycling	49	40	16	0.33	0.40	Low
	14	Water cycling	19	57	13	0.68	0.23	Low
Cultural services	15	Social cohesion	69	72	49	0.71	0.68	Moderate
	16	Sense of identity	95	72	60	0.63	0.83	High
	17	Mental & physical well-being	74	95	65	0.88	0.68	Moderate
	18	Recreation	58	60	41	0.71	0.68	Moderate
	19	Tourism	64	52	32	0.50	0.62	Moderate
	20	Aesthetic & spiritual sensibility	54	87	43	0.80	0.50	Moderate

3.3.4 Results (Not) Supporting the Hypotheses

I considered that ES would be useful, to better address environmental concerns in planning, if planners were able to link ES terminology with the tasks and outcomes drawn from the planning practice. One way to prove this would be to compare the respondents' answers of the two questions. In question 1, all the options were the 20 ES with descriptors (see Table 7). In this way, even though the respondents may not have been familiar with the original ES terms, they could get a hint from the descriptors. In question 2, I let respondents choose from the related options using translated terms (planners' terminology). The correlation analysis found no

consistent correlation pattern shown in the subjects' answer. Of the 20 ES mentioned in the survey, 5 were shown to have a high correlation between the selected ES and the paired benefits, 7 were moderately correlated, while 8 had a low correlation with the benefits. All eight items with a low correlation are regulating and supporting services. Hypothesis 1 (that respondents would understand the relation between ES and their benefits) was supported in some cases. Likewise, hypothesis 2 (that there would not be a correlation between ES and the paired benefits) was partially supported.

3.4 Discussion

3.4.1 What does the ES Mean to Planners?

In this study, I used the information booklet and the survey to introduce ES to urban planners (see Appendix 4). The study is not limited to a scientific purpose, but has some relevance to management and policy. As a small-sample survey, the study focused on the identification of a better planning tool to address local concerns in ecocity planning. I did not make further group comparisons relating to the demographic information (the respondent's age, education level, profession, and residence). I collected such information only to control the target subjects.

Our method of introducing ES entailed asking the respondents which services they considered important. This phrasing emphasized the supply-demand relationship between natural and human values. This process clarified the respondents' concerns, which, in turn, highlighted certain ES. The analysis of respondents' answers regarding their perception of the significance of ES helped me to identify what areas the Tianjin Ecocity's planning community focus on. However, such an analysis does not explain what the ES mean to the respondents. Here are a few clues to explain the results:

- **The planners saw a direct connection between the environmental problem and an ES because of their related terminology.** For example, respondents may select the ES item "Pollution mitigation" without knowing the specific ES, because they see it as a response to the problem of pollution appearing frequently in newspaper headlines.

- **ES are related to both the personal and professional concerns of the respondents.** Certain ES may have represented policy options that were also closely related to the local inhabitant's

quality of life. For the Singaporean and Chinese partnership, finding solutions to the current environmental challenges facing SSTEC and thereby achieving and sustaining a clean and green environment is crucial to the project's success. Fourteen out of 22 quantitative KPIs for SSTEC are environment-related (Baeumler et al., 2009). Since many respondents were familiar with the KPIs, they might prioritize ES that are related to the KPIs. The respondents who are governmental employees may have also given priority a service that is closely related to their work.

- **Some ES may be undervalued due to a lack of ecological knowledge or a focus on immediate benefit.** As previous studies have found, *supporting* and *regulating* services have been frequently underrated in planning decision-making processes (Díaz et al., 2011). A large number of respondents prioritized ES that simply match existing policies. This leads us to believe that a lack of ecological knowledge could be a barrier for urban planners to more fully manage ecosystem and human welfare by incorporating a broader range of ES into ecocity planning.

3.4.2 Applications and Limitations

This study takes an experimental approach to introducing ES to urban planners, by addressing their concerns about the Tianjin Ecocity ecosystem. Our study showed the disadvantages of not linking ES to planning i.e. that many potential ecosystem benefits are overlooked in the planning process.

- **Reviewing current policy using ES helps planners to identify achievements and missing issues of ecosystem management and/or planning.** ES is a process that facilitates the co-production and active sharing of knowledge. Ecosystem management is a complex process dealing with ecosystem structures, ecosystem functions and processes, and the consequential benefits and ES. Introducing ES into the planning process means bringing in a range of knowledge related to ecosystem management, while simultaneously meeting the socioeconomic, political and cultural needs of current and future generations. By participating in the study, planners were exposed to a range of services and benefits drawn from ecosystems (i.e., the informative booklet about ES, the ES descriptors within the survey options, and examples of possible planning actions that can be taken). These resources were intended to help planners focus attention on how their work contributes to different ES.

- **Tianjin is seeking planning solutions that are linked to specific outcomes**. For the Singaporean and Chinese partnership, finding solutions to the current environmental challenges facing SSTEC and thereby achieving and sustaining a clean and green environment was considered to be crucial to the project's success. ES are a tool that planners can use to communicate certain (ecological and environmental) values and concerns of the local community within the planning process. An ecosystem usually contributes to multiple ES and multiple benefits (Voß & Bornemann, 2011). Incorporating an awareness of ES into planning can also connect multiple ES to the benefits drawn from a specific planning action. For example, wetland restoration can increase a range of outputs, including tourism, clean water, carbon sequestration, seasonal drought mitigation and biodiversity.

- **Raising awareness of unaddressed environmental goals in the current practice of ecocities.** The selection of ES for inclusion in this survey was based on a review of Tianjin's environmental documents and the SSTEC project itself. The resultant list of ES, therefore, reflects local concerns. I have found a total of fifteen ES to be missing. These unaddressed ES are ones that future policy making should address in planning policies, as well as ecosystem management.

This study has a few notable limitations:
First, since our survey questionnaire options were based on a review of current policies, a large portion of ES items were not addressed. Future ES research should consider introducing the full range of ES options to planners.

Second, correlation analysis fails to inform us about whether planners know how planning actions can contribute to ES. Urban ecosystems generate multiple ES and benefits (e.g., urban farms produce food, and contribute to soil fertility, individual well-being, and social cohesion). Without some training in ES, planners are unable to know all the ES and benefits drawn from such policy alternatives as urban farming.

Thirdly, I did not analyse how the terminology used in the study might have affected the respondents' answers. In this study, the pairing of ES and their related benefits was undertaken by the researcher and the options under the description were created from the current planning policies that were reviewed. Therefore, it may not be a good match to the relating ES at all. This

fault might create a problem for the respondents to learn the ES-benefit relation, and even worse, cause my correlation result incorrect. In order to understand if the terminology used in the study might have confused the respondents, further study needs to investigate the descriptions of ES given to respondents.

3.4.3 What are the SSTEC's Environmental Achievements?

Among Chinese ecocities, SSTEC is commonly considered to be a successful example but what has the Tianjin Ecocity achieved over the past decade?

During our field research, I visited the Exhibition Center, which showcases the achievements of the SSTEC project to date. After completing a review of scientific reports, observation notes, corporate documents and literature, I offer the following findings:

- **Green building**: By 2015, the performance of green housing had reached the relevant KPI—all buildings within SSTEC built after 2008 met the National Green Building Standard.

- **Public green spaces**: Many of the officials and planners I interviewed claimed that public green spaces were one of the most visible achievements that SSTEC had made (i.e., urban parks, per capita green spaces within residential communities). The high standard of green spaces is being used in the marketing of residential units to homebuyers. Some communities have become concerned about the ongoing burden of the maintenance and upkeep of these landscapes.

- **Water quality and quantity**: Current indicators have focused on quality rather than quantity.[6] In terms of improvements, most of the SSTEC documents and reports direct readers to note the construction of the Water Treatment Center, without clearly stating whether the water management system meets the requirements of future development.

- **Community activities**: Active community living is part of the SSTEC propaganda, and has been implemented in detailed plans in community management. Residents have access to plenty of sports and exercise programs, social events, art activities and seminars in the Community Center to help them develop hobbies.

[6] There are three KPIs that are water-related. KPI 2 specifies the goal that water bodies within the SSTEC should be applicable for industrial water supply and recreational waters, so long as there is no direct human contact with the water (World Bank, 2006). KPI 3 stipulates that tap water should be potable. KPI 11 refers to domestic water consumption.

- **Public transit:** Local residents of SSTEC can ride the buses for free. However, a large number of residents still drive to work, due to insufficient bus services. Data from online ticket booking programs suggest that there has been an increase in the number of riders for the extended subway lines and train networks coming into the SSTEC. Private cars still dominate the intercity and local commutes (source: an SSTEC Administration policy analysis report).

- **Industrial impact**: The energy efficiency of local industry has significantly improved. However, the way this improvement has been achieved is problematic. Hundreds of factories that did not meet China's Energy Efficiency Standards were either forced to close or move to a different location. A list of SSTEC's newly launched companies indicates that these companies are predominantly high-tech (e.g., biotech, animation, Internet) and cultural companies. There is little evidence that existing industries have improved their environmental performance/impact since moving into the SSTEC.

- **Neighborhood systems**: Environmental advances can be seen in terms of sustainable urban design. China expects to benefit from Singapore's extensive knowledge and experience in integrated urban planning and resource management. The current hierarchical model of urban communities is based on the Singaporean neighborhood model.[7] However, such a model has only been implemented in a few locations. Most neighborhoods are no different from other Chinese cities.

Many of what the government has posted as "achievements" on the SSTEC official website reflect an eagerness for continued investments, to support further housing projects and the building of infrastructure. Environmental protection is not a high priority. For example, the water shortage problem within the municipality not only has not gained much attention—it has rendered industrial production liable to interruptions and seasonal suspensions. Caprotti et al. (2015) argue that ecocity development has focused exclusively on ecological benefits for inhabitants, at the cost of ecological benefits for the broader socio-environmental landscape. The above list of "environmental achievements" supports their view.

To improve planning practice, I suggest that ecocities should give priority to holistic strategies, formulated within a sustainability framework, rather than focusing on short-term individual

[7] The original Master Plan of the SSTEC followed a hierarchical model of neighborhood system: Eco-cell, eco-neighborhood, and eco-district. Each eco-cell is a human-centric 400m by 400m module. The eco-cells are designed to maximize accessibility and efficiency, with basic amenities located within the cell. Four eco-cells make an eco-neighborhood, and several of these together in turn form an eco-district.

outputs. The results of this study suggest that the respondents have given little or no consideration to soil fertility, nutrition cycling, and solutions for dealing with seasonal droughts. In long term, this may cause environmental degradation in the SSTEC, habitat loss and or failure of provisioning and regulating ES.

3.4.4 Green Infrastructure for Ecosystem Services

Tianjin has well-designed parks that exemplify the natural process of plant adaption. For example, Tianjin Qiaoyuan Wetland Park provides a range of ES including stormwater purification, soil pollution remediation, aesthetic values, wildlife habitat, and native plant diversity. However, I found that planners were not able to identify green infrastructure components that supported ES. A more detailed understanding and measurement of the ES provided by green infrastructure is needed.

Different types of green infrastructure deliver a range of ES. For example, vegetation and soils within a rain garden can handle flood and drought by facilitating groundwater recharge. Bioswales can increase infiltration and pollutants removal and parks can support biodiversity and cultural ES. These green infrastructure/ES relationships are summarized in Table 8, after Brown and Mooney 2013.

In addition, there are a number of tools that have been developed to quantitatively measure the ES that might be derived from green infrastructure: Co$ting Nature and VELMA (Visualizing Ecosystems for Land Management Assessment Model) can analyse ES with natural capital accounting, so as to help green infrastructure implementation decisions for ecosystem management. EPA's National Stormwater Calculator, National Green Values Calculator are designed for more broad users to evaluate performance of urban stormwater, therefore to reduce runoff from a specific site. Future research may incorporate the quantitative tools to measure not only the presence or absence but also amount if the different ES being planned for.

Table 8 Biodiversity and ES Derived from a given type of Green Infrastructure (GI)

Type of GI	Case Study	Relative increase or Proportion		
		High	**Medium**	**Low**
Wetlands (region)	**Beijing Urban Wetland Planning** Beijing, China **Columbia, Missouri Treatment Wetlands** Missouri, U.S.A. (Kadlec et al., 2010)	• Fresh water • Carbon sequestration & storage • Water pollution mitigation • Reduced flooding • Wastewater treatment Water cycling • Sense of identity	• Local climate & air quality regulation • Nutrient cycling • Recreation	-
Wetlands (city-scale)	**Tianjin Qiaoyuan Municipal Park** Tianjin, China	• Increased genetic diversity • Carbon sequestration • Wastewater treatment • Water cycling • Sense of identity • Mental & physical wellbeing • Recreation • Aesthetic appreciation	• Noise reduction	-
Riparian Corridors	**Rock Creek and Ignacio Creek stream restoration** Southwestern Colorado, U.S.A.	• Water pollution mitigation • Reduced erosion	• Biodiversity • Habitat for native species • Reduction in landslide potential • Preservation and generation of soils	• Carbon sequestration & storage • Primary productivity • Water cycling
Parks	**Southeast False Creek Community** Vancouver, Canada **Masdar City Urban Planning** Abu Dhabi, United Arab Emirates (Gret-Regamey et.al., 2013)	• Habitat for native species • Fresh water • Seasonal drought mitigation • Mental & physical wellbeing • Recreation • Aesthetic appreciation	• Carbon sequestration & storage • Water pollution mitigation • Local climate & air quality regulation • Pollination • Social cohesion • Tourism	• Food • Raw materials • Fresh water • Air pollution mitigation • Primary productivity • Habitat for native species
Bioswales (restorative)	**Phytoremediation of a pond contaminated by the Chernobyl nuclear disaster** Chernobyl, Ukraine	• Pollution mitigation (water) • Mental & physical wellbeing	• Pollution mitigation (soil) • Reduced erosion	• Habitat for native species
Bioswales (garden)	**Alex Wilson Community Garden** U.S.A.	• Food • Mental & physical wellbeing	• Habitat for native species • Water cycling	• Carbon sequestration & storage • Local climate & air quality regulation • Pollination • Noise reduction • Primary productivity
Rain garden	**Fisherman's Wharf Park and Rain Garden** Victoria, British Columbia, Canada	• Flood control • Seasonal drought mitigation • Fresh water	• Biodiversity • Carbon sequestration & storage • Pollution mitigation (air+ water) • Social cohesion • Mental & physical wellbeing • Recreation	• Local climate & air quality regulation • Primary productivity • Tourism
Green roof	**Gary Comer Youth Center** Chicago, U.S.A 8,160 sq ft	• Food • Mental & physical wellbeing • Reduced flooding	• Carbon sequestration & storage • Local climate & air quality regulation	• Habitat for native species • Water cycling • Carbon sequestration & storage

3.5 Conclusions

The provision of ES is intended to increase human benefits. This study investigated the merits of a survey tool that introduced the concept of ES to urban planners. The tool is comprised of, the selection of ES discovered in the review of current planning documents (see Appendix 2); and secondly the statements of the benefits of the ecosystem service paired with policy statement as found in the two-question survey (see Table 5). This approach helped planners to be aware of how planning interacts with ecosystem management, in terms of scope and outputs. Raising awareness of unaddressed ES is important, because the incorporation of pertinent ES at an early stage will increase the likelihood of achieving ecocity goals. It is dangerous to pursue certain values without understanding the consequences in a broad context.

I hypothesized that ES would be a good tool to help increase planners' awareness of how ecosystem management and human welfare relate to each other. If a large number of respondents prioritize ES/benefits that merely match existing policies, this might indicate a lack of ecological knowledge. This leads me to believe that a lack of such knowledge is an impediment for urban planners. The data analysis drawn from this survey study suggests respondents prioritize ES that match the benefits found in the existing ecocity indicators. The findings of this study also support Díaz et al. (2011) that regulating and supporting ES are undervalued ES by planners.

For future research, input from environmental experts is required to enable planners to identify and address the missing ES. These unaddressed ES require further research pertaining to the question: "Can linking ES to planning actions help to focus attention on those low-rated or missing ES items?" Further research should investigate which strategies would help planners to identify overlooked ES, and pay more attention to those ES. The analysis of the role of ES in urban planning should relate to questions of content (what is defined and measured) and process, in terms of methodologies, interest group involvement, and the resulting policy functions.

Chapter 4. A survey of the public's perceptions of community building in Tianjin, China

4.1 Introduction

This study draws from the socio-psychology literature on communities as it relates to place attachment and community planning. Typically, the literature on place attachment focuses on the feelings and experiences of residents, which have not been fully addressed in planning practice. Conversely, the literature on planning practices emphasizes participation and empowerment but overlooks the emotional connections to place (Manzo & Perkins, 2006; Sanoff, 2000). To close this gap, this study addresses the theory of place attachment from both the socio-psychological and urban planning perspectives. By investigating the Chinese experience, this paper takes a more holistic view of how such relationships influence the experience of place and the success of communities.

This paper presents a survey study conducted in Tianjin, China, to addresses the following questions:

(1) What is the relationship between community satisfaction and community engagement in China?
(2) What demographic characteristics do the Chinese local leaders, or those who are actively engaged in their community, have in common?

Place attachment fosters sense of community because long-term residency leads to development of neighborhood social networks. This relationship between length of residency and the formation of community social network is reported in western literature but was also found in this study (see conclusions). Historically, the sense of community for Chinese people is based on a patrilineal kinship network, where extended families live in close proximity, and care for each other in times of need (Xu, Perkins, & Chow. 2010). Chinese society provides individuals who bond to the community with a sense of security and order (Yan & Gao, 2007). Under the socialist regime of 1949-1976, urban residents were restricted to geographically-based communities. These new communities were constructed by the means of employeeship and the associated welfare system (Xu & Chow, 2006). The integration of work, residence, and social facilities during the Maoist socialist regime resulted in intensive community involvement and

strong social cohesion among residents (Hazelzet & Wissink, 2012; Li, 1993). In the 1980s, when housing reform created a mixed ownership housing system, this situation gradually changed. Massive labor migration and a growing middle-class also triggered a better standard of living (He & Wu, 2007; Wang, 2012). Home ownership dominated the market throughout China, and it underpinned the rationale that social and community service programs should be carried out in the community by community members, and with community input (Guan, 2000; Guan & Chow, 2003).

At the beginning of the 21st century, the Ministry of Housing and Urban-Rural Development (MOHURD) of China began promoting the Community Building Campaign (CBC), in which each municipality developed its own plan or agenda, aiming to empower the community as a whole and community members to get involved in their neighborhood (Zhu, 2015). To achieve such a goal, it is important to understand how the psychological sense of community and neighborly relations relate to each other, and how their respective characteristics are to be measured.

In the West, public participation is considered to be a necessity of good governance. Public participation enables the achievement of desired community or societal outcomes, such as the government's trust in citizens and government legitimacy (Cooper, Bryer, & Meek, 2006). An increasing number of American cities experimented with citizen-centered collaborative public management in the 1990s. Local residents of these cities were encouraged to participate in their communities, both politically and socially (Barry, Portney & Thomson, 1993). In the context of Western democracy, community participation can include joining voluntary associations and civic engagement (e.g., attending community meetings and exercising voting privileges), informal neighbor-to-neighbor interactions, or all of the above (Stone, Dwyer & Sethi, 1996). High voting rates and an increasing number of community organizations are considered indicators for community building or strong community engagement. However, it would be incorrect to apply the Western concept of community and community participation in China (Xu et al., 2010; Zhu, 2015). To begin with, voters in China participate passively. Due to censorship, Chinese people do not gain membership within the context of politics or religion through voluntary processes. "Membership" and "voting" behavior, therefore, do not indicate that Chinese people are actively involved in their communal affairs or that they participate in their society. Many Chinese people build strong ties to their communities simply by knowing and helping their neighbors (i.e., through social interaction), rather than through formal affiliations or

by exercising voting privileges (Xu et al., 2010). Given this situation, some scholars argue that the people of China may gain influence through social connections in their community rather than through political activities (Yip et al., 2007). In this study, we acknowledge the limitations of using the Western perspective to study Chinese communities, and have developed a method to address the gap in this measurement.

Section 4.2 outlines the key concepts of social capital, neighborly relations, community participation, and place attachment, and describes how these concepts are related to community building in the Chinese context. Section 4.3 introduces the context of this survey study, its design, the data generated, and the analytic approach. Section 4.4 presents the findings. Section 4.5 discusses the implications of the survey, and is followed by the Conclusion section.

4.2 Literature Review

This section of the chapter outlines key concepts drawn from community psychology and community planning. We then discuss how community participation in the Chinese context can be studied in the planning of neighborhoods.

4.2.1 Social Capital and its Measurement

Community psychologists have developed a rich understanding of the psychological dimensions of people's interactions with community (Greenfield & Reyes, 2015; Nasar & David, 1995). Scholars generally agree that the proximity of neighbors contributes to community efficacy and trust among its members, which helps local authorities to better mobilize resources for the renewal and improvement of their respective communities (Larsen et al., 2004; Unger & Wandersman, 1985). In this context, the proximity of neighbors indicates stronger social ties (Perkins et al., 1996; Perkins & Long, 2002).

The concept of *social capital* is predominantly associated with behavior, and emphasizes observable interpersonal interactions and impact (Häuberer, 2011). According to the norm of social capital proposed by Narayan-Parker (1999), social capital is an individual's capacity to secure benefits resulting from social engagement. Comparison studies of low-income communities in various countries indicate that those who actively interact with their neighbors usually have better access to social and welfare support (see Xu et al., 2010; Yamamura, 2010).

This observation matches the sociology literature regarding individual health and social exclusion (see Stanley et al., 2012; Garoon et al., 2016; Lin, Ye & Ensel, 1999; Greenfield & Reyes 2015; Tomaka, Thompson, & Palacios, 2006). Researchers report that people who are isolated and alienated from their community are likely to withdraw from political participation, and are less likely to gain benefits from community services. Conversely, people who frequently participate in organized social groups (e.g., community sports clubs, volunteer groups), socialize with neighbors, or engage in other neighborly behaviors, are considered to have high individual social capital, and benefit more from community services.

Compared to the west, social capital in China refers to the establishment of social ties that emphasize informal rather than formal relationships, self-interest rather than the collective common-good, and economic rather than social, psychological or political well-being (Bian, 2001). In his nation-wide survey of the social mobility of individuals, Wei (2010) found that migrant workers who had actively interacted with their coworkers were more likely to receive training opportunities and had a smaller wage gap compared to local employees, than those who did not. This suggests that social capital which aligns with the values of traditional, kinship-oriented communities also benefits the emerging diversity of newcomers.

Scholars have long been interested in understanding the determinants of the psychological construct of social capital. Earlier social capital research tended to use individuals' demographics (i.e., gender, age, income, residential stability), while research in recent years has relied heavily on the use of self-report surveys, with a focus on the quality of one's social relations (i.e., size, frequency, and intensity of social contacts) (Lin, Cook, & Burt, 2001). This shift from individual-level determinants to social determinants indicates a change in practical implications relating to social capital. In those studies, researchers code the participants' answers into measurable variables, to understand the dynamics between a neighborhood and its interpersonal relationships (Buckner, 1988). Frequently used variables include sense of community, community efficacy, neighborly relations, and community participation.

Sense of community refers to the quality of neighborhood bonds, a sense of belonging, mutual influence, and place meaning. Sense of community emphasizes the collective beliefs and expectations among neighbors (Hughey & Speer, 2002; McMillian & Chavis, 1986). Here, "place" is a meaning-oriented concept. A communal place (e.g., a post office, coffee shop, or a school in a neighborhood) is one that arouses nostalgic sentiments from community members,

based on their interpretation of its physical setting (Shumaker & Taylor, 1983; Stedman, 2003; Vanclay, 2008). Nostalgia is a key element in fostering a sense of community. Community members find meaning in their lives through their sense of belonging and acceptance, thereby establishing a connection between their past and present (Sedikides & Wildschut, 2018). In fast-changing physical environments, individuals may feel disconnected from the place where they grew up. A typical example is the disappearing Hutongs[8] in Beijing. During the past three decades, as China underwent urban development, old neighborhoods and streets were demolished. The growing mobility of urban populations has a weakened "sense of community" and lessened community participation (Li et al., 2008). The residents have lost their sense of place, and home has become nothing more than an address.

Community efficacy is the most important community predictor of physical and social disorder in neighborhoods (Cohen et al., 2008). Kingston et al. (1999) and Long & Perkins (2003) define it as collective action and feelings of community control; however Sampson, Raudenbush, and Earls (1997) argue that collective efficacy consists of both informal social control and neighborly mutual trust. Both groups of scholars agree that with strong efficacy residents are more likely to take active part in community decision-making (Ohmer, 2007). The argument is embedded in a broader debate that mutual trust and help, and neighborly shared norms are likely to motivate community actors to achieve the common good (Putnam, 2000; Morenoff, Samposon & Raudenbush, 2001).

Neighboring (or neighborly behavior) refers to interactions or closeness between neighbors, and uses different scales to distinguish casual social contact from friendship-oriented interactions (Perkins & Long, 2002; Woldoff, 2002). Positive neighboring indicates stronger social ties (Perkins et al., 1996; Perkins & Long, 2002). There is a lack of research that examines how the gated neighborhoods influence neighborly relations, and how China's community experience has been shaped within the commodity housing neighborhood (Lu, Zhang, & Wu, 2018).

[8] Hutongs are a type of narrow street or alley, commonly associated with northern Chinese cities. Hutongs are considered to be the source of the socio-cultural identity of Beijingers. When the Forbidden City (a palace complex) was built as the imperial palace in Beijing in the early 15th century, the hutongs surrounded the palace (high-ranking officials and wealthy merchants wanted to live closer to the Inner City, while aristocrats lived to the east and west of the imperial palace). Some hutongs are named after a profession, and for generations, their residents have made a living by serving imperial families. Even today, there are still commoners, merchants, and laborers who depend on hutongs to make a living, providing services for their neighbors and tourists who are curious about life in a modern-day hutong.

Community participation is the local population's voluntary involvement in community political or social affairs (Sanoff, 2000). McMillian & Chavis (1986) indicate that community participation is a predictor of community solidarity, political mobilization, and local organization. Scholars use the term *community participation* and *citizen participation* interchangeably in the literature. These concepts may differ, and sometimes the boundary between them is fluid. For example, some authors refer to "participation" as a political act rather than as a social one, while other authors focus on the frequency of participation, without distinguishing whether it was political or social (see Ohmer, 2007).

How do the psychological constructs described above relate to community building in the Chinese context? The scholarly study of "community" and Chinese "community building" have a common purpose, which is to improve the quality of people's life. Empirical studies on neighborhood satisfaction in China suggest that demographic characteristics used to define vulnerable groups (i.e., women, children, the elderly, minorities, and the disabled) do not correlate to one's gains in community life (Yan & Gao, 2007; Zhang, 2007). A cross-geographic and repeated display of harmonious neighborly relations are much more crucial than demographics in creating friendship bonds, social capital, increasing social inclusion, and eventually enhancing neighborhood satisfaction (Hipp, 2009). Some scholars think the disappearance of traditional spaces is causing individuals to feel a weakened "sense of community" or belonging to their cultural identity (i.e., the sense of being a Chinese, or belonging to a particular locality).

Against the backdrop of China's fast-paced urbanization and dramatic changes in the physical urban environment, a "sense of virtual community" is emerging. Internet users find themselves motivated to communicate and collaborate in a virtual community. Studies show that these members contribute to the community without expectation of return or reciprocation (see Ye, Feng & Choi, 2015). An example of the Chinese "sense of virtual community" is through social media, such as Wechat and Sina Weibo, to protect the housing rights shared by homeowners. The social-relational antecedents of citizenship behavior are explored through an examination of how the member's general attitude and desire for relationship building and maintenance (including attachment motivation, social support orientation, and disposition to trust) influence their trusting beliefs and citizenship knowledge-sharing behavior (Xu, Li & Shao, 2011).

4.2.2 Brief History of Chinese Transformation of Urban Community

Table 9 The transition of China's urban communities from 1912 to 2018

Period	Provision of Housing	Provision of Community Services	"Sense of Community"	Typical problems
Before the Chinese Communist Revolution: Patriarchal familial tradition				
1912-1949	Private housing ownership dominated	Local institutionalized welfare services system + state welfare programs	Community is based on a patrilineal kinship network.	Shortage and overcrowding; unclear property rights during wartime
Maoist "socialist regime": Housing as a welfare provision and service				
1949-1956	Gradual change from private rental housing to public rental housing	Confiscation from1949-1950; rent control in the private sector	Nationalization	Shortage and overcrowding; inefficient use of land
1956-1976	Public housing ownership dominated	Work Unit for the employed and state welfare for the non-employed	Urban residents felt a sense of belonging to their Work Unit	Lack of investment in housing; unequal distribution between cadres and workers
Neo-liberal "capitalist revolution": Moving towards privatization				
1977-1998	Implementation of hybrid housing through gradual privatization	Work Unit and state welfare	Work Unit served as the home community for many urban residents	Inequalities: 1 million migrant workers were excluded from social/welfare services
1992-1998	Comprehensive implementation of privatization in all urban areas	Residents' Committee + property management company + Homeowners' Association	Gated communities with exclusive services (e.g. schools, club memberships) form a new social identity for individuals	Controlled access and gated communities; strong private property rights (complicated by state ownership of land)
1998-2007	Deep marketization: commodity housing 15%, affordable housing 70%, social rental housing 15%	Same as above, except more services were provided by local communities in some cases	HOA empowerment-support for home ownership for middle-and-high income families	Price inflation; land shortage and environmental costs; Strengthened private property rights
2008-	Recurrence of public housing provision	Emergence of NGOs; increase in variety of service providers (not limited to public funds)	Increasing number of self-organized community groups	Many properties sold but some were unoccupied; social segregation; increasing income gap

* Note: The subdistrict is the smallest political administrative unit in urban China. A typical subdistrict may consist of several neighborhoods, comprising of a population between 3,000 and 16,000 people. The operation and maintenance of an urban neighborhood includes: (1) a professional property management company (PMC); (2) the owner-elected Homeowners' Association (HOA); and (3) the Residents' Committee (RC) – to supervise neighborhood activities (Bray, 2006).

Many studies have documented the changes in China's culture, politics, and economy due to the urbanization that followed the Chinese Revolution of 1949 (Fleischer, 2010; Friedmann, 2005). However, the foundation of self-governing urban life has long existed for the Chinese. Table 6 outlines a brief history of China's urban communities in transition.

4.2.2.1 Before the Revolution (1912-1949)

Before the Chinese Revolution, most urban and rural Chinese had a very low standard of living (e.g., 3m^2/person per dwelling). "Historically, sociopolitical control in China was … organized with natural communal and intimate groups, notably with the family and the clan system." (Liu 2006, P.133) During warfare, local elites played a key role in strengthening community solidarity by supporting local charities to help the urban poor. Historian William Rowe (1989) observed the remarkable public welfare system that emerged in Hankow during the 19th century, when the city experienced a rising rate of urbanization. In the early 18th century, Hankow implemented local institutionalized welfare services that supplanted state welfare facilities. These local charities provided social initiatives for orphaned children, care for the homeless, an urban militia, firefighting, and other public services. The Hankow study supports the well-accepted observation that the delivery of community-based services, charity, and resident-initiated activities contribute to community efficacy and trust among its members (Narayan-Parker, 1999).

4.2.2.2 Maoist "Socialist Regime" (1949-1976)

Under the Maoist regime, public housing was a product of socialist public ownership. From 1949 to 1953, the government appropriated most properties from the private sector and converted them into public rental housing. These subsidized properties were assigned to cadres, mostly communist party members, who ran the state-owned enterprises. The Work Unit, a form of social organization that linked the workplace to housing, provided health care and other social welfare services to employees. From the 1950s to 1970s, a new sense of community and identity emerged, as well as financial and social protection for many urban residents who lived and worked in the same neighborhood. The Work Unit also handled conflict resolution and requests for community improvement.

4.2.2.3 Neo-liberal "Capitalist Revolution" (1977-2018)

Market reforms in the 1980s brought tremendous transformation to China's urban landscape and community governance. A series of housing policies were initiated to increase home ownership. For example, the Chinese government launched the Housing Provident Fund (HPF, *Zhu Fang Gong Ji Jin*) program to reduce the number of tenants living in publicly owned housing and to promote private home ownership. Since the 1990s, urban residents' living conditions have improved noticeably. However, the strict rural-urban division of the *hukou* household registration system excluded over 220 million migrant workers from social welfare programs

provided by the government. Migrant housing has become a serious issue, causing inequalities and worsening social segregation.

New commodity housing projects have dominated China's communities since 2008. The more abundant space of commodity housing and a three-tiered urban greenspace model have gradually become the community's landscape framework.[9] In many new housing units, residents who live in the same apartment building share little in common. Communal spaces (such as activity centers and parks) are becoming increasingly standardized, and the living environment is often tediously repetitious. Unlike older inner-city neighborhoods, the "gated communities" of commercial housing projects have restricted access to homeowners and their guests. It is unclear how urban residents will adapt to the changes in spatial and social infrastructure and respond to the social services in place. While some scholars argue that traditional forms of social bonding and civic trust have eroded in these new neighborhoods (Ma, 2002), others believe that this is offset by the privatization of community services. Pow's (2007) early-1990s commodity housing study suggests that the homeowners who moved to gated communities are more engaged in community affairs, compared to the beneficiaries of socialist welfare housing. The emergence of gated communities as part of the marketized housing system in early 1990s has provided the local population with greater autonomy over community affairs (Pow, 2007). Ye's survey (2012) on a Shanghai gated community shows a strong correlation between the "marketization of housing" and "a sense of community". The practice of excluding outsiders, on the other hand, has no correlation to a sense of community.

4.2.3 The Implication of Social and Political Participation in Community Planning

The validity of public participation in planning is found in the political science debate of "good governance" (Masango, 2002; Rydin & Pennington, 2000). Public participation is a well-accepted practice that is often seen as essential to sustainable community development (Innes, 1996). Healey (2006) indicates that participatory processes in the early planning stages are key elements for communities to reach a consensus toward a healthy transition, (i.e., evolving from a

[9] The contemporary Chinese residential communities follow greenspace standards, called the "community-group-yard" model. "Communities" are divided by city roads or natural lines (rivers, green buffers, etc.), and equipped with recreational features, such as playgrounds, shaded sidewalks, fountains, and recreational facilities for children. "Groups" are subordinated to "communities", and they usually have fences and residents-only entrances to the community. A group can be the unit for a housing sale (phase I, II, III, with group ABC). "Yards" refers to the small proximate enclaves between buildings. Their design usually meets daylighting regulations, without any proposed features or functions.

neighborhood in decline that is dependent on massive investments into an inclusive, socially sensitive community supported by multiple players without causing gentrification). Suzuki (1994) states that real change can occur only when grassroots movements are empowered with a vision and the means to achieve it. Taking the environmental movement as an example, to transform the vision of a sustainable future into action requires more than experts educating the public. It requires community commitment and mutual exchanges of knowledge between experts and laypeople. Therefore, public participation helps to foster a mutually shared vision of the community's future and generates channels for blending knowledge.

A form of participation drawn from the productive interface between laypeople and planning actors is mapping and spatial learning. It can be traced back to Kevin Lynch's experimental research on "imageability" (1960) – an experimental approach that extracted the "mental images" (AKA cognitive maps) held by citizens of the visual quality of the environment.[10] Lynch explained that planners can access the local residents' knowledge by using survey and interview methods. Spatial learning, in the form of cognitive mapping, presents a two-way knowledge sharing of planning physical environments. Spatial learning can also be applied to identify social problems. For example, Wendel (2009) incorporated Lynch's mapping method into his research to illustrate the uneven neighborhood recovery effort in the reconstruction of New Orleans. However, spatial learning has constraints in its use due to the high level of community expertise it requires. To train laypeople and to collect their drawings is expensive and time-consuming. Therefore, spatial learning is better suited to small-sample studies.

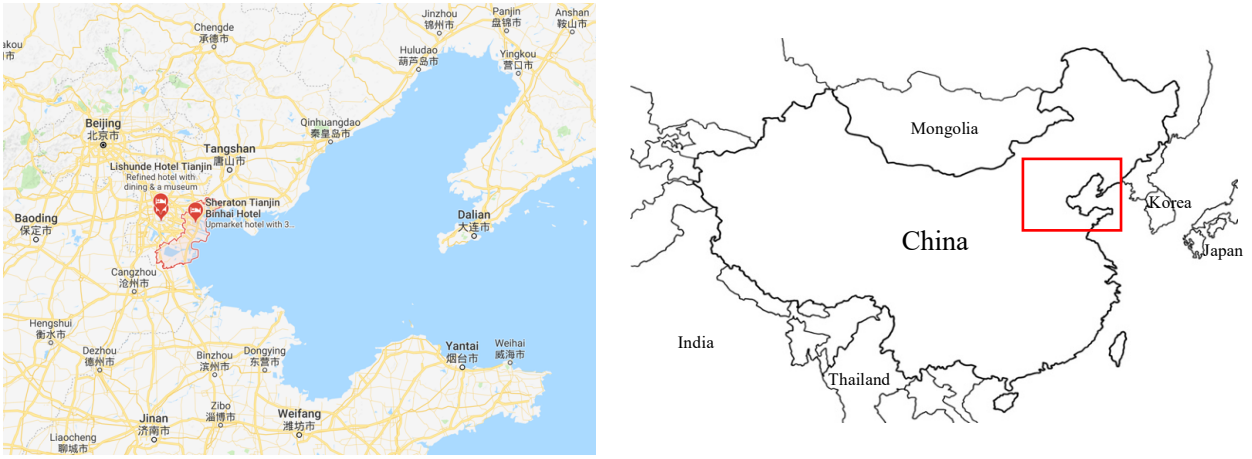
The survey questionnaire method is frequently used for social capital research. However, conducting large-scale surveys for academic research without political support is rare in China. Very often, researchers use official data rather than data collected by themselves. This is especially true for studies on social issues, which rely on large-scale samples (see for example, Xu et al. 2010; Zhang et al. 2006). In China, resident satisfaction surveys are gaining increasing attention as meaningful and essential sources of information for identifying gaps and developing an effective action plan for service quality improvement in community management. The neighborhood accommodates most social activities that are handled by the Civil Affairs Department (Friedmann & Fang, 2011). The Planning Department has not participated in neighborhood services (Zhao & Zhao, 2002). Using surveys to draw critical connections among

[10] Cognitive maps represent the structural knowledge of the human mind to interact with the surrounding environment (Jonassen, Beissner & Yacci, 1993).

people's experience of community living and the implications for planning is still rare. The planning literature in China focuses on using the survey method to improve the physical environment, rather than on investigating the level of participation and the social dynamics in planning. Further investigation is required to link neighborhoods' feedback to the Planning Department's participation.

4.3 Setting and Method

Figure 13 Tianjin Binhai New Area on the map of China



Note: The red line of left image encloses the Tianjin Binhai New Area

I conducted a survey study in multiple neighborhoods in the Tianjin-Binhai New Area (TBNA), concentrating on the respondents' experiences of community participation in the selected neighborhoods. Geographically, TBNA has the advantage of being close to Beijing and Tianjin, where some rich scientific resources are located (See Figure 13). In the past decade, the Tianjin-Binhai government has invested heavily in infrastructure and public services to attract skilled technical workers. Top schools and discounted rates for medical care were introduced, with premier deals being offered to new homeowners. In addition, TBNA incorporated advanced principles of urban design, meaning that all construction meets state-of-the-art green building codes, and bus transportation was being provided free-of-charge for all residents. The region welcomes the implementation of experimental policies that will make it an example of sustainable development.

4.3.1 Context of the Case

My field research was conducted in the Mangrove Bay Subdistrict (红树湾社区), a high density residential site under development since 2010 (See Figure 14). This site is one example of the commodification of urban housing, a practice that is pervasive in contemporary Chinese cities. In the Mangrove Bay Subdistrict, the average floor area ratio is 2.0, with strict daylighting regulations for residential buildings. As a result of many factors, (i.e., land size, housing prices, and the spacing of city streets), the dominant type of housing is high-rise towers. There are a few multi-storey apartments, covering 4-6 floors, for more high-end customers. The SSTEC requires that 20% of the total available units should be affordable housing, targeted at blue-collar migrants and low-income families. Each affordable public housing unit is no larger than 60 m^2, while the market commodity housing units are 90-180m^2. The residents of the Mangrove Bay Subdistrict are a mixture of resettled locals with Tianjin *hukou* (household registration), commuters who work or live in nearby cities, and rural migrants who buy properties to gain a Tianjin *hukou*. According to the official meeting minutes, by early 2017, the Mangrove Bay Subdistrict had 27,000 registered households, and of this total 3,100 are working migrants.

I first conducted a sample survey in three subdistricts on their Homeowners' Association meetings. After sitting in a couple meetings of each community, I found that Mangrove Bay had a variety of ancestral, age, and income residents. I selected Mangrove Bay, over the other subdistricts, for this study because their staff responded to my request to study their neighborhoods, so I had access to a larger pool or research participants.

The final survey questionnaire was distributed and collected during seven meetings. Community staff helped me call for these meetings (on the weekend and during the week) to answer the questionnaires, and afterward conduct a discussion with residents and community staff. Everyone who participated in the meeting was given a small gift.

In 2013, soon after the central government announced the Community Building Campaign (CBC), the Binhai government initiated the CBC with a clear political agenda—to improve community social cohesion with minimum government interaction. Along with the campaign, specific programs were implemented to secure community participation. For example, newly-built neighborhoods were directed to elect resident representatives to establish a Homeowners'

Association (HOA).[11] In older neighborhoods, the delivery of basic social services is handled by Residents' Committees (RCs), whereas in new higher-income neighborhoods, homeowners tend to be more active about organizing a variety of activities and hobby groups. Local governments welcome non-political self-organized groups (i.e., sports clubs, social support services, and volunteer groups) to take over community services. Considering the important role that community participation plays in the CBC, it is crucial to learn more about the local leaders who contribute to community-based services.

Figure 14 The Mangrove Bay Subdistrict site

4.3.2 Survey Design

I conducted a survey study in multiple neighborhoods in the Mangrove Bay Subdistrict of Tianjin, China, to measure community engagement and identify local leaders—those who are deeply engaged in community services and decision-making and individuals with leadership potential.

[11] The HOA members are either elected by the homeowners or assigned by the RC members. A neighborhood which has regular HOA meetings usually encourages residents to become actively involved in community life.

Reviewing the Western approach to community studies, I found limitations in employing the existing indicators and protocols used to measure neighborly relations, group membership, and community participation. The most obvious type of affiliation was membership in community groups, which is frequently used as an indicator of community participation in Western countries. In China, local government undertakes supervision and censorship of membership in groups relating to politics or religion. Therefore "membership" is only an indicator for measuring collective efficacy and neighborhood cohesion (Zhang, 2007). Current literature on Chinese community social capital focuses on measuring individual behavior patterns (Gui & Huang, 2008). In this study, I adopted two indirect constructs of social capital: (1) *neighboring*, and (2) *citizen participation*. These constructs are used in both Western and Chinese literature, to explore their potential to identify local leaders—individuals who are actively engaged in community services and decision-making (e.g., are able to call a meeting to discuss property service issues). I consider local leaders to be the ones who have high scores in both constructs.

Neighboring indicates the closeness of ties the participants developed informally with their neighbors, including the frequency of their interaction, a sense of attachment, and the growth of friendships. These neighborly behavior patterns are measured by asking, "How would you describe your relationship with your neighbors?" using a 4-point Likert scale measurement. 1= I do not know my neighbors well; 2= I have limited contact with my neighbors; 3= I often meet my neighbors outside of the home; 4= I am close to my neighbors with whom I share my private concerns. Scales 1 and 2 suggest that residents have distant neighborly behaviors; scales 3 and 4 indicate positive neighborly behaviors.

Citizen participation measures the membership in residential groups. Again, I used a 4-point Likert scale to measure the level of engagement of neighborhood activities. Citizen participation was measured by asking, "Which of the following options best describe your involvement in community group meetings?" 1= I am not a member of any community groups; 2= I am a member of at least one community group; 3= I have participated in the Homeowners' Association meetings; 4 = I am involved in community management. I considered respondents who chose option 1 as not engaged in community activities, option 2 as community service users, and options 3 and 4 as service providers or residents involved in community decision-making.

Two rounds of surveys were done to collect data for the study. The first round of data was collected through personally-administered questionnaires to those who were involved in the CBC,

which included volunteers, social workers, activity organizers, and local business owners. The second round of data was obtained from two resident meetings in the Mangrove Bay Subdistrict. I asked community staff to notify the residents about the purpose of this research, and distributed the survey questionnaires after making a brief introduction. I gave everyone who returned their completed questionnaire a small gift. Respondents were residents and people who worked in the community.

I collected personal information as four independent variables: age, profession, education level, and length of residence. I paired these demographics with the two constructs to analyse their impact on the respondents' experiences in participating in community activities. I hypothesized that the new residents and the old residents differed in their neighborly behaviors and citizen participation. Therefore, I tested the following hypotheses.

- **Hypothesis (1)**: The length of residence is associated with the rate of neighborly behavior.
- **Hypothesis (2)**: The length of residence is associated with the rate of citizen participation.

Joong-Hwan (2003) indicates that one's neighborly behavior pattern changes over the course of time. Newcomers are more unlikely to participate in community activities and make friends with neighbors than long-term residents. The data related to hypotheses 1 and 2 will test if his view is supported in this study. Hypothesis 2 is based on Narayan's (1999) social capital model, which suggests that individuals with high social capital are more likely to lead or act towards achieving collectively shared goals.

In addition to testing neighboring and citizen participation in the self-supported questionnaire, I asked residents to describe their level of satisfaction with their community using a 5-point Likert scale (1=Very dissatisfied; 2=Dissatisfied; 3=Neutral; 4=Satisfied; 5=Very satisfied). I then tested the relationship between the levels of satisfaction and participation.

- **Hypothesis (3)**: A low level of satisfaction in community life correlates with low participation.

This hypothesis is based on Uzzell et al.'s (2002) study in which residents with low social capital may be in high risk of social exclusion. A common approach to determining a group of individuals' social capital is to investigate their level of satisfaction with their community life. If hypothesis 3 is supported, it suggests that residents who report a low level of satisfaction with

their community life are unlikely or unwilling to be involved in neighborhood activities. Low community participation is neither the cause nor the result of low satisfaction. However, if a correlation exists between these two, I could employ the survey as a means to identify the vulnerable groups, and to better provide them with the needed services.

The last objective of this study was to discover the relationship between community involvement and local leadership. I found that local leaders were longer, time-period residents, who were highly involved in the community. This would indicate that, over-time, they gained social capital that was then used to support their leadership activities.

In China, local leaders have a good reputation. They host discussions across groups, and devote themselves to conflict management, all in the pursuit of the delivery of community services. However, the major goal of this survey was not to highlight such contributions but to discover what characteristics local leaders possess. By analysing the demographics of those who scored high in social capital, I was better able to locate the groups in which the local leaders are likely to belong.

4.4 Study Findings

Among the 125 participants, the clear majority (71.2%) were degree holders, while 20% of the participants were unemployed or retired. In addition, 17.6% of the respondents had moved to the current neighborhood sometime within the past 12 months. Furthermore, 6.4% did not live in Mangrove Bay. Those respondents either lived nearby, or worked in nearby neighborhoods, commuting from Tianjin. Table 10 provides the respondents' personal information.

Table 10 Demographics of the sample (n=125)

Variables	Frequency	%
Age		
18-24	4	3.2
25-34	59	47.2
35-44	29	23.2
45-54	8	6.4
55-64	17	13.6
65 and above	8	6.4
Profession		
Planners	2	1.6
Environmental scientists	3	2.4
Administrators	14	11.2
Social workers and community employees	17	13.6
Residents with a job	64	51.2
Residents without a job	25	20.0
Education		
Primary/junior high school (<9 yrs)	4	3.2
High school (<12 yrs)	32	25.6
Undergraduate	57	45.6
Graduate	32	25.6
Length of Residence		
Does not reside here.	8	6.4
Short-term resident (< 1 year)	22	17.6
Mid-term resident (1-3 years)	45	36.0
Long-term resident (3-5 years)	31	24.8
From local area (> 5 years)	19	15.2

4.4.1 Community Engagement

Table 11 Survey on neighboring and citizen participation

Measurements	Survey Options using the 4-point Likert Scale	Score	Counts (N=125)	%
Neighboring	I do not know my neighbors well.	1	17	13.6%
	I have limited contact with my neighbors.	2	27	21.6%
	I often meet my neighbors outside of the home.	3	21	16.8%
	I am close to my neighbors with whom I share my private concerns.	4	60	48.0%
Citizen Participation	I am not a member of any community groups.	1	38	30.4%
	I am a member of at least one community group.	2	35	28.0%
	I have participated in the Homeowners' Association meetings.	3	34	27.2%
	I am involved in community management.	4	18	14.4%

Note: Respondents were asked, "How would you describe your relationship with your neighbors?", and "Which of the following options best describes your involvement with community group meetings?"

In measurements using a 4-point Likert scale, a high score in neighboring means that the respondents are close to their neighbors; a high score in citizen participation indicates that the respondents are more actively involved in community groups (e.g., sports clubs, social circles, and discussion groups).

Table 11 presents the survey results on neighboring and citizen participation, based on the number of respondents who chose these options. Using Woldoff's (2002) measurement of neighboring, about one-third of the respondents (35.2%) were quite disengaged from their neighbors (scores 1 and 2), while the remaining two-thirds showed purposeful, friendship-oriented interactions with their neighbors (scores 3 and 4). As for citizen participation, 30.4% of the respondents considered themselves not to be members of any community groups (score 1), 28% participated in community groups (score 2), and 41.6% participated in some sort of community decision-making (scores 3 and 4). This result shows that inhabitants of the Mangrove Bay Subdistrict had a higher rate of citizen participation than the combined residential communities in Binhai, using the rate reported by the social services sector of Binhai for comparison (Hu & Li, 2016).

As I further paired the demographics with the two independent variables—neighboring and citizen participation (see Table 12), I found that age had no correlation with either variable. The length of residence, however, had a positive correlation to both variables.

In terms of neighboring, long-term residents (> 5 years) had a much higher score than new residents (< 1 year) (3.84:2.00/4). This result supports my first hypothesis that residents become closer to their neighbors the longer they reside in a neighborhood. I also found a positive correlation between age and positive neighborly behaviors. This finding suggests that local friendship ties and community attachment are stronger among middle-aged and elderly residents than among younger residents. As I compared participants from the first round of surveys (recruiting professionals using personally administered questionnaires) and the second round (recruiting residents from the community), I found that despite other variables, the second-round participants (mostly blue-collar workers), in general, had closer relationships with their neighbors than the professionals did.

Hypothesis 2 was also supported: A positive correlation between the length of residence and citizen participation is found in this study. Long-term residents (3-5 years) and residents originally from this place had higher scores in citizen participation. In addition, they were significantly more active in political participation than short-term and medium-term (1-3 years) residents. This finding is consistent with the community attachment literature.

The survey results show that long-term residents (2.58/4) and older residents (2.50/4) are more likely to participate in community groups. This same group (long-term residents and older

residents) also exhibits a higher neighborly relation score (3.5 and 3.84/4) than the other groups. Meanwhile, I found that the length of residence predicted positive neighborly relations and strong citizen participation. Therefore, I concluded that residents who live in a neighborhood long enough are inclined to be local leaders who contribute to the identity of the community.

I previously mentioned that education does not predict participation. However, respondents who are degree holders were found to be more active in citizen participation than non-degree holders. Holders of master's and bachelor's degrees each scored 2.35/2.25, while those possessing a middle school and primary school education scored 1.75/2.16.

Table 12 Neighboring and citizen participation, and a demographics comparison (n=125)

Variables	Total (%)	Neighboring (mean/SD)	Participation [b] (mean/SD)	Positive Neighboring (%)	Active Participation (%)
Age					
18-24	3.2	2.00/0.82	2.25/0.82	25.0	50.0
25-34	47.2	2.73/4.27	2.27/3.50	55.9	40.7
35-44	23.2	3.24/6.70	2.28/2.22	72.4	41.4
45-54	6.4	3.38/2.71	2.25/0.82	75.0	37.5
55-64	13.6	3.29/4.50	2.06/3.10	76.5	41.2
65 and above	6.4	3.50/2.71	2.50/1.15	87.5	50.0
Profession					
Planners	1.6	2.50/0.58	3.00/1.00	50.0	100.0
Environmental scientists	2.4	3.33/0.96	3.00/1.50	66.7	100.0
Administrators	11.2	2.43/1.00	2.79/1.29	42.9	57.1
Social workers and community employees	13.6	2.76/2.22	2.59/1.50	52.9	52.9
Residents with a job	51.2	3.11/11.17	2.06/7.39	70.3	31.3
Residents without a job	20.0	3.16/5.85	2.08/4.35	72.0	40.0
Education					
Primary/junior high school	3.2	2.75/0.82	1.75/0.82	50.0	25.0
High school	25.6	3.44/9.42	2.16/5.48	84.4	34.4
Undergraduate	45.6	3.04/9.00	2.35/2.36	66.7	43.9
Graduate	25.6	2.50/2.58	2.25/3.92	43.8	46.9
Length of Residence					
Does not reside here.	6.4	-	-	-	-
Short-term resident (< 1 year)	17.6	2.00/4.43	1.91/3.42	18.2	27.3
Medium-term resident (1-3 years)	36.0	2.91/4.86	2.20/3.59	66.7	37.8
Long-term resident (3-5 years)	24.8	3.51/9.60	2.42/4.27	87.1	51.6
From local area (> 5 years)	15.2	3.84/8.18	2.58/0.50	94.7	52.6

a Ranging from 1 to 4, the higher the number, the higher the perceived neighborly relations
b Ranging from 1 to 4, the higher the number, the more active the participation is
SD Standard deviation
"Positive neighboring (%)" refers to scores that are larger than 2. As such, I count the percentage of respondents who chose 3= "I often meet my neighbors outside of the home" and 4= "I am close to my neighbors with whom I share private concerns" in the sub-group analysis.
"Active participation (%)" refers to scores that are larger than 2. I consider active community participants as those who selected 3= "I have participated in the Homeowners' Association meetings" and "I am involved in community management."

In examining the professional groups, I noticed that the social worker group did not show a higher score in citizen participation or in active participation. The groups most active in participation were planners (100%), environmental scientists (100%), administrators (57.1%), and individuals with a master's degree (46.9%). The planners, administrators, and graduates of master's degree programs, however, had a relatively lower score in positive neighborly relations. This finding suggests that a relatively large portion of people who are actively involved in community activities do not necessarily developed close relationships with their neighbors. Neighboring and citizen participation were not found to be correlated in this study.

4.4.2 Participant Satisfaction

In the section of the survey on participant satisfaction, I asked respondents if they were satisfied with their neighborhood in terms of quality of life, property management, and the HOA. I eliminated the data of eight participants who were living somewhere other than Mangrove Bay. The results showed that residents were positive about their neighborhood's quality of life (3.8/5), and less satisfied with property management (3.3/5) and with the HOA (3.2/5). The operation and maintenance of all the observed neighborhoods were provided by professional property management companies and the HOA. This low score (indicating dissatisfaction with such services) communicates the concerns of homeowners and neighborhood residents regarding property management.

Ten out of 117 (8.5%) respondents reported a low level of satisfaction with community living. The data shows that these respondents originate from all age groups, educational levels, and lengths of residence. Surprisingly, 3 out of these 10 respondents also reported a relatively higher level of participation, and all 3 are employed. Looking closely at those who reported the lowest level of participation, their demographic does not suggest that they were at high risk of social exclusion. They know their neighbors well, and have actively participated in community decision-making. Hypothesis 3 "Low level of satisfaction in community life correlates with low participation" is not supported in this study.

4.4.3 Identifying Local Leaders

In this study, I defined local leaders as those who exhibit positive neighboring and strong citizen participation. By analysing the demographics of 41 out of 125 respondents who reported strong neighborly relations and active citizen participation, I found the following pattern of local community leaders: Length of residence dominates all other demographic features. The number of long-term local leaders (3-5 years) and residents from local groups (>5 years) outweighed the two groups' population percentage. Similarly, retirees (55-64, and 65+ age group) with a high school education were likely to be local leaders.

Surprisingly, the observed sample of social workers failed to indicate a high percentage of local leaders. One explanation for this finding is that this professional group was comprised of new residents, mostly in their 20s. The combination of such demographics indicates a low social capital construct as well as a short length of time in the community. Another explanation is that young professionals may build social networks beyond their neighborhood, and not make as many friends as retirees within the neighborhood. Since this sample is small (two planners, three scientists, and eleven social workers), the results had limitations, and failed to suggest a relationship between professionals and social capital.

4.5 Discussion

The Chinese proverb, "A close neighbor is better than a brother far off" illustrates the important role of neighbourly mutual help to support daily life in China. To a certain extent, this kind of informal reciprocity is still relevant to today's urban communities. This paper aims to apply the knowledge of social capital to the practice of community action, particularly methods that community planners can implement in terms of community building. More specifically, I used the survey method to understand the residents' behavior, in their respective neighborhoods.

I have adopted a total of seven variables in this study. As dependent variables, I use two social capital constructs: neighboring and citizen participation. Age, profession, education, and length of residence were selected as independent variables. Such an approach is experimental in the study of Chinese communities and poses the following two challenges.

First, even though the Western concepts of community and community participation are arguably adaptable to China, it is inappropriate to generalize the findings of the studied community to all Chinese communities. In short, the importance of local community may be greater in China than in the West but the mechanisms of length of stay influencing community attachment and engagement is not fundamentally different than that reported in the West.

Measuring community participation in the Chinese context is challenging. Scholars state that community participation in China rarely involves local political decision-making (Xu et al., 2010). Promoting homeowners' involvement in community decision-making is the central task of community building, according to the propaganda posted on the Tianjin-Binhai official website. Therefore, I include the typical behavior of political participation – the attendance of HOA meetings – in my measurement. Although residents may have attended HOA meetings only once, a higher participation scale is set for them compared to residents who frequently attend meetings of other community groups. I believe this is because involvement in political decision-making serves as a valid indicator in the cultivation of local leaders, which is essential for democratic development. The theory of social capital tells us that the contributors to neighborhood services, compared to the receivers of such services, are more likely to form a new status in their respective communities.

Second, conducting surveys for academic research without political support is rare in China. Most previous studies have relied on officially provided data (i.e. national surveys) to attain large samples. In this case, I contacted the local authorities for permission to distribute and collect the survey questionnaires on my own. Doing so allowed access to the targeted groups and direct contact with the participants in the field. The latter proved to be especially fruitful. Talking to the participants face to face provided the opportunity for me to find out what considerations they deemed the most essential for community life (e.g., security, maintenance fees). I was also able to identify the profile of local leaders as (1) middle-aged or retired long-term residents who had established a large circle of connections with their neighbors; or (2) young or middle-aged married homeowners who have strong social networking skills and are actively involved in community decision-making.

In terms of its application, this study has the potential to empower communities by using a resident survey to identify community leaders. Community leadership is about people who live with you and interact with you. With solid leadership, a community develops greater resilience

for dealing with crises (Guo et al., 2018). This study enables local authorities and policy makers to understand the public's desires and expectations regarding those who govern at the community level. The resident survey explores measurements that are suitable for accessing community leadership in China. However, neighborly relations and the behavioral pattern of citizen participation may be better supported by a larger-sample study. Another limitation of this study is the lack of data on the physical environment. The examined neighborhoods were built according to recent architectural designs and planning codes. The type of housing was quite uniform, consisting mostly of high-rise buildings, with a few three-story or four-story walk-up apartments for the higher-end homebuying market. Therefore, this survey did not distinguish residents by housing type. As such, the research could not measure social behavior based on different residential structures in various physical environments (e.g., flats vs high-rises in high, medium, or low-density living spaces, facing large parks or streets). Future research should address the impact of the physical environment on community experience in newly-built neighborhoods.

4.6 Conclusion

Public participation in community management remains limited because of China's political environment. Censorship has a huge impact on political views and daily life in terms of posting on social media, promoting membership in NGOs, and maintaining self-organized groups. However, citizen participation is evident in the growing middle class. In the past decade, Chinese homeowners' involvement in environmental issues has drawn much attention in local governance. Although homeowners have very little impact on public decision-making due to the central government's control over local policy issues, the involvement of homeowners in public policy discussions is being tolerated to a certain extent, and this constitutes a substantial improvement compared with the intolerance of civic participation under the Maoist regime (Huang & Sun, 2014).

Community building is based on the idea that attachment to community is an important resource for the local authorities to consider, as they mobilize resources for the renewal and improvement of their respective communities. Participation is seen as a critical component of community building. This paper draws a connection between community engagement (e.g., neighborly interaction and community participation) and its implications for community building. Previous

studies suggest that length of residence has a positive impact on community attachment in Western society (Kasarda & Janowitz, 1974). This study found little difference in how "length of stay" influenced community attachment in China. What's new is finding that the length of residence is positively correlated to community engagement. This means most local leaders have lived in the neighbourhood for at least three years. One implication of this finding is that if researchers have limited access to Chinese communities, they could use length of residence to identify potential local leaders. However, this finding would need to be replicated in other studies to confirm its validity.

I recognize that community participation and neighborly behavior have social applications in China that are different from the West. On the one hand, social ties and social networks at the local level in China are more social than political. Residential homeownership has weakened the traditional resources of community mobilization, such as the Work Unit and the Subdistrict office. New communities, in which homeowners have increased autonomy over community affairs, have been created within the SSTEC neighbourhoods. In addition, organized volunteer support, such as that of the Homeowners Association, has emerged at the community level and plays an important role in community building.

The purpose of studying neighborly relationships and community engagement is to discover how social interaction influences the quality of life in new communities through the delivery of various cultural ES to both individuals and communities. Based on these findings, I suggest that the quality of social relationships can better explain neighborhood satisfaction than demographic characteristics might. As such, I acknowledge the urgent need for further research on local leaders: (1) the distinguishing characteristics of individuals who have become local leaders; and (2) the extent to which they influence their neighborhood (i.e., their ability to mobilize resources and win their neighbors' support for community initiatives). These topics are important for differentiating social support strategies for vulnerable groups in China's urbanizing areas. The implication of research on local leaders can develop better explanations regarding social capital and the "neighbor effect theory" for Chinese communities.

Chapter 5. Dissertation Conclusions

The original idea of "Ecocity," which emerged in Europe and North America, is an approach to urban development that respects environmental limits. The rise of ecocity developments on the global stage, in many ways, tells us the story of how ecocities have been framed by power, globalization, privatization, and the emergent discourse of sustainability.

Over the past decade, China has undertaken aggressive urban development. This urbanization has been detrimental to public health, has caused the degradation of ecosystems, and has been the source of a biodiversity loss in many environments. In the face of rising public anxiety over these issues, many local governments have turned to "ecocities". Ecocities create a vision for a sustainable urban future in China, and many local governments call their new development projects "ecocities" (Zhou et al., 2012).

Given the lack of a common understanding of "sustainability", what makes a city an "ecocity" the term is ambiguous: Does it refer to delivering a healthy and prosperous city development model, or does it describe a way to provide urban growth while being socially and environmentally responsible?

To resolve this vagueness, **Chapter 2** began with an overview of the theoretical roots from which the concept of "ecocity" evolved and investigates how Chinese ecocities have adapted these ideas. After reviewing more than fifty Chinese ecocities, I concluded that "ecocity", in the Chinese context, is a pragmatic approach to sustainable urban development that incorporates technology, design, and political innovations to support sustainability. In many cases, the prefix "eco" is merely a marketing buzzword meant sell real estate on city edges with much-needed supporting infrastructure (e.g., public transportation). Meanwhile, the affix "city" reflects the local governments' real agenda to quickly develop city projects that include, but are not limited to, new residential and commercial neighbourhoods, high-tech development parks, eco-tourism destinations and cultural attractions, with some forms of pollution remediation.

Table 13 A comparison between Berkeley and Tianjin ecocity models

Project	Berkeley	SSTEC
Goals	Self-sustaining resilient; Function of natural ecosystems; Healthy abundance to its inhabitants; Social justice, fairness, and equity	The "three harmonies" (social, economic, and ecological sustainability); Create an urban ecosystem upon a non-livable area
Scale & Timeline	27 km^2, 11K residents by 2010 1975-1990s	30 km^2, 90K by 2010; propose 350K residents 2008-2020s
Ecological planning themes	Enhance biodiversity; Prioritize reuse of land and public transport; Conservation of water and energy;	Biodiversity; Ecological restoration and construction on saline-alkaline soil; Residents' access to green open space (high green space ratio)
Outcomes	Well-planned city layout that support walkability, biking and the use of public transit; Planetary-supportive lifestyles (reduced waste, detoxicate of neighboring ecosystems, local agriculture production); Waste management that promotes recycling and reuse	Restoration of bird habitats, enhanced biodiversity; Green and blue infrastructure; Energy conservation and emissions reduction; A light-rail transit system, supplemented by a secondary network of trams and buses; All housing and commercial buildings meet green building standard

After spending years studying the SSTEC, it is inevitable for me to ask: Is Tianjin really an ecocity?

There is no obvious answer to this question. When I compared Berkeley and Tianjin (see Table 13), the goals of the Tianjin Ecocity seemed ambiguous. The language that SSTEC uses to describe the "three harmonies" has nothing to do with "living on a limited ecological footprint", or with promoting a lifestyle that supports local businesses or local food production. Phrases repeated throughout SSTEC's current planning documents, such as "economic growth", "improved living conditions", "better mobility", and "social progress", refer to *development* and *improvements*. In a way, Tianjin delivered public services (e.g., hospitals, schools etc.) and parks that allow residents to enjoy a decent quality of life. However, such an "ecocity" does *not* necessarily focus on ecological sustainability. Instead, Tianjin exemplifies how a planning structure may provide a variety of cultural ES within urban neighborhoods, by implementing green infrastructure.

A new question arises then: Is this "enough" to make Tianjin an "ecocity"?

To answer this question, this dissertation focuses on the development of relevant ecological and social metrics, shown respectively in Chapter 3 and 4.

Chapter 3 began with the identification of the planning scope of SSTEC using the widely used ES metrics in the MEA (2005) and Brown and Mooney (2013.) A review of current planning policy in the SSTEC shows that a large number of ES were missing (15 out of 35). The SSTEC only addressed a limited environmental agenda that matched what officials considered important to ecosystem and resident wellbeing. Since Tianjin is not what Register defined as an "ecocity", would integrating ES into Tianjin's planning practice contribute to turn it into an ecocity? I addressed this question through a survey study that introduce ES to local planners of Tianjin in **Chapter 3**.

Considering that the majority of respondents lack knowledge of ES, I only included 20 ES that were found in current planning policies, and phrased the description of benefits in a way that planners would be familiar with, and ran a correlation analysis of two questions paired with ES and associated benefits. The results indicate that the inadequate scope of environmental sustainability in SSTEC is associated with planners' lack of ecological knowledge, however this finding is not definitive. This lack of awareness of ES and ecological issues may contribute to omissions and oversights in the formulation of planning solutions linked to broader ES outcomes. However, these are only first indications and the impact of integrating ES into Tianjin's planning practice remains unsure. For a more responsive approach to urban planning, I recommend that future research should address a full list of ES to evaluation.

Chapter 4 developed social metrics of Chinese ecocities by examining two social capital indicators (neighbourly behavior and citizen participation) in Tianjin. Using a small-sample survey, I paired the participants' demographic characteristics (age, education, profession, and length of residence) with the participants' neighbourly behavior and citizen participation. I found that the length of residence in a neighborhood is strongly correlated with both indicators. Long-term residents were the most likely candidates to act as local leaders—individuals who are essential to the delivery of community services. The study of neighborhood involvement indicates a variety of cultural ES at neighborhood scale (e.g., sense of community, physical wellbeing etc.). The findings of this chapter suggest that the quality of social relationships can better explain neighborhood satisfaction than demographic characteristics might. Considering these findings, I call for further research on: (1) the distinguishing characteristics of local leaders; and (2) the influence that local leaders have on their communities. These topics are important for devising a variety of social support strategies that will meet the specific needs of diverse and vulnerable groups in China's urbanizing areas.

Looking closely at what differentiates Tianjin from Berkeley, one cannot neglect the scale and timeline. The Tianjin Ecocity is considerably more ambitious than Berkeley in terms of scale: Berkeley is known for its prestigious international campus and as a west coast village that has long been cultivated as a home for environmentalists. In Register's plan, the population of Berkeley remains stable and so does its ecological footprint; The Tianjin Ecocity, in contrast, was controversially built on saline-alkaline soil, and is geographically isolated from existing urban infrastructure and plans to accommodate 350,000 people within 20 years, providing housing, jobs, businesses, and a vibrant urban environment. This new urban infrastructure, consumption and services will create a large ecological footprint that cannot be ignored.

I believe that the scale is a key factor that limits Tianjin's realization of Register's Ecocity model. Considering their influence on the region, ecocities force local governments to pay attention to the environmental as well as social objectives. Housing affordability has become a crippling crisis in many ecocities. Caprotti (2014) points out the need to address social resilience in ecocity research.

So, what might be a solution for the Chinese ecocities?

As mentioned, land resource is crucial to the planning of Chinese cities. Local governments acquire the majority of their revenue by collecting income from leasing land. Therefore, a strong real estate market is pivotal in successfully operating a Chinese city. This also applies to Chinese ecocities. In fact, many cities offer privileges, such as reduced land leases, in ecocity developments to attract investment in housing, business, and infrastructure. Local politicians are constantly struggling to lease land rapidly in order to maintain a sustained flow of revenue for the city. This explains why Chinese cities and ecocities are often scattered, leapfrog development with low density. Without innovations in municipal financing that introduces more revenue channels, the planning of Chinese cities is not likely to change. However, new revenue streams alone will not suffice. Greater understanding of environmental imperatives and the recognition that the human social and economic systems are set within a finite ecological system must also become standard operating procedure for city planning in China.

I would like to quote Richard Register to end my dissertation. My vision of hope for Chinese ecocities fits with his words on what ecocity is about.

“Nature’s economics is the foundation for human economics … survival and thriving hangs in the balance. There is good and bad in both capitalism and socialism – choose the best from both. Let nature’s economics be the guide.” (Register, 2016a)

Bibliography

Ahern, J. (1996). Greenways as a planning strategy. In J.G. Fabos & J. Aherns (eds.) *Greenways: The beginning of an international movements* (pp. 131-155). New York: Elsevier.

Ahern, J., Cilliers, S., & Niemelä, J. (2014). The concept of ecosystem services in adaptive urban planning and design: A framework for supporting innovation. *Landscape and Urban Planning, 125*(5), 254-259. doi:10.1016/j.landurbplan.2014.01.020

Alberti, M. (1996). Meauring urban sustainability. *Environmental Impact Assessment Review, 96*(16). 381-424.

Baeumler, A., Chen, M., Dastur, A., Maruyama, H., & Suzuki, H. (2009). *Sino-Singapore Tianjin Eco-City: A case study of an emerging eco-city in China*. Technical Assistance Report. Washington, DC: World Bank.

BBC. (2007). Brown outlines 'eco towns' plan. Retrieved from http://news.bbc.co.uk/2/hi/uk_news/politics/6650639.stm

BBC. (2009). Four sites to become 'eco-towns'. Retrieved from http://news.bbc.co.uk/2/hi/uk/8152985.stm

Berrini, M., L. Bono. (2011). Measuring urban sustainability: Analysis of the European Green Capital Award 2010 & 2011 Application round. European Green Capital Program Report. available at http://ec.europa.eu/environment/europeangreencapital/docs/cities/egc_analysis2010-2011.pdf.

Berry, J. M., Portney, K. E., & Thomson, K. (1993). *The rebirth of urban democracy*. Washington, D.C: Brookings Institution.

Botequilha Leitão, A., & Ahern, J. (2002). Applying landscape ecological concepts and metrics in sustainable landscape planning. *Landscape and Urban Planning, 59*(2), 65-93.

Boyd, J., & Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics, 63*(2), 616-626. doi:10.1016/j.ecolecon.2007.01.002

Boyd, J., Ringold, P., Krupnick, A., Johnston, R. J., Weber, M. A., & Hall, K. (2016). Ecosystem services indicators: Improving the linkage between biophysical and economic analyses. *International Review of Environmental and Resource Economics, 8*(3-4), 225-279. doi:10.1561/101.00000073

Bray, D. (2006). Building 'community': New strategies of governance in urban China. *Economy and Society, 35*(4), 530–549.

Breuste, J. (2012). The concept of ecocities and solarCity Linz, Austria, as example for urban ecological development. Laufener Spezialbeiträge Report. Retrieved from https://www.anl.bayern.de/publikationen/spezialbeitraege/doc/lsb2012_002_breuste_concept_of_solarcity_linz.pdf

Breuste, J., & Riepel, J. (2008). Development of the EcoCity-Why and where sustainable urban development? In A. L. Singh, & F. Sahab (Eds), *Urban environmental management*. New Delhi: B. R. Publishers.

Brown, G. & Mooney, P. (2013). *Ecosystem services, natural capital & nature's benefits in the urban region: Information for professionals & citizens*. Report supported by Landscape Architecture Canada Foundation. Retrieved from: https://www.bcsla.org/sites/default/files/documents/Sent%20Final%20Ecosystem%20Services%20Natural%20Capital%20%20Natures%20Benefits%20%20In%20the%20Urban%20Region%20Information%20for%20Professionals%20%20Citizens.pdf

Buckner, J. (1988). Development of an instrument to measure neighborhood cohesion. *American Journal of Community Psychology, 16* (6), 771–91.

Butler, C. D., Corvalán, C. F., & Koren, H. S. (2005). Human health, well-being, and global ecological scenarios. *Ecosystems, 8*(2), 153-162. doi:10.1007/s10021-004-0076-0

Caprotti, F. (2014). Eco-urbanism and the eco-city, or, denying the right to the city?: Eco-urbanism and the eco-city. *Antipode, 46*(5), 1285-1303.

Caprotti, F., Springer, C., & Harmer, N. (2015). 'Eco' for whom? Envisioning eco-urbanism in the Sino-Singapore Tianjin Eco-City, China. *International Journal of Urban and Regional Research, 39*(3), 495-517. doi:10.1111/1468-2427.12233

Castle, H. (2008). Dongtan, China's flagship Eco-City: An interview with peter head of Arup. *Architectural Design, 78*(5), 64-69. doi:10.1002/ad.741

Chan, K. M. A., Guerry, A. D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., ... Woodside, U. (2012). Where are cultural and social in ecosystem services? A framework for constructive engagement. *Bioscience, 62*(8), 744-756.

Chance, T. (2009). Towards sustainable residential communities; the Beddington Zero Energy Development (BedZED) and beyond. *Environment & Urbanization, 21*(2), 527-544. doi:10.1177/0956247809339007

Chang, I. C., & Sheppard, E. (2013). China's eco-cities as Variegated urban sustainability: Dongtan eco-city and Chongming eco-island. *The Journal of Urban Technology, 20*(1), 57. doi:10.1080/10630732.2012.735104

Chiariotti, F., Condoluci, M., Mahmoodi, T., & Zanella, A. (2016). SymbioCity: Smart cities for smarter networks. *Transactions on Emerging Telecommunications Technologies, 29*(1). doi:10.1002/ett.3206

Chi, G., & Yang, Z. (2009). Evaluation model of scientific development based on circulating revision. *Systems Engineering - Theory & Practice Online, 29*(11), 31-45. doi:10.1016/S1874-8651(10)60081-6

Craig, D., Uchida, Marc, L. S, Shellie, E. S., & Sean, V. (2014). *Neighborhoods and Crime: Collective Efficacy and Social Cohesion in Miami-Dade County*. Report to the National Institute of Justice, Office of Justice Programs.

Cohen, D. A., Inagami, S., & Finch, B. (2008). The built environment and collective efficacy. *Health and Place, 14*(2), 198-208. doi:10.1016/j.healthplace.2007.06.001

Cooper, T. L., Bryer, T. A., & Meek, J. W. (2006). Citizen-centered collaborative public management. *Public Administration Review, 66*(1), 76-88. doi:10.1111/j.1540-6210.2006.00668.x

Costanza, R., & Kubiszewski, I. (2012). The authorship structure of "ecosystem services" as a transdisciplinary field of scholarship. *Ecosystem Services, 1*(1), 16-25. doi:10.1016/j.ecoser.2012.06.002

CSUS – Chinese Society for Urban Studies (2012). *China's low-carbon cities and ecocities 2012 report.* Beijing: China Construction Press. [In Chinese]

CSUS – Chinese Society for Urban Studies (2015). *Chinese green book: Chinese ecocity development 2015 report*. Beijing: China Construction Press. [In Chinese]

Cugurullo, F. (2015). Urban eco-modernisation and the policy context of new eco-city projects: Where Masdar City fails and why. *Urban Studies, 53*(11), 2417-2433. doi:10.1177/0042098015588727

de Jong, M., Wang, D., & Yu, C. (2013). Exploring the relevance of the eco-city concept in China: The case of Shenzhen Sino-Dutch low carbon city. *Journal of Urban Technology, 20*(1), 95-113.

de Jong, M., Yu, C., Chen, X., Wang, D., & Weijnen, M. (2013). Developing robust organizational frameworks for Sino-foreign eco-cities: Comparing Sino-Dutch Shenzhen

low carbon city with other initiatives. *Journal of Cleaner Production, 57*, 209-220. doi:10.1016/j.jclepro.2013.06.036

Díaz, S., Quétier, F., Cáceres, D. M., Trainor, S. F., Pérez-Harguindeguy, N., Bret-Harte, M. S., . . . Poorter, L. (2011). Linking functional diversity and social actor strategies in a framework for interdisciplinary analysis of nature's benefits to society. *Proceedings of the National Academy of Sciences of the United States of America, 108*(3), 895-902. doi:10.1073/pnas.1017993108

Ding, C. (2003). Land policy reform in China: Assessment and prospects. *Land use Policy, 20*(2), 109-120. doi:10.1016/S0264-8377(02)00073-X

Erickson, P. A. (1979). Environmental impact assessment: Principles and applications. New York: Academic Press.

Freilich, R. H., & Popowitz, N. M. (2010). The umbrella of sustainability: Smart growth, new urbanism, renewable energy and green development in the 21st century. *The Urban Lawyer, 42*(1), 1-39.

Fishman, R. (1977). *Urban utopias in the twentieth century: Ebenezer Howard, Frank Lloyd Wright, and le Corbusier*. New York: Basic Books.

Fleischer, F. (2010). *Suburban Beijing: Housing and consumption in contemporary China*. Minneapolis: University of Minnesota Press.

Friedmann, J. (2005). *China's urban transition*. Minneapolis, MN: University of Minnesota Press.

Friedmann, J. & Fang, C. (2011). Towards sustainable neighborhoods: The role of social planning in China-A case study of Ningbo, Zhejiang province. *City Plan 1*(1), 30-40.

Grêt-Regamey, A., Celio, E., Klein, T. M., & Wissen Hayek, U. (2013). Understanding ecosystem services trade-offs with interactive procedural modeling for sustainable urban planning. *Landscape and Urban Planning, 109*(1), 107-116. doi:10.1016/j.landurbplan.2012.10.011

Garoon, J., Engelman, M., Gitlin, L., & Szanton, S. (2016). Where does the neighborhood go? trust, social engagement, and health among older adults in Baltimore city. *Health & Place, 41*, 58-66. doi:10.1016/j.healthplace.2016.07.002

Geddes, P. (1915). Cities in evolution: An introduction to the town planning movement and to the study of civics. London: Ernest Benn.

Geng, Y., Dong, H., Xue, B., & Fu, J. (2012). An overview of Chinese green building standards. *Sustainable Development, 20*(3), 211-221.

Granek, E. F., Polasky, S., Kappel, C. V., Reed, D. J., Stoms, D. M., Koch, E. W., . . . Wolanski, E. (2010). Ecosystem services as a common language for coastal ecosystem-based management. *Conservation Biology, 24*(1), 207-216. doi:10.1111/j.1523-1739.2009.01355.x

Green Building Index (2010). International series 2010: The planning of Sino-Singapore Tianjin Eco-City + update on GBI Malaysia. Advertising pamphlet. *Green Building Index*, Kuala Lumpur.

Greenfield, E. A., & Reyes, L. (2015). Continuity and change in relationships with neighbors: Implications for psychological well-being in middle and later life. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 70*(4), 607-618. 10.1093/geronb/gbu084

Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., & Briggs, J. M. (2008). Global change and the ecology of cities. *Science, 319*(5864), 756-760. doi:10.1126/science.1150195

Guan, X. (2000). China's social policy: Reform and development in the context of marketization and globalization. *Social Policy and Administration, 34*(1), 115–130.

Guan, X., & Chow, J. (2003). The development of urban community services in China. *Social Development Issues, 25*(3), 51–61.

Gui, Y., & Huang, R. (2008). Shequ shehui ziben celiang: yixiang jiyu jingyan shujude yanjiu. Measuring social capital at community scale: A quantitative study based on survey. *Social Science Study, 3*, 122-142.

Guo, Y., Zhang, J., Zhang, Y., & Zheng, C. (2018). Catalyst or barrier? The influence of Place attachment on perceived community resilience in tourism destinations. *Sustainability, 10*(7), 1-14.

Haines-Young, R., & Potschin, M. (2009). *Methodologies for defining and assessing ecosystem services*. Final Report to JNCC by Center for Environmental Management and University of Nottingham. Contract No: C08-0170-0062.

Haines-Young, R. & Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. In Raffaelli, D. & C. Frid (eds.) *Ecosystem ecology: A new synthesis*. BES Ecological Reviews Series, CUP, Cambridge.

Hall, P. (1996). Cities of tomorrow: An intellectual history of urban planning and design in the twentieth century. Oxford: Blackwell.

Hansen, R., Frantzeskaki, N., McPhearson, T., Rall, E., Kabisch, N., Kaczorowska, A., Pauleit, S. (2015). The uptake of the ecosystem services concept in planning discourses of European and American cities. *Ecosystem Services, 12*(12), 228-246. doi:10.1016/j.ecoser.2014.11.013

Hauck, J., Gorg C, Varjopuro. R., Ratamaki, O., Maes, J., Wittmer, H., & Jax, K. (2013). Maps have an air of authority: Potential benefits and challenges of ecosystem service maps at different levels of decision making. *Ecosystem Services, 4*(4):25–32.

Hauck, J., Saarikoski, H., Turkelboom, F., & H. Keune (2016): Stakeholder Analysis in ecosystem service decision-making and research. In: Potschin, M. and K. Jax (eds): *OpenNESS Ecosystem Services Reference Book*. EC FP7 Grant Agreement no. 308428. Available via: www.openness-project.eu/library/reference-book

Häuberer, J. (2011). *Social capital theory: Towards a methodological foundation*. VS Verl. für Sozialwiss.

Hazelzet, A., & Wissink, B. (2012). Neighborhoods, social networks, and trust in post-reform China: The case of Guangzhou. *Urban Geography, 33*(2), 204-220.

He, S., & Wu, F. (2007). Socio-spatial impacts of property-led redevelopment on China's urban neighbourhoods. *Cities, 24*(3), 194–208.

Healey, P. (2006). Relational complexity and the imaginative power of strategic spatial planning1. *European Planning Studies, 14*(4), 525-546. doi:10.1080/09654310500421196

Heinze, M., & Voss, K. (2009). Goal: Zero energy building exemplary experience based on the solar estate Solarsiedlung Freiburg am Schlierberg, Germany. *Journal of Green Building, 4*(4), 93-100. doi:10.3992/jgb.4.4.93

Hipp, J. R. (2009). Specifying the determinants of neighborhood satisfaction: A robust assessment in 24 metropolitan areas. *Social Forces, 88*(1), 395-424. doi:10.1353/sof.0.0239

Howard, E. (1898). *To-morrow: A peaceful path to real reform*. London: Swann Sonnenschein.

Hu, X., & Li, X. (2016). *The study on transformation of government functions in urban community care services for the old: Based on a survey of Tianjin Binhai New Area*. The 2016 International Conference on Public Management (IPM, 2016), Advances in economics, business and management research. doi:10.2991/icpm-16.2016.100

Huang, L., Wu, J., & Yan, L. (2015). Defining and measuring urban sustainability: A review of indicators. *Landscape Ecology, 30*(7), 1175-1193.

Huang, R., & Sun, X. (2014). Weibo network, information diffusion and implications for collective action in China. *Information, Communication & Society, 17*(1), 86-104. doi:10.1080/1369118X.2013.853817

Hughey, J., & Speer, P. W. (2002). Community, sense of community, and networks. In A.T. Fisher, C.C. Sonn, & B. J. Bishop (Eds.), *Psychological sense of community: Research, applications, and implications* (pp. 69-84). New York: Kluwer Academic/Plenum.

Ignatieva, M.E., & Berg, P. (2014). *Hammarby Sjöstad —* A new generation of sustainable urban eco-districts. *The Nature of Cities*. Retrieved from https://www.thenatureofcities.com/2014/02/12/hammarby-sjostad-a-new-generation-of-sustainable-urban-eco-districts/

Imura, H. (2010). Eco-cities: re-examining concepts and approaches. In Lye, L. F. & Chen, G. (Eds) *Towards a liveable and sustainable urban environment: Eco-cities in East Asia* (19–46). Singapore: World Scientific Publishing.

Innes, J. (1996). Planning through consensus building: A new view of the comprehensive planning ideal. *Journal of the American Planning Association, 62*(4): 460–472.

Innes, J., & Booher, D. (2003). Collaborative policymaking: Governance through dialogue. In H. Maarten, & H. Wagenaar (Eds.) *Deliberative policy analysis: Understanding governance in the network society* (pp. 33-59). Cambridge: Cambridge University Press.

James, P. (2014). *Urban sustainability in theory and practice: Circles of sustainability*. Abingdon, Oxon; New York, NY: Routledge. doi:10.4324/9781315765747

Jing, Y., Cui, Y., & Li, D. (2015). The politics of performance measurement in China. *Policy and Society, 34*(1), 49-61. doi:10.1016/j.polsoc.2015.02.001

Jonassen, D.H., Beissner, K., & Yacci, M.A. (1993). *Structural knowledge: Techniques for representing, conveying, and acquiring structural knowledge*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Jongman, R. H. G., Külvik, M., & Kristiansen, I. (2004). European ecological networks and greenways. *Landscape and Urban Planning, 68*(2), 305-319.

Jordan, H. (1994). Public parks, 1885-1914. *Garden History, 22*(1), 85-113.

Joss, S., & Molella, A. P. (2013). The eco-city as urban technology: Perspectives on caofeidian international eco-city (China). *The Journal of Urban Technology, 20*(1), 115-137.

Joss, S., & Molella, A. (2013). The eco-city as urban technology: Perspectives on Caofeidian international eco-city (China). *Journal of Urban Technology, 20*(1), 115-137.

Kaiman, J. (2014). China's "eco-cities": Empty of hospitals, shopping centers and people. *The Guardian*, April 14. https://www.theguardian.com/cities/2014/apr/14/china-tianjin-eco-city-empty-hospitals-people

Kadlec, R.H., C. Cuvellier, and T. Stober. 2010. Performance of the Columbia Missouri treatment wetland. *Ecological Engineering 36*(5), 672 – 684

Kasarda, J. D., & Janowitz, M. (1974). Community attachment in mass society. *American Sociological Review, 39*(3), 328-339. doi:10.2307/2094293

Kenworthy, J. R. (2006). The eco-city: Ten key transport and planning dimensions for sustainable city development. *Environment & Urbanization, 18*(1), 67-85. doi:10.1177/0956247806063947

Kingston, S., Mitchell, R., Florin, P., & Stevenson, J. (1999). Sense of community in neighborhoods as a multi-level construct. *Journal of Community Psychology, 27*, 681-694.

Kuo, F. (2010). *Parks and other green environments: Essential components of a healthy human habitat*. National Recreation and Park Association research series. https://www.nrpa.org/uploadedFiles/nrpa.org/Publications_and_Research/Research/Papers/MingKuo-Summary.PDF

La Notte, A., D'Amato, D., Mäkinen, H., Paracchini, M. L., Liquete, C., Egoh, B., . . . Crossman, N. D. (2017). Ecosystem services classification: A systems ecology perspective of the cascade framework. *Ecological Indicators, 74*(3), 392-402.

Larsen, L., Harlan, S. L., Bolin, B., Hackett, E. J., Hope, D., Kirby, A., Nelson, A., Rex, T. R., & Wolf, S. (2004). Bonding and bridging: Understanding the relationship between social capital and civic action. *Journal of Planning Education and Research, 24*(1), 64-77. doi:10.1177/0739456X04267181

Larson, K. (2013). Foreword: From mass customization of goods and services to mass customised cities: A global imperative. In Piroozfar, Poorang A.E, and Piller, Prank T (Eds.) *Mass Customisation and Personalisation in Architecture and Construction* (xviii-xxi), New York: Abingdon.

Lee, S. M. Y. (2011). Preliminary research of carbon-sink effect of Tianjin's wetlands system in the context of global climate change. *Energy Procedia, 11*, 2666-2671. doi:10.1016/j.egypro.2011.10.593

Li, B. (1993). Danwei culture as urban culture in modern China: The case of Beijing from 1949 to 1979. In G., Guldin, A. Southall (Eds.) *Urban Anthropology in China* (pp. 345–352). Leiden, The Netherlands: E.J. Brill.

Li, X., & Liu. Y. (2011). The current situations, problems solutions of Chinese eco-cities development. *Urban Planning Forum, 4*, 23-29.

Li, Y., Sun, F., He, X., & Chan, K. S. (2011). Sense of community and depressive symptoms among older earthquake survivors following the 2008 earthquake in Chengdu China. *Journal of Community Psychology, 39*(7), 776-785. doi:10.1002/jcop.20469

Lin, N., Cook, K. S., & Burt, R. S. (2001). *Social capital: Theory and research*. New York: Aldine de Gruyter.

Lin, N., Ye, X., & Ensel, W. M. (1999). Social support and depressed mood: A structural analysis. *Journal of Health and Social Behavior, 40*(4), 344-359.

Liu, M., Liu, X., & Yang, Z. (2016). An integrated indicator on regional ecological civilization construction in China. *International Journal of Sustainable Development & World Ecology, 23*(1), 53-60.

Liu, M. M., Ness, D., & Huang, H. (2011). *The green economy and its implementation in China*. Chicago: Enrich Professional Publishing.

Liu, Z., & Salzberg, A. (2012). Developing low-carbon cities in China: Local governance, municipal finance, and land-use planning – The key underlying drivers. In A., Baeumler, E. Ijjasz-vasquez, & S. Mehndiratta (Eds.), *Sustainable low-carbon city development in China* (pp.97-127). Washington, DC: World Bank.

Liu, C. (2006). Social Changes and neighbourhood policy in Shanghai. *Policy and Society, 25*(1), 133-155, DOI: 10.1016/S1449-4035(06)70130-8

Long, D. A., & Perkins, D. D. (2003). Confirmatory factor analysis of the sense of community index and development of a brief SCI. *Journal of Community Psychology, 31*(3), 279-296. doi:10.1002/jcop.10046

Low, M. (2013). Eco-cities in Japan: Past and future. *The Journal of Urban Technology, 20*(1), 7. doi:10.1080/10630732.2012.735107

Luederitz, C., Lang, D. J., & Von Wehrden, H. (2013). A systematic review of guiding principles for sustainable urban neighborhood development. *Landscape and Urban Planning, 118*(10), 40-52.

Lu, T., Zhang, F., & Wu, F. (2018). Place attachment in gated neighbourhoods in China: Evidence from Wenzhou. *Geoforum, 92*, 144-151. doi:10.1016/j.geoforum.2018.04.017

Lye, L. F., & Gang, C. (2010). *Towards a liveable and sustainable urban environment: Eco-cities in East Asia*. Hackensack, NJ; Singapore: World Scientific.

Lynch, K. (1960). *The image of the city*. Cambridge, MA: Technology Press.

MacKaye, B. (1940). Regional planning and ecology. *Ecological Monographs, 10*(3), 340-351.

Maclaren, V. (1996). Urban sustainability reporting, *Journal of the American Planning Association, 62*(2): 1-21.

Maclaren, V. W. (1996). Urban sustainability reporting. *Journal of the American Planning Association, 62*(2), 184-202.

Manzo, L. C., & Perkins, D. D. (2006). Finding common ground: The importance of place attachment to community participation and planning. *Journal of Planning Literature, 20*(4), 335-350. doi:10.1177/0885412205286160

Margules, C. R., & Sarkar, S. (2007). *Systematic conservation planning*. Cambridge; New York: Cambridge University Press.

Martin-Lopez, B., Gomez-Baggethun, E., Garcia-Llorente, M., & Montes, C. (2014). Trade-offs across value-domains in ecosystem services assessment. *Ecological Indicators, 37*, 220.

Masango, R. (2002). Public participation: A critical ingredient of good governance. *Politeia, 21*(2), 52-65.

McHarg, I. (1969). *Design with nature*. Garden City, NY: Natural History Press.

McHarg, I. (1997). Ecology and design. In G. F. Thompson & F. R. Steiner (Eds.) *Ecological design and planning* (pp. 321-332). New York: John Wiley and Sons.

McManus, P. (2012). Measuring urban sustainability: The potential and pitfalls of city rankings. *Australian Geographer, 43*(4), 411.

McMillan, D. W., & Chavis, D. M. (1986). Sense of community: A definition and theory. *Journal of Community Psychology, 14*(1), 6–23.

MEA – Millennium Ecosystem Assessment. (2005). Millennium *ecosystems assessment*. Washington, DC: Island Press.

Mooney, P. (2014). A systematic approach to incorporating multiple ecosystem services in landscape planning and design. *Landscape Journal, 33*(2), 141-171.

Morenoff, J. D., Sampson, R. J., & Raudenbush, S. W. (2001). Neighborhood inequality, collective efficacy, and the spatial dynamics of urban violence. *Criminology, 39*(3), 517-558. doi:10.1111/j.1745-9125.2001.tb00932.x

Mori, K., & Christodoulou, A. (2012). Review of sustainability indices and indicators: Towards a new city sustainability index (CSI). *Environmental Impact Assessment Review, 32*(1), 94-106. doi:10.1016/j.eiar.2011.06.001

Mumford, L. (1938). *The culture of cities*. New York: Harcourt, Brace and company.

Narayan-Parker, D. (1999). *Bonds and bridges: Social capital and poverty*. Washington: World Bank.

Nasar, J. & David, A. (1995). Psychological sense of community in the neighborhood. *Journal of the American Planning Association* 61, 178–84.

Ndubisi, F. (2002). *Ecological planning: A historical and comparative synthesis*. Baltimore and London: The Johns Hopkins University Press.

Ndubisi, F. (2008). Sustainable regionalism: Evolutionary framework and prospects for managing metropolitan landscapes. *Landscape Journal, 27*(1), 51-68.

Ndubisi, F. (2014). *The ecological design and planning reader*. F. Ndubisi (Ed.). Washington, DC: Island Press.

Newig, J., & Fritsch, O. (2009). Environmental governance: Participatory, multi-level – and effective? *Environmental Policy and Governance, 19*(3), 197-214.

Northridge, M. E., Sclar, E. D., & Biswas, P. (2003). Sorting out the connections between the built environment and health: A conceptual framework for navigating pathways and planning healthy cities. *Journal of Urban Health, 80*(4), 556-568. doi:10.1093/jurban/jtg064

Nusca, 2010. China's solar valley: Biggest solar energy production base in world. *ZDNet*, May 21, 2010.

Ohmer, M. (2007). Citizen participation in neighborhood organizations and its relationship to volunteers' self- and collective efficacy and sense of community. *Social Work Research, 31*(2), 109–120.

Pandis Iverot, S., Brandt, N. (2011). The development of a sustainable urban district in Hammarby Sjöstad, Stockholm, Sweden? *Environment, Development and Sustainability, 13*(6), 1043-1064. doi:10.1007/s10668-011-9304-x

Perkins, D., Barbara, B., & Ralph, T. (1996). The ecology of empowerment: Predicting participation in community organizations. *Journal of Social Issues, 52*(1): 85–110.

Perkins, D., & Long, A. (2002). Neighborhood sense of community and social capital: A multi-level analysis. In A. Fisher, C. Sonn, and B. Bishop (Eds.) *Psychological sense of community: Research, applications, and implications* (pp. 291–316). New York: Plenum.

Plant, R. & Ryan, P. (2013). Ecosystem services as a practicable concept for natural resource management: some lessons from Australia, International Journal of Biodiversity Science, *Ecosystem Services & Management, 9*(1), 44-53, DOI: 10.1080/21513732.2012.737372

Pow, C. P. (2007). Securing the 'civilised' enclaves: Gated communities and the moral geographies of exclusion in (Post-)socialist Shanghai. *Urban Studies, 44*(8), 1539-1558.

Pow, C. P., & Neo, H. (2010). Building ecotopia: Critical reflections on eco-city development in China. In L.F. Lye & C. Gang (Eds.), *Towards a liveable and sustainable environment: Eco-cities in East Asia* (pp. 91-106). Singapore: World Scientific.

Pow, C. P., & Neo, H. (2015). Modelling green urbanism in China. *Area, 47*(2), 132-140.

Putnam, R. D. (2000). *Bowling along: The collapse and revival of American community*. New York: Simon & Schuster.

Qiu, B. X. (2009). Cong lüse jianzhu dao ditan shengtaicheng [From green building to low carbon eco-city], *Urban development studies, 16*(7), 1–11. [In Chinese]

Rapoport, E. (2014). Utopian visions and real estate dreams: The eco-city past, present and future: Utopian visions and real estate dreams. *Geography Compass, 8*(2), 137-149. doi:10.1111/gec3.12113

Rees, W. (1992). Ecological footprints and appropriated carrying capacity: What urban economics leaves out. *Environment & Urbanization, 4*(2), 121-130.

Rees, W. (1996). Revisiting carrying capacity: Area-based indicators of sustainability. Populations and Environment: *A Journal of Interdisciplinary Studies, 17*(3), 195-215.

Register, R. (1987). *Ecocity Berkeley: Building cities for a healthy future*. Berkeley, CA: North Atlantic Books.

Register, R. (2002). *Ecocities: Building Cities in Balance with Nature.* Berkeley, CA: Berkeley Hills Books.

Register, R. (2016a). *World rescue: An economics built on what we build*. Richard Register.

Register, R. (2016b). *Ecocities illustrated: the easily built visionary future of*. Richard Register.

Robert, K. W., Parris, T. M., & Leiserowitz, A. A. (2005). What is sustainable development? goals, indicators, values, and practice. *Environment: Science and Policy for Sustainable Development, 47*(3), 8-21. doi:10.1080/00139157.2005.10524444

Roggema, R. (2017). The future of sustainable urbanism: Society-based, complexity-led, and landscape-driven. *Sustainability, 9*(8), 1442. doi:10.3390/su9081442

Roseland, M. (1997). Dimensions of the eco-city. *Cities, 14*(4), 197-202. doi:10.1016/S0264-2751(97)00003-6

Rowe, W. T. (1989). *Hankow: Commerce and society in a Chinese city, 1796-1889*. Stanford, California: Stanford University Press.

Rydin, Y., & Pennington, M. (2000). Public participation and local environmental planning: The collective action problem and the potential of social capital. *Local Environment, 5*(2), 153-169. doi:10.1080/13549830050009328

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science, 277*(5328), 918-924. doi:10.1126/science.277.5328.918

Sanoff, H. (2000). *Community participation methods in design and planning*. New York: Wiley.

Sedikides, C., & Wildschut, T. (2018). Finding meaning in nostalgia. *Review of General Psychology, 22*(1), 48-61. doi:10.1037/gpr0000109

Shashua-Bar, L., Tsiros, I. X., & Hoffman, M. (2012). Passive cooling design options to ameliorate thermal comfort in urban streets of a Mediterranean climate (Athens) under hot summer conditions. *Building and Environment, 57*, 110-119. doi:10.1016/j.buildenv.2012.04.019

Shen, L., Jorge Ochoa, J., Shah, M. N., & Zhang, X. (2011). The application of urban sustainability indicators: A comparison between various practices. *Habitat International, 35*(1), 17-29.

Shepard, W. (2015). *Ghost cities of China: The story of cities without people in the world's most populated country*. London: Zed Books.

Shepard, W. (2017). No joke: Chia is building 285 Eco-cities, here's why. *Forbes*, September 2017. https://www.forbes.com/sites/wadeshepard/2017/09/01/no-joke-china-is-building-285-eco-cities-heres-why/#3b7b7c672fe8

Shiuh-Shen, C. (2013). Chinese eco-cities: A perspective of land-speculation-oriented local entrepreneurialism. *China Information, 27*(2), 173-196.

Shumaker, S., & Taylor, R. B. (1983). Towards a clarification of people-place relationship: A model of attachment to place. In E.S., Geller, & R. Nickolaus. (eds.), *Environmental Psychology: Directions and perspectives* (pp. 219-251), London: Sage Publication.

Skinner, S. (1982). *The living earth manual of Feng-shui*. London: Routledge & Kegan Paul.

Soy-Massoni, E., Langemeyer, J., Varga, D., Sáez, M., & Pintó, J. (2016). The importance of ecosystem services in coastal agricultural landscapes: Case study from the Costa Brava, Catalonia. *Ecosystem Services, 17*, 43-52.

Stedman, R. C. (2003). Is it really just a social construction?: The contribution of the physical environment to sense of place. *Society & Natural Resources, 16*(8), 671-685. doi:10.1080/08941920309189

Stone, R., Dwyer, L., & Sethi, G. (1996). Exploring visions of "built" community. In R. Stone (ed.) *Core issues in comprehensive community-building initiatives* (p.21). Chicago: Chapin Hall Center for Children at the University of Chicago.

Suzuki, D. T. (1994). *Time to change: Essays*. Toronto, Canada: Stoddart.

Solecki, W., Rosenzweig, C., Mehrotra, S., & Hammer, S. A. (2010). Cities lead the way in climate-change action. *Nature, 467*(7318), 909-911. doi:10.1038/467909a

Svane, Ö. (2008). Situations of opportunity – Hammarby sjöstad and Stockholm city's process of environmental management. *Corporate Social Responsibility and Environmental Management, 15*(2), 76-88. doi:10.1002/csr.138

Sze, J. (2015). Fantasy islands: Chinese dreams and ecological fears in an age of climate crisis. Oakland, California: University of California Press.

Termorshuizen, J. W., Opdam, P., & van den Brink, A. (2007). Incorporating ecological sustainability into landscape planning. *Landscape and Urban Planning, 79*(3), 374-384.

TEEB – The Economics of Ecosystems and Biodiversity. (2011). TEEB manual for cities: Ecosystem services in urban management. www.teebweb.org

TEEB – The Economics of Ecosystems and Biodiversity. (2012). *TEEB in local and regional policy and management*. Washington, DC; London: Earthscan.

The Guardian. (2017). *Too fast, too soon: How China's growth led to the Tianjin disaster*. https://www.theguardian.com/cities/2017/may/23/city-exploded-china-growth-tianjin-disaster-inevitable

Tomaka, J., Thompson, S., & Palacios, R. (2006). The relation of social isolation, loneliness, and social support to disease outcomes among the elderly. *Journal of Aging and Health, 18*(3), 359-384. doi:10.1177/0898264305280993

Turiel, J., Ding, I., & Chung-En Liu, J. (2017). *Environmental governance in China: State, society, and market*. Leiden: Brill.

Unger, D. G., & Wandersman, A. (1985). The importance of neighbors: The social, cognitive, and affective components of neighboring. *American Journal of Community Psychology, 13*(2), 139-169. doi:10.1007/BF00905726

Uzzell, D., Pol, E., & Badenas, D. (2002). Place identification, social cohesion, and environmental sustainability. *Environment and Behavior, 34*(1), 26-53. doi:10.1177/0013916502034001003

Vanclay, F. (2008). *Making sense of place*. Canberra: National Museum of Australia Press.

Voß, J., & Bornemann, B. (2011). The politics of reflexive governance: Challenges for designing adaptive management and transition management. *Ecology and Society, 16*(2), 9. doi:10.5751/ES-04051-160209

Wackernagel, M., & Rees, W. E. (1996). *Our ecological footprint: Reducing human impact on the earth*. Gabriola Island, BC: New Society Publishers.

Wallace, K. J. (2007). Classification of ecosystem services: Problems and solutions. *Biological Conservation, 139*(3), 235-246. doi:10.1016/j.biocon.2007.07.015

Walmsley, A. (2006). Greenways: Multiplying and diversifying in the 21st century. *Landscape and Urban Planning, 76*(1), 252-290.

Wang, Y., Ding, Q., & Zhuang, D. (2015). An eco-city evaluation method based on spatial analysis technology: A case study of Jiangsu province, China. *Ecological Indicators, 58*, 37-46. doi:10.1016/j.ecolind.2015.05.032

Wang, Y.P. (2012) Housing the urban poor in a marketised system in China, *Urban Policy and Research, 30*(4), 423- 441.

Wei, Y.F. (2010). Urban migrants' job assessment: A comparison theory study. Chengshi xinyimin de zhiye huode: yige bijiao lilun yanjiu. *Zhejiang Social Sciences, 11*(11), 47-53.

Wendel, D. (2009). Imageability and justice in contemporary New Orleans. *Journal of Urban Design, 14*(3), 345-375. doi:10.1080/13574800903056804

Wiens, J. A. (1989). Spatial scaling in ecology. *Functional Ecology, 3*(4), 385-397.

Wissen Hayek, U., Teich, M., Klein, T. M., & Grêt-Regamey, A. (2016). Bringing ecosystem services indicators into spatial planning practice: Lessons from collaborative development of a web-based visualization platform. *Ecological Indicators, 61*(2), 90-99. doi:10.1016/j.ecolind.2015.03.035

Wolfe, L. D. S., & Larry Wolfe Associates. (1987). *Methods for scoping environmental impact assessments: Review of literature and experience*. Vancouver: Federal Environmental Assessment Review Office.

Woldoff, R. A. (2002). The effects of local stressors on neighborhood attachment. *Social Forces, 81*(1), 87-11. Doi.org/10.1353/sof.2002.0065

World Bank. (2006). Water quality management: Policy and institutional considerations. Discussion Papers. Washington DC: The World Bank. Available online http://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/China_WPM_final_lo_res.pdf

World Bank. (2012). Sustainable low-carbon city development in China. Washington DC.

World Bank & Development Research Center of the State Council of People's Republic of China. (2014). *Urban China: Toward efficient, inclusive, and sustainable urbanization*. Washington, DC. doi:10.1596/978-1-4648-0206-5solutions

Wu, C. P. (2014). Low-carbon policy and action in the Chinese mainland: An overview of current development. *Chinese Studies, 3*(4), 157-164.

Wu, F. L. (2012). China's eco-cities. Geoforum, 43(2), 169-171.

Xu, B., Li, D., & Shao, B. (2012). Knowledge sharing in virtual communities: A study of citizenship behavior and its social-relational antecedents. *International Journal of Human-Computer Interaction, 28*(5), 347-359. doi:10.1080/10447318.2011.590121

Xu, Q., & Chow, J. C. (2006). Urban community in China: Service, participation and development. *International Journal of Social Welfare, 15*(3), 199-208.

Xu, Q., Perkins, D. D., & Chow, J. C. (2010). Sense of community, neighboring, and social capital as predictors of local political participation in china. *American Journal of Community Psychology, 45*(3), 259-271. doi:10.1007/s10464-010-9312-2

Yamamura, E. (2010). Effects of interactions among social capital, income and learning from experiences of natural disasters: A case study from Japan. *Regional Studies, 44*(8), 1019-1032. 10.1080/00343400903365144

Yan, M. C., & Gao, J. G. (2007). Social engineering of community building: Examination of policy process and characteristics of community construction in China. *Community Development Journal, 42*(2), 222–236.

Yeh, E. (2015) Political ecology in and of China. In R. Bryant (ed.) *Handbook of political ecology* (pp.619-632), London: Edward Elgar.

Ye, H. J., Feng, Y., & Choi, B. C. F. (2015). Understanding knowledge contribution in online knowledge communities: A model of community support and forum leader support. *Electronic Commerce Research and Applications, 14*(1), 34-45. doi:10.1016/j.elerap.2014.11.002

Yip, W., Subramanian, S. V., Mitchell, A. D., Lee, D. T. S., Wang, J., & Kawachi, I. (2007). Does social capital enhance health and well-being? Evidence from rural China. *Social Science & Medicine, 64*(1), 35-49. doi:10.1016/j.socscimed.2006.08.027

Yu, K. J. (1994). Landscape into places: Feng-shui model of place making and some cross-cultural comparison. In J.D. Clark (ed) *History and culture* (pp. 320-340). Mississippi, MS: Mississippi State University.

Yu, K. J., Li, D. H., & Ji, Q. P. (2001). Chengshi jingguanyu shengtaisheji:gainianyu yuanze [Ecological design for landscape and city: Concepts and principles]. *Journal of Chinese Landscape and Architecture, 6*, 3-9. [In Chinese]

Yu, K. J., Duan, T.W., Li, D.H., & Peng, J.F. (1999). Jingguan kedaxing zuowei hengliang chengshi lvdixitong gongneng zhibiao de pingjia fangfa yu anli [Landscape accessibility as a measurement of the function of urban green system. *City Planning Review 23*(8), 8-11. [In Chinese]

Zhang, L. (2007). The interpretation of ecological modernisation in China. *Environmental Politics, 16*(4), 659-668.

Zhang, L., Wang, H., Wang, L., & Hsiao, W. (2006). Social capital and farmer's willingness-to-join a newly established community-based health insurance in rural China. *Health Policy, 76,* 233– 242.

Zhang, W. (2007). Zhongguo de shehui ziben yanjiu: Gainian, caoduohua celiang he jingyan yanjiu. A literature review of China's social capital: Concept, measurement and practices. *Jiangsu Social Science, 3*, 142-149.

Zhang, Z. (2010). China in the transition to a low-carbon economy. *Energy Policy, 38*(11), 6638-6653. doi:10.1016/j.enpol.2010.06.034

Zhao, W., & Zhao, M. (2002). From residential area planning to community planning. *Urban Plan. Forum, 6*(6), 68-71.

Zhou, N., He, G. & Williams, C. (2012). *China's development of low-carbon eco-cities and associated indicator systems* (LBNL-5873E). Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory.

Zhou, N., Williams, C. (2013). *An international review of eco-city theory, indicators, and case studies*. Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory.

Zhu, Y. (2015). Toward community engagement: Can the built environment help? Grassroots participation and communal space in Chinese urban communities. *Habitat International, 46*, 44-53.

Appendices

Appendix 1 Key Performance Indicators (KPIs) developed for the SSTEC project

Quantitative KPIs (22)	Description
A. Good Natural Environment	
Ambient Air Quality	The air quality in the Eco-city should meet at least China's National Ambient Air Quality Grade II Standard for at least 310 days. The SO2 and NOx content in the ambient air should not exceed the limits stipulated for China's National Ambient Air Quality Grade 1 standard for at least 155 days.
Quality of water bodies	Water bodies in the Eco-city should meet Grade IV of China's latest national standards.
Quality of Water from Taps	Water from all taps should be potable.
Noise Pollution Levels	Noise pollution levels must satisfy the stipulated standards for different functional zones.
Carbon Emission Per Unit GDP	The carbon emission per unit GDP should not exceed 150 tonne-C per US$1 million.
Net Loss of Natural Wetlands	There should be no net loss of natural wetlands in the Eco-city.
B. Healthy Balance in the Man-made Environment	
Proportion of Green Buildings	All buildings in the Eco-city should meet green building standards.
Native Vegetation Index	At least 70% of the plant varieties in the Eco-city should be native plants/vegetation.
Per Capita Public Green Space	The public green space should be at least 12 square metres per person.
C. Good Lifestyle Habits	
Per Capita Daily Water Consumption	The daily water consumption per day each person should not exceed 120 litres.
Per Capita Daily Domestic Waste Generation	The amount of domestic waste generated by each person should not exceed 0.8 kg.
Proportion of Green Trips	At least 90% of trips within the Eco-city should be in the form of non-motorised transport, i.e. cycling and walking, public transport.
Overall Recycling Rate	At least 60% of total waste should be recycled.
Access to Free Recreational and Sports Amenities	All residential areas in the Eco-city should have access to free recreational and sports amenities within a walking distance of 500m.
Waste Treatment	All hazardous and domestic waste in the Eco-city should be rendered non-toxic through treatment.
Barrier-Free Accessibility	The Eco-city should have 100% barrier-free access.
Services Network Coverage	The entire Eco-city will have access to key infrastructure services, such as recycled water, gas, broadband, electricity and heating.
Proportion of Affordable Public Housing	At least 20% of housing in the Eco-city will be in the form of subsidised public housing.
D. Developing a Dynamic and Efficient Economy	
Usage of Renewable Energy	The proportion of energy utilised in the Eco-city which will be in the form of renewable energy, such as solar and geothermal energy, should be at least 20%.
Usage of Water from Non-Traditional Sources	At least 50% of the Eco-city's water supply will be from non-traditional sources such as desalination and recycled water.
Proportion of R&D Scientists and Engineers in the Eco-city Workforce	There should be at least 50 R&D scientists and engineers per 10,000 workforce in the Eco-city.
Employment-Housing Equilibrium Index	At least 50% of the employable residents in the Eco-city should be employed in the Eco-city.
Qualitative KPIs (4)	
Maintain a safe and healthy ecology through green consumption and low-carbon operations. Adopt innovative policies that will promote regional collaboration and improve the environment of the surrounding regions. Give prominence to the river estuarine culture to preserve history and cultural heritage, and manifest its uniqueness. Complement the development of recycling industries and promote the orderly development of the surrounding regions.	

Resource: The official website of the SSTEC (available at https://www.tianjinecocity.gov.sg/bg_kpis.htm)

Appendix 2 A review of individual ES in planning documents

ES	Description	Findings	Policy examples
Provisioning services: Material outputs from ecosystems			
Food	*Agriculture, food, crops, grain/dairy/vegetables produced, vegetable garden, fishery*	Regional food systems related to ES are not mentioned but are considered an important goal.	**TJ_1** Fishery is important for local economy. **TJ_3** Agriculture and fishery shall be supported to enhance the regional food system.
Ornamental plants	*Local plants, invasive plants, all season greenery, flowers and fruit trees, neighbourhood park*	Increasing vegetation is mentioned in several policies. This ES is used as an argument to introduce the goal and benefit.	**SSTEC_2** >12 m^2 per capita public green space; **SSTEC_4** Residents have access to parks **TJ_4** Community parks within 500 m circle to all new neighbourhoods
Freshwater	*Freshwater, drinking water, water supply, groundwater, water infiltration, water suspension, water storage*	Problem of water shortage is mentioned but is not linked to ES. Policies to promote better management of water resources focus on conserving water. No planning solutions are mentioned.	**TJ_7** Water availability of the region is decreasing **SSTEC_2** < 120 liters water consumption per day per person **SSTEC_7** 100% portable tap water within the eco-neighbourhood
Genetic resources	*Genetic material of actual or potential value. Any material of plant, animal, microbial or other origin containing functional units of heredity*	Not mentioned at all	-
Medicinal resources	*Biotechnological and pharmaceutical use of plants etc.*	Not mentioned at all	-
Raw materials	*Timber, energy (from biomass)*	Not mentioned at all	-
Biomass fuel	*Woody fuels, animal wastes, source for municipal solid waste*	Not mentioned at all	-
Regulating services: Ecosystem processes that serve as regulations of ecological systems			
Carbon sequestration and storage	*Gas cycles, carbon sequestration and storage, biomass/soils as carbon sinks*	Addressing potential climate change impacts as regional task is mentioned but is not related to ecosystems or planning solutions.	**SSTEC_2** Carbon emissions per unit of GDP: ≤150 tons C per one million US$ GDP **SSTEC_2** 100% green buildings **SSTEC_2** 20% renewable energy usage
Hazard regulation	*Noise reduction, stormwater regulation, reducing stormwater runoff; disease control*	Noise is mentioned as problem that needs to be mitigated. Toxic management is discussed as a new issue but is not related to ES.	**SSTEC_2** Mitigate noise caused by traffic, industries, and other resource **SSTEC_3** Reduce the risk of natural hazard while reclaiming and treating previously toxic sites.
Pollution mitigation	Quality of water, soil, and air, geological and hydrogeological resources	Goals and policies are related to reduction of air pollution and water body pollution but are not related to ES.	**SSTEC_2** Water quality reaches IV type **SSTEC_2** Air quality reaches II type **SSTEC_3** Safe handling of chemicals
Local climate & air quality regulation	*Local climate regulation, microclimate regulation, mitigating heat island effect, evapotranspiration, cooling, shading, reflecting solar radiation, wind blocking*	Vegetation loss is mentioned as problematic. Landscape policies in relation to vegetation protection – but are not related to ES	**TJ_4** Critical areas such as wetlands and floodplains are defined as non-for-development zone **SSTEC_4** Street trees and pedestrian shading affects comfort and visibility

ES	Description	Findings	Policy examples
Moderate impacts of weather extremes	*Flood prevention, buffering from damage through storms/floods/waves*	Flooding is mentioned several times. Ocean tides and summer storms are mentioned as problematic. Policies include: Protection of natural wetlands and redwood forests	**TJ_7** Reducing stormwater drainage infrastructure can lower infrastructure costs. **TJ_2** A hotter climate increases risks of noxious pest infection, and affect human health
Reduced erosion	*Erosion prevention, maintaining nutrient content*	Protection of natural resource land is mentioned as a goal but is not related to ES	**TJ_5** Prevent damaged riparian areas from further erosion
Seasonal drought mitigation	*Alternative water resource*	Water scarcity is mentioned as a problem but is not related to ES. Solutions rely on technology rather than on holistic planning/design	**SSTEC_2** 50% water supply from non-conventional sources **SSTEC_7** Integrate water supply into planning effort by coordinating infrastructure projects with water resource management activities
Wastewater treatment	*Wastewater treatment, filtering wastewater, sewage*	Impact on water quality; policies for reducing waste water but not related to ES	**SSTEC_1** 100% wastewater treated within the ecocity
Maintenance of soil fertility	*Crop rotations, manure management, compost, soil acidity and liming, fertilizer applications*	Not mentioned as a goal, but several policies do mention related planning solutions, e.g., gardening, urban farming, local food	**SSTEC_4** Yard and patio used to grow food **SSTEC_6** Growing number of urban farms
Erosion control	*Preventing or controlling wind or water erosion in agriculture, land development, coastal areas, river banks and construction*	Not mentioned at all	-
Pest and disease regulation	*Through actions of predators and parasites by the defence mechanism of their prey*	Not mentioned at all	-
Pollination	*Pollinations, bees, seed dispersal*	Not mentioned at all	-
Supporting services: The provision of living spaces and maintenance of plant and animal diversity (serve as the foundation for all other services)			
Water cycling	*Stormwater regulation/retention, rainwater infiltration/absorption, balancing stormwater peaks, reducing stormwater runoff*	Stormwater management is discussed as an important issue but is not related to ES. Vegetation is mentioned as one solution.	**SSTEC_6** 80% of rainfall is collected in the rainwater catchment system **TJ_7** Reducing stormwater drainage infrastructure can lower infrastructure costs
Preservation and generation of soil	*Gardening and farming, salinity management, irrigation, maintain soil pH, community education*	Goals of salinity management and tree planting are mentioned, but are not directly related to ES	**SSTEC_1** Salinity management as a main task for the Tianjin Ecocity **SSTEC_5** Community-based educators and advocates provide gardening and farming workshops to teach how to cultivate soil
Nutrient cycling	*Biogeochemical cycles, carbon, nitrogen, and oxygen*	Protection of wetland and forests is discussed as important issue. Composting management is suggested as a neighborhood-level service but is not required in planning.	**SSTEC_2** Net loss of wetland **SSTEC_4** Waste organic plant management **SSTEC_5** Compost collecting and reuse are included as a neighbourhood service
Production of atmospheric oxygen	*Photosynthesis, produces free oxygen from carbon dioxide and water*	Mentioned but not related to planning	-
Primary productivity	*Organic compounds from atmospheric or aqueous carbon dioxide, base of the food chain*	Not mentioned at all	-

ES	Description	Findings	Policy examples
Cultural services: Non-material benefits obtained from human contact with ecosystems			
Social cohesion	*Trust, a sense of belonging, participation, inclusion, recognition and legitimacy*[12]	Inclusion is mentioned as important to quality of life but is not linked to ES.	**SSTEC_5** Citizens have access to judicial review and appeals **SSTEC_6** Recognizing the resources that makes one feel connected to the community
Sense of identity	*Identity, spiritual experiences, neighborhood life, sense of place, experiences in nature*	Environmental health and human health are seen as related. The value of landscape for community life is mentioned.	**SSTEC_4** There is a growing understanding of how the environment fosters a sense of place.
Mental & physical well-being	*Mental and physical health, tranquilizing effects*	The value of ecosystem and its value on the quality of life are mentioned as important, but no specific suggestion is related to health.	**SSTEC_2** 90% green trips by 2020 (30% by 2013) **TJ_4** Managing the wetland ecosystem is important to human well-being.
Recreation	*Outdoor recreation, sports, walking, fishing, gardening*	The value of outdoor recreational options is mentioned. No landscape sites are addressed in planning policies.	**TJ_5** Plenty of outdoor leisure choices **SSTEC_4** Gardening in private and public spaces is encouraged
Tourism	*Tourism, sights*	The value of natural areas for tourism is mentioned. Policies focus on tourism in urban landscapes.	**TJ_2** Economic opportunities through recreation and tourism **SSTEC_1** Wetlands as a tourists' destination
Aesthetic & spiritual sensibility	*Aesthetic appreciation, cultural sensibility, art and design*	Regional identity is recognized (preservation of archeological sites, and historic and cultural landscapes)	**TJ_2** Enhancing current physical geography (e.g., wetlands, waterways, redwood forests)
Cultural heritage values	*Customs, which are traditions and rituals; values, which are beliefs; and culture, which is all of a group's guiding values*	Mentioned but not related to ecosystems	-
Spiritual & religious values	*The relationship to a superior being and are related to an existential perspective on life, death, and the nature of reality*	Not mentioned at all	-
Educational values	*People's views or ideas on the whole core or basic values of education have influence on other educational concept*	Mentioned but not related to ecosystems	-
Knowledge systems	*A program for extending and/or querying a knowledge base*	Not mentioned at all	-
Cultural diversity	*Recognize and respect "ways of being" that are not necessarily our own*	Not mentioned at all	-

Note:

- The selection of ES is adapted from Mooney 2014; Brown and Mooney 2013; MEA 2005
- Policy examples (Document code shown in Table 2)

[12] http://www.unesco.org/most/besseng.htm

Appendix 3 Survey research questionnaire

Study Title: Generating innovation in urban planning: Applying the Ecosystem Service assessment to planning projects

Thank you for agreeing to take part in this research questionnaire. Your responses will assist us in our efforts to advance the evaluation system of urban planning projects. Please be assured that your responses will be kept in strict confidentiality. This questionnaire will take approximately 20 minutes to complete. Your participation in this study is absolutely voluntary, and you may refuse to answer any questions or stop at any time.

A. Context questions

1. **What is your age?**
   □ 18-24 □ 25-34 □ 35-44 □ 45-54 □ 55-64 □ 65 or over

2. **What is your highest degree or highest level of education completed?**
   □ High School
   □ Attended College
   □ University
   □ Post-Graduate with Master Degree
   □ Post-Graduate with Doctoral Degree
   □ Still in a Post-Graduate Program
   □ Scholar with Subsidy

3. **Who is your current employer?** (If possible, please also specify the department you are currently working in.) _____

4. **Have you ever been involved in any environmental projects?**
   □ Yes □ No

   If "YES", please provide a few examples that you consider the most relevant and important.

   _____

5. **Have you ever been involved in designing, developing, or managing the Sino-Singapore Tianjin Eco-City (SSTEC) project?**
   □ Yes □ No

   If "YES", how would you describe your involvement in the Sino-Singapore Tianjin Eco-City (SSTEC)? (e.g. project manager involved in the scoping stage since 2009)

   _____

6. **Have you ever been trained in or have access to sustainability research?**
   □ Yes □ No

7. **Do you know anything about the following concepts, tools, or methods?** (Multiple responses apply.)

□ Environmental Impact Assessments □ Life Quality Assessments
□ Strategic Environmental Assessments □ Adaptive Design
□ Sustainability Indicators □ Key Performance Indicators
□ Ecological Footprints □ Ecological Carrying Capacity
□ Environmental Recovery Planning □ Ecosystem Services

B. Your Views on Sustainability and Ecocities

8. **What services do you consider important for your living environment?** (Multiple responses apply.)

□ Biodiversity Maintenance or Increase
□ Fresh Air and Water
□ Food Security and Provision
□ Plants and Greenery
□ Carbon Sequestration and Storage
□ Pollution Mitigation (Air and Water)
□ Local Climate and Air Quality Regulation
□ Moderate Impact of Weather Extremes
□ Hazard Regulation (Reduced Flooding, Landslide, Noise, Disease)
□ Seasonal Drought Mitigation
□ Sewage Treatment
□ Solid Waste Treatment
□ Maintenance of Soil Fertility
□ Preservation and Generation of Soil
□ Nutrient Cycling
□ Water Cycling (Hydrologic Flows)
□ Walkways and Cycling Routes
□ Mobility (Including Driving and Transit)
□ Social Cohesion
□ Justice and Equity
□ Sense of Identify
□ Mental and Physical Well-being
□ Recreation
□ Tourism
□ Aesthetic Appreciation/Spiritual Well-being
□ Others

9. **What benefits would you consider important when choosing a neighborhood?** (Multiple responses apply.)

□ Biodiversity Maintenance or Increase
□ Fresh Air and Water

□ Food Security and Provision
□ Plants and Greenery
□ Carbon Sequestration and Storage
□ Pollution Mitigation (Air and Water)
□ Local Climate and Air Quality Regulation
□ Moderate Impact of Weather Extremes
□ Hazard Regulation (Reduced Flooding, Landslide, Noise, Disease)
□ Seasonal Drought Mitigation
□ Wastewater Treatment
□ Solid Waste Treatment
□ Maintenance of Soil Fertility
□ Preservation and Generation of Soil
□ Nutrient Cycling
□ Water Cycling (Hydrologic Flows)
□ Walkways and Cycling Routes
□ Mobility (Including Driving and Transit)
□ Social Cohesion
□ Justice and Equity
□ Sense of Identity
□ Mental and Physical Well-being
□ Recreation
□ Tourism
□ Aesthetic Appreciation/Spiritual Well-being
□ Others

(End of the questionnaire)

Confidentiality Statement

The information gathered during this study will remain confidential on secure premises during this project. Only the researchers will have access to the study and information. This research is part of a doctoral dissertation and is intended to be published in academic journals.

Follow-ups

If you have any questions or concerns before or after the questionnaire has been completed, please contact the study leader or the co-investigator.

Appendix 4 Booklet attached to questionnaire (translated into Chinese)

Ecosystem Services	Service description	Translated in Chinese
Provisioning services: Ecosystem services that describe the material or energy outputs from ecosystems		
Food	Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems, but marine and freshwater systems, forests and urban horticulture also provide food for human consumption.	生态系统为种植提供条件。食物来源包括农业生态系统，海洋和淡水系统、森林和都市农园。
Raw materials	Ecosystem provide a great diversity of materials for construction and fuel including wood, biofuels and plant oils that are directly derived from wild and cultivated plant species.	生态系统为建筑和燃料提供大量材料，木材、生物燃料和植物油这些材料直接来自野生和栽培物种。
Freshwater	Ecosystems play a vital role in the global hydrological cycle, as they regulate the flow and purification of water. Vegetation and forests influence the quality of water available locally.	生态系统在水文循环中起着至关重要的作用，调节水流和净化。植被和森林影响当地可用的水质。
Medicinal resources	Ecosystems and biodiversity provide many plants used as traditional medicines as well as providing the raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources.	生态系统和生物多样性提供了许多用作传统药物的植物，也为制药工业提供了原材料。所有生态系统都是潜在的医药资源来源。
Regulating services: The services that ecosystems provide by acting as regulators (e.g., regulating the quality of air and soil or by providing flood and disease control).		
Local climate & air quality regulation	Trees provide shade whilst forests influence rainfall and water availability both locally and regionally. Trees or other plants also play an important role in regulating air quality by removing pollutants from the atmosphere.	树木提供荫蔽，而森林影响当地和区域的降雨量和水资源可用性。树木或其他植物也通过清除大气中的污染物来调节空气质量。
Carbon sequestration and storage	Ecosystems regulate the global climate by storing and sequestering greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues. In this way forest ecosystems are carbon stores. Biodiversity also plays an important role by improving the capacity of ecosystems to adapt to the effects of climate change.	生态系统通过储存和隔离温室气体来调节全球气候。植物生长吸收二氧化碳，并有效地将其锁在组织中。因此森林就是固碳仓库。
Moderation of extreme events	Extreme weather events or natural hazards include floods, storms, tsunamis, avalanches and landslides. Ecosystems and living organisms create buffers against natural disasters, thereby preventing possible damage. For example, wetlands can soak up flood water whilst trees can stabilize slopes. Coral reefs and mangroves help protect coastlines from storm damage.	极端天气事件或自然灾害包括洪水、风暴、海啸、雪崩和滑坡。生态系统和生物为自然灾害提供缓冲，从而防止可能的损害。例如，湿地可以吸收洪水，而树木可以稳定斜坡。珊瑚礁和红树林有助于保护海岸线免受风暴的破坏。
Wastewater treatment	Ecosystems such as wetlands filter both human and animal waste and act as a natural buffer to the surrounding environment. Through the biological activity of micro- organisms in the soil, most waste is broken down. Thereby pathogens are eliminated, and the level of nutrients and pollution is reduced.	湿地等生态系统既过滤人类和动物的排泄物，又对周围环境起到自然缓冲作用。通过土壤中微生物的生物活性，大部分废物被分解。从而消灭病原体，减少营养物质和污染。
Erosion prevention and maintenance of soil fertility	Soil erosion is a key factor in the process of land degradation and desertification. Vegetation cover provides a vital regulating service by preventing soil erosion. Soil fertility is essential for plant growth and agriculture and well- functioning ecosystems supply the soil with nutrients required to support plant growth.	土壤侵蚀是土地退化和荒漠化过程中的一个关键因素。植被覆盖通过防止水土流失提供了重要的调节服务。土壤肥力对植物生长和农业至关重要，而功能良好的生态系统为土壤提供了支持植物生长所需的养分。
Pollination	Insects and wind pollinate plants and trees which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats.	昆虫和风为植物、树木授粉，这些植物和树木对水果、蔬菜和种子的发育至关重要。动物授粉是以昆虫为主，部分鸟类和蝙蝠为辅的生态系统服务。
Biological control	Ecosystems are important for regulating pests and vector borne diseases that attack plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls.	生态系统对于调节害虫和侵袭植物、动物和人类的媒介传播疾病很重要。通过捕食者和寄生虫活动调节害虫和疾病。
Habitat or supporting services: These services underpin almost all other services ecosystem provide living spaces for plants or animals; they also maintain a diversity of different breeds of plants and animals.		
Habitats for species	Habitats provide everything that an individual plant or animal needs to survive: food; water; and shelter. Each ecosystem provides different	栖息地为个体植物或动物提供它们生存所需的一切。不同的生境对物种的生命周期至关重要。迁徙

Ecosystem Services	Service description	Translated in Chinese
	habitats that can be essential for a species' lifecycle. Migratory species including birds, fish, mammals and insects all depend upon different ecosystems during their movements.	物种，包括鸟类、鱼类、哺乳动物和昆虫，在迁徙过程中都依赖于不同的生态系统。
Maintenance of genetic diversity	Genetic diversity is the variety of genes between and within species populations. Genetic diversity distinguishes different breeds or races from each other thus providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock. Some habitats have an exceptionally high number of species which makes them more genetically diverse than others and are known as 'biodiversity hotspots'.	遗传多样性是指种群间和种群内的基因多样性。遗传多样性将不同品种或种族区分开来，从而为当地适应良好的品种和进一步发展商业作物和牲畜的基因库提供了基础。一些生境的物种数量特别多，这使得它们的遗传多样性高于其他生境，被称为“生物多样性热点”。
Cultural services: These include the non-material benefits people obtain from contact with ecosystems. They include aesthetic, spiritual and psychological benefits.		
Recreation and mental and physical health	Walking and playing sports in green space is not only a good form of physical exercise but also lets people relax. The role that green space plays in maintaining mental and physical health is increasingly being recognized, despite difficulties of measurement.	在绿地上散步、运动不仅是种锻炼形式，还能让人放松。人们越来越认可绿地对保持身心健康的作用。
Tourism	Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and is a vital source of income for many countries.	生态系统和生物多样性对许多类型的旅游业起着重要的作用，而这些旅游业又为许多国家提供了可观的经济效益和重要的收入来源。
Aesthetic appreciation and inspiration for culture, art and design	Language, knowledge and the natural environment have been intimately related throughout human history. Biodiversity, ecosystems and natural landscapes have been the source of inspiration for much of our art, culture and increasingly for science.	语言、知识和自然环境在人类历史中有着密切的联系。生物多样性、生态系统和自然景观一直是人类艺术、文化和科学的灵感来源。
Spiritual experience and sense of place	In many parts of the world natural features such as specific forests, caves or mountains are considered sacred or have a religious meaning. Nature is a common element of all major religions and traditional knowledge, and associated customs are important for creating a sense of belonging.	在世界的许多地方，诸如特定的森林、洞穴或山脉等自然特征被认为是神圣的或具有宗教意义。自然是所有主要宗教和传统知识的共同元素，相关的习俗对于创造归属感很重要。

Appendix 4 Data of respondents reported low level of satisfaction to the community

	ID	Age	Profession	Education	Length of Residence	Neighborly Relations	Participation
1	58	25-34	Administrator	Graduate	1-3yrs	2	1
2	68	25-34	Social worker	Undergraduate	< 1yr	1	1
3	116	35-44	Residents with a job	High school	> 5yrs	4	1
4	133	35-44	Residents with a job	High school	3-5yrs	4	3
5	136	25-34	Residents with a job	Undergraduate	3-5yrs	4	4
6	137	55-64	Residents with a job	Undergraduate	> 5yrs	4	4
7	152	35-44	Residents with a job	Undergraduate	< 1yr	2	1
8	153	35-44	Residents with a job	Undergraduate	1-3 yr	2	1
9	156	45-54	Residents with a job	High school	3-5 yrs	4	2
10	162	65 and above	Residents with a job	High school	1-3 yrs	3	2

Appendix 5 Demographic features of those who reported both positive neighborly relations and active citizen participation

ID	Age	Profession	Education	Length of Residence	Neighborly Relations	Participation
42	25-34	4	Undergraduate	3	4	3
43	25-34	3	Graduate	3	3	4
44	25-34	4	Undergraduate	3	4	4
49	25-34	4	Undergraduate	4	4	4
51	35-44	3	Graduate	1	4	3
59	25-34	3	Undergraduate	3	3	4
63	25-34	3	Undergraduate	1	3	3
66	25-34	4	Graduate	3	3	3
69	25-34	5	Undergraduate	4	4	3
80	35-44	2	Undergraduate	4	4	3
82	65 and above	2	Undergraduate	5	4	3
93	25-34	5	Undergraduate	5	4	3
100	18-24	5	Undergraduate	3	3	3
103	25-34	5	Undergraduate	3	4	3
104	25-34	5	Undergraduate	3	4	4
105	25-34	5	Graduate	3	4	3
107	25-34	5	Graduate	3	4	3
109	35-44	5	Graduate	3	4	4
110	35-44	5	Undergraduate	5	3	3
112	35-44	5	High school	4	4	3
113	45-54	5	Undergraduate	4	4	3
126	45-54	4	Undergraduate	3	4	4
127	25-34	4	Undergraduate	3	4	4
128	35-44	3	Graduate	5	4	4
130	35-44	3	Graduate	5	4	4
133	35-44	5	High school	4	4	3
135	45-54	6	High school	4	4	3
136	25-34	5	Undergraduate	4	4	4
137	35-44	5	Undergraduate	5	4	4
140	55-64	6	High school	4	4	3
141	65 and above	6	High school	4	4	3
143	65 and above	6	High school	4	4	3
145	55-64	6	High school	4	4	3
146	55-64	6	High school	4	4	3
154	25-34	5	Graduate	5	4	4
155	25-34	5	Undergraduate	2	4	3
157	35-44	5	Graduate	3	3	3
159	65 and above	5	High school	5	4	4
165	55-64	6	High school	4	4	3
166	55-64	6	Undergraduate	4	4	3
168	55-64	6	High school	5	4	3