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DOI
10.2139/ssrn.3935892

Publication date
2021

Document Version
Final published version

Published in
Social Science Research Network (SSRN)

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Shanghai's Strive to Excel in Climate Change Adaptation and Low-Carbon Promises: A Model to Follow?

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The subtitle of Shanghai's latest Master Plan (2017–2035) is "Striving for an Excellent Global City."[1] According to this plan, Shanghai wants to compete with, and possibly surpass, other global cities such as New York, London, Paris, Singapore, and Tokyo in terms of economy, image, and quality of life. The plan's authors state that "the world has stepped into an era of ecological civilization that puts environmental friendliness and humanistic approach first;" Shanghai aims "to play the pioneering role in the reform and opening-up into this new era and set up the pace for innovation and development."[2]

To achieve its aims, the Master Plan includes ecological ambitions and promises, such as a five percent reduction of total carbon emissions, a halving of particulate matter emissions, a ban on raw waste landfills, and the development of more than 300 square kilometers of new green structures, all to be realized before 2035. The plan also puts a cap on Shanghai's total population to a maximum of 24 million registered residents and adds red lines around the city to limit its footprint and protect agricultural lands against urban sprawl. Furthermore, the plan commits Shanghai to becoming "a more adaptable and resilient eco-city as well as a benchmark for international megacities in terms of green, low-carbon and sustainable development by developing pilot spaces and infrastructures."[3] The message is clear: Shanghai not only wants to set a national example for other Chinese cities, but also to cross borders to inspire others to become more adaptable and resilient.

How can Shanghai manage to implement large-scale ecological improvements—in the context of high building density, land scarcity, and booming real estate prices—when it took other metropolises, such as New York, Tokyo, and Singapore, many years to realize much less ambitious aims? And how will Shanghai integrate ecological values with its other aims, such as flood defense, place-making, and the preservation of industrial heritage? This chapter considers these questions, highlighting the tension between China's push towards growth and urbanization against the need to safeguard its cities from environmental threats. As will be described, this tension has played out in stark terms in Shanghai, where leaders are grappling with how to advance their development objectives, which have historically relied on reclaiming wetlands, while adapting to rising seas and strengthening storms.

Ecological Vulnerability in Urbanizing Deltas

During the last three decades, urbanization across the globe has accelerated dramatically, especially in the world's emerging economies. China is without doubt a frontrunner in this trend. Most of the urbanization in China has occurred in a 100-kilometer zone along its coastline, and has been highly concentrated in three main deltaic areas: the Pearl River Delta, the Bohai Rim, and the Yangtze River Delta. These deltas are also where many fertile agricultural lands[4] are situated and where most of China's ecologically important wetlands exist.

Approximately 41 percent of the world's population lives in river deltas.[5] Cities like Shanghai, Rotterdam, Amsterdam, New York, London, Venice, New Orleans, St. Petersburg, and many others were all at least partially built on wetlands and swamps. Due to their strategic location, deltas are the scene of complex land use conflicts: urban development, infrastructure, ports, wetlands, and fertile agricultural land all fight for positions on the same

land. And due to rapid large-scale urbanization and the prioritization of these other land uses, wetlands are increasingly under threat.

Wetlands are crucial ecosystems. They provide habitat and breeding grounds for almost 40 percent of all plant and animal species,[6] as well as, either directly or indirectly, almost all of the supply of freshwater that is consumed around the world.[7] Wetlands also provide a range of ecosystem services, such as rainwater storage or sponge capacities, water purification, carbon sequestration,[8] biodiversity conservation, and, critically for our perspective, storm surge protection.[9] Wetland can also provide limited options for urban recreation (limited to protect the wetland), which can be very valuable in cities with scarce open space. Despite all these benefits, nearly 35 percent of the world's wetlands were lost between 1970 and 2015, and this loss has been accelerating since 2000.[10] Moreover, decision-makers often undervalue the importance of wetlands. Urban wetland management and policy guidance is lacking around the world,[11] and tensions usually exist between conservation and development.

Since the 1950s, more than half of China's coastal wetlands have disappeared; 53 percent of temperate coastal ecosystems, 73 percent of mangroves, and 80 percent of near-shore coral reefs have vanished.[12] This loss has occurred mainly because "huge economic returns from land reclamation have prompted local governments to 'bypass' regulations issued by the central government."[13] Reclaiming land from the sea is a relatively quick and cheap way to get more land and profits—although land needs four years to firm up and solidify in the Netherlands, for example, construction in China can often start within one or two years. Yet, while development on wetlands may appear economically attractive, it poses serious consequences in light of the rising threats of climate change: weakening the shoreline and increasing the vulnerability to threats of sea level rise and flooding, and making adaptation more challenging.

Shanghai, China's Economic *'Head of the Dragon'* in a Vulnerable Yangtze River Delta

Over many centuries, an efficient network of waterways steered the spatial and economic development of the Yangtze Delta in a relatively sustainable manner.[14] This started to change in the middle of the 20th century, when Chairman Mao ruled the country. Under Mao's leadership, there was a shift toward extreme technocratic engineering: "Man must conquer nature," Mao insisted.[15] Natural capital and landscape values were neglected, and planning practices are accordingly based on a tabula rasa approach. Many natural waterways in the region were transformed into canals, while others were dammed or cleared. More recently, during the last three decades, GDP-oriented motives also started to dominate waterfront planning, with additional collateral damage for ecosystems and livability, fed by extreme urbanization pressure, mass migration to the city from rural areas, and a change of lifestyle in the new urban areas. The combined effects of Maoist disregard for nature and capitalist tendencies to exploit it has reaped significant damage on Shanghai's coasts and riparian lands.

The origins of Shanghai are inseparable from its location beside the water; the city's name even literally translates as "upon the sea." Along the coastline, there has always been a strip of natural wetlands that grew via sedimentation from the Yangtze River's estuary. This eastward shifting of the coastline largely created the territory of Shanghai. But since the 1950s, this natural process has been greatly accelerated by breakwaters and land reclamations. Approximately 40 percent of the tidal flats around Shanghai have disappeared since 1980, mainly due to land reclamations in the Yangtze estuary zone, Chongming Island, and along the coastline of Pudong. In total, these land reclamations have created about 816.6 square kilometers of new land between 1974 and 2018.[16] Shanghai currently still counts

approximately 464,600 hectares of wetlands, mainly spread over Chongming, Pudong and Qingpu districts.[17]

There is a constant clash between urbanization desires and ecological protection, and new lands are increasingly used for agriculture and urban expansion, including housing, airports, infrastructure, and recreational landscapes. One example of this clash is the Nanhui Coastal Wetland Reserve at the southeast edge of Shanghai's Pudong District, just south of Pudong International Airport, which saw a situation reminiscent of what occurred in Jamaica Bay in New York, as the city made way for JFK Airport. In 2002, the huge wetlands reserve, measuring 122.5 square kilometer in area, was a tidal flat; it was reclaimed from the sea one year later. Officials planned to build Lingang New Harbor City there, with an expected 800,000 inhabitants by 2020.[18] This planned city was supposed to accompany the Yangshan Deep-water Port complex, constructed in 2010—currently the largest container terminal in the world—and adjacent heavy industry complexes. However, due to the remote and unattractive location, as well as a temporary collapse of world trade and container transport, the growth of the new city stopped. About three quarters of the planned city has not yet been built and lies fallow.

In the original plan, the city would have been surrounded by lush nature and wetlands. Instead, a large part of the lands reserved for nature development is currently in use for aqua farming and plantations. From an agricultural point of view, wetlands are often seen as wastelands, and thus farming, including aqua farming, is prioritized above nature conservation,[19] especially in times when agricultural grounds are becoming increasingly scarce in the fertile region around Shanghai. However, there has also been pushback against the agricultural use of this land, in favor of conservation. A group of environmentalists, scientists, and nature lovers launched a protest, addressed to Tesla's new Gigafactory that started construction nearby, to raise awareness and counter the threat against the wetlands.[20]

The so-called Long Island project at the northwestern edge of Shanghai's Chongming Eco-Island provides a more scandalous example of the tensions between conservation and urbanization. Chongming Island was appointed as a National Ecological Demonstration Zone in 1996 and was to serve as a pilot project for sustainable urban planning.[21] But there was a loophole in the policy covering the northwest corner of the island, which developers and profit-seeking local governments exploited to their advantage. In short, under the guise of protecting land through conservation, natural wetlands have been reclaimed for the sake of massive speculative real estate.[22] This loophole has since been adjusted by the central government—unfortunately, after the damage was already done.[23]

Besides threats of land reclamation, the wetlands also face threats from sea level rise and changes in sedimentation due to a decrease in discharge after construction of the Three Gorges Dam in 2003.[24]

Despite each of these threats and challenges, it is encouraging that China, with Shanghai as a forerunner, is attempting to restore the damage that has been done to the environment during the last few decades of extreme massive urbanization. In 2018, the State Council launched a new regulation on land reclamation to protect coastal wetlands.[25] And to compensate for the collateral damage of rapid urbanization, Shanghai is searching for ways to protect the remaining wetlands and stimulate the establishment of new ones.

China's Shift to an Eco-Civilization

China's extreme and hasty shift towards urbanization, accompanied by industrialization and intensified agricultural production, has resulted in prosperity and high living standards for many. But it has also brought serious environmental pollution, a shortage of resources, social-economic unbalance, and increasing vulnerability to flooding and sea level rise.

Since the beginning of this century, Chinese national policy has been increasingly searching for a new Green Economy, which essentially turns away from the Western idea of industrialization.[26] In fact, since its 11th Five-Year Plan (2006–2010), the People's Republic of China has committed itself to achieving a Green Economy and has specifically pledged to increase the use of renewable energy sources, reduce carbon emissions drastically, and increase forest coverage of lands. In the 12th Five-Year Plan (2011–2015), additional targets were added, including reversing ecological deterioration and enhancing environmental regulatory institutions.[27] China declared a "war on pollution" and started to introduce multiple green policies. It also started to decouple environmental pressure from economic growth,[28] and promised that the year 2030 will be a turning point, not only because China promises to react effectively on the Sustainable Development Goals set by the United Nations,[29] but also because China is aiming to realize an eco-civilization by that time.[30] On March 11, 2021 the National People's Congress of China voted to pass the resolution on the "14th Five-Year Plan" and the 2035 long-term goal outline.[31] This plan sets out goals for an 18 percent CO_2 emissions reduction and a 13.5 percent energy-intensity reduction for the coming 5 years. This goal is significantly higher than what was set in Shanghai's master plan, and in the coming months, it will become clearer what this will mean for local policies. The previous Five-Year Plans showed a trend of overachieving the previously-set goals, and according to some researchers, this will happen again this new period.[32]

The concept behind "ecological civilization" has been gradually integrated in the policies of the ruling Communist Party since the 17th National Congress in November 2007.[33] The integration of measures to counterbalance the negative effects of environmental changes became a national strategy under General Secretary Hu Jintao in 2007: "We will adopt fiscal and taxation systems conducive to scientific development and set up sound compensation systems for use of resources and for damage to the ecological environment."[34]

Ecological civilization can be defined as "a dynamic equilibrium state where humans and nature interact and function harmoniously."[35] To realize an ecological civilization means a drastic societal reform with serious consequences for economy, society and daily life. The concept of ecological civilization has received a lot of skeptical reactions from several international observers.[36] Although some scholars claim that ecological civilization originates from the western discourses on ecological modernization,[37] it also has deep roots in Marxism, and has the potential to challenge or even replace global capitalism.[38] A remarkable aspect of the concept is the call for a new balance between top-down and bottom-up governance approaches, and for exploring public private partnerships and new forms of participation—ideas which are also mentioned in the final chapter of Shanghai's latest Master Plan.[39] This is still in an elementary phase, and time will tell us how this will work out in practice over the next few years. However, outwardly, at least, General Secretary Xi has strongly endorsed the eco-civilization discourse and called for a more balanced model of economic growth. With his statement that "clear waters and green mountains are as valuable as mountains of gold and silver," he stresses the economic importance of a strong environmental act.[40]

In recent years, the concept of an ecological civilization has permeated Chinese urban planning and architecture. For example, in 2009, the National Development and Reform Commission established the "Low-Carbon City Initiative" and in 2015, it launched the "Sponge City" initiative, which aims to create water storage buffers in so-called "sponge districts" to capture storm water. As part of these initiatives, several experimental pilot projects have also been implemented in Shanghai, with varying results.[41]

Shanghai's Steps toward Ecological Civilization

According to Shanghai's Master Plan, "citizen happiness" is fundamental to Shanghai's development and a key motivator of officials' efforts to build a prosperous and innovative

city. To achieve citizen happiness, officials believe they must engineer "a desirable ecological city," which is formulated as "a beautiful space that meets the demands of the increasing number of citizens, where the water is more blue, and the land is more green, living in harmony with nature to satisfy the citizens yearning for a better life."[42]

A crucial step toward the implementation of Shanghai's ecological civilization and combat against climate change is the promise to create a "green and open eco-network," with at least 60 percent of the municipal land area used for ecological land.[43] According to the Master Plan, this is an increase of about ten percent of green lands compared with today—a massive amount, given the high building density and scarcity of land in Shanghai. In dense downtown areas, this green ambition will be realized in part through green roofs and other forms of vertical green infrastructure. To connect the downtown with the surrounding open landscape, a series of more than 1,000-meter-wide green corridors are planned, as well as large new wetlands along the coastline. Several new huge city parks, hundreds of small pocket parks, and small-scale green features on a neighborhood level are planned as well. A showcase of this ambition for ecological restoration is the massive transformation of former industrial waterfronts, explained in more detail in the following section. Many of these green projects have already been implemented over the last few years, or are under construction; in some cases, construction plans have been accelerated and prioritized due to the COVID-19 crisis.

Similar to the Green Belt around London and other green buffers, such as the Green Heart of the Randstad metropolis in the Netherlands, a main function of Shanghai's green and open eco-network is to accommodate the leisure needs of the emerging new middle class. The eco-network is intended to bring citizens closer to nature and to reconnect the city with the countryside—literally, "introducing the forest to the city." Moreover, this green

framework is considered to be a new backbone for urban development (an alternative to a water- or road-based one).

In 2015, the local authorities started constructing an Overall Plan for Ecological Civilization System Reform, which is an integrated component of the Shanghai Master Plan (2017–2035). In this plan, the term "ecological space" refers to "land that is used to provide ecosystem services in the city, including green land, forest land, garden land, cultivated land, tidal flat reed land, pond aquaculture water surface, unused lands, etcetera."[44] This broad definition seems to encompass all the land that is not an urban built-up area and not paved. However, the ecological values of these spaces vary greatly. In fact, some built-up spaces can have ecological values—for example, Shanghai has a fast-increasing amount of roof gardens—while some un-built and unpaved lands have almost zero ecological value. Additionally, a large share of the green or ecologically earmarked spaces are clearly meant for recreational or decorative purposes, to serve human beings; usage by other species to stimulate biodiversity is often a secondary consideration, or is entirely absent. It seems that in land use planning, quantity still prevails above quality in Shanghai.

The Huangpu River Waterfront as a Stage for Innovation and Eco-Civilization

A key project to realize the promise to become an "Excellent Global City" and to fulfill the goals of ecological restoration and eco-civilization is Shanghai's ambitious transformation of the former industrial-dominated waterfront of the Huangpu River and Suzhou Creek. In 2018, the Huangpu Waterfront became a "demonstration zone for the development capability of the global city of Shanghai."[45] Besides strengthening the embankments to reduce flood risk, the purposes of the new waterfront were: (1) to create a continuous open public space as an "urban living room" and central park to counterbalance the densely populated metropolis, (2)

to preserve industrial heritage and emphasize Shanghai's identity as a port city, (3) to create new cultural centers (mainly in vacant industrial heritage buildings) to facilitate the expected needs of a new international-oriented middle class, and (4) to strengthen ecological connections. Combining this effort with urban regeneration or renewal in former industrial waterfronts and adjacent densely build urban areas is a vast challenge, especially in urban economic centers that face land scarcity and additional problems, such as needing flood defense systems. Yet, impressively, more than half of this project has already been completed.[46]

In Shanghai's current Master Plan, the Huangpu River is regarded as an important ecological corridor and a "green and low-carbon demonstration zone."[47] The Huangpu and Suzhou Creek waterfront transformations are engines to speed up the ecological restoration of former industrial areas. The Master Plan promises to improve the diversity of green spaces, benefit from existing eco-system services, and create a blue and green interconnected ecological network to replace former polluting industries. Attractive greening projects and walking trails have been created along both riversides of the Huangpu River, and also along the Suzhou Creek, accompanied by massive real estate projects, thematic office parks aimed at the finance sector, international trade centers, centers for high-tech and artificial intelligence, five-star hotels, and many cultural facilities. However, much-needed housing is lacking at the new waterfronts, especially affordable housing.[48]

Due to the large scale of the project (120 kilometers of waterfront will be transformed by its end) different sections of the Huangpu River's waterfront are in different stages of development and usage; they also belong to different municipal districts and differ in their implementation and maintenance. Today, more than 25-kilometer river-length, which means 50-kilometer waterfront in total, has already been transformed, after many polluting industries were removed. In less than five years' time, an almost continuous and attractive

public waterfront with greenery, renovated industrial heritage buildings, cultural facilities, and biking and walking trails emerged here with abundant public recreational space, offices, shopping, and hotels, offering a welcome and pleasant relief from the urban congestion for many. Plans are underway to relocate the last remaining industries, including Baosteel, the second largest steel producer in the world. These measures surely benefit the quality of air and water and also add needed green spaces for recreation.

Massive new real estate clusters also emerged along the riverbanks during the last five years. All of the newly built buildings received green labels to match the National Green Building Standard, especially regarding low-carbon emissions, although the application of these standards in practice is questionable.[49] Unfortunately, field surveys and multiple talks with real estate developers and other specialists indicate that a large share of the new buildings are used for speculation purposes and remain mainly empty, even several years after completion. Other office locations, such as those around the Hongqiao Hub, are preferred to the above waterfront locations due to lower pricing and better connectivity to elsewhere, according to interviewed leading specialists from the real estate sector.

The extremely dense concentration of buildings on both riverbanks of the Huangpu River, in combination with the almost continuous industrial sites, makes it nearly impossible to create an ecological corridor here that would match the scale of the Master Plan's ambition. Yet officials have successfully relocated a large share of the polluting industries to outside the edge of the city, even to other provinces—to reduce carbon emissions in the city and to improve the general image and quality of life—and made a place for a scenic landscape crossed by recreational walking and cycling trails, in a period of about five years. Thus, the city has made meaningful, if imperfect, progress towards eco-restoration.

Can Shanghai Become an Excellent Example for Climate Change Adaptation?

The policies and projects that have been launched in Shanghai over the last few years are impressive in terms of scale and speed. Many city leaders and experts from all over China see Shanghai as a model and gateway to the international world, and many trends that have started in Shanghai have since been transplanted all over China. Shanghai's Master Plan connects convincingly with the discourse and practice of the international community in its language and promises, trying to absorb the ethos of sustainability into its planning approach. Indeed, the plan has the ambition to exceed international best practices in terms of speed, scale, and quality. Moreover, many of the promising words in Shanghai's Master Plan have already been translated into plans, and a large part have already been implemented, thanks to the decisive centrally-managed government, in possession of money flows and land positions. There have been some impressive accomplishments as well: the new Huangpu waterfronts are breathtaking, and it is mindboggling that they were realized in such a short time span. The amount of greening integrated in a new eco-network, partly already under construction, is also unprecedented.

Yet, these facts, supplemented with impressive numbers of sizes or amounts of square kilometers, distract us from some substantial deficiencies. In many cases, such as with the new waterfronts in downtown Shanghai, the aim still seems to be improving the public image and status, attracting foreign investment, or accommodating comfortable living environment for a selective upper middle class.[50] And the plan to cap Shanghai's total population at a maximum of 24 million registered residents, meant to limit the urban pressure, is also causing social-economic tensions. Real estate values are booming, and Shanghai is increasingly becoming the domain for the happy few; the affordable housing crunch is especially acute in the new waterfronts, where low-income housing neighborhoods have quite literally been

erased. Moreover, the municipality of Shanghai is already home to several million more inhabitants than the desired cap of 24 million, if unregistered residents are included in the calculation.[51] What will happen with these unregistered migrant workers? Will they return to their rural villages? And what about informal street markets? Systematically, they are disappearing. The disappearance of the street markets has taken place at an accelerated pace following the COVID-19 crisis, as the government has demolished a number of such markets and traditional low-rise working-class neighborhoods. Relatedly, unemployment will increase, and the gap between rich and poor will widen further.

Although public awareness is increasing, many voices are not being considered during implementation of the Master Plan. In recent government policy documents and communications, the focus on unbridled GDP-growth seems to have decreased, and been replaced by terms like "ecosystem services," "eco-civilization," "ecological restoration," "Green GDP," "harmony with nature," and so on. Yet, as we have seen, even where governments have very good environmental intentions, projects or policies can easily fail when public participation is lacking. And although Shanghai has made some efforts to include the public in the development and implementation of the Master Plan—the fact that the Master Plan is largely available online in several languages is unprecedented and a step towards real openness—there is still a way further to go.

Surprisingly, China's constitution has recognized the importance of public participation and consultation since the time of Mao, but the government has generally neglected the public's role in the years since. Several scholars have called for the government to reprioritize the public's role in China's environmental policymaking.[52] The realization of a true eco-civilization is necessarily a process of gradual adjustment and understanding, which cannot be implemented from the top-down at once; rather, it needs more involvement, consultation, and incentives.[53] If this participatory approach can be incorporated into the

Chinese pilot or demonstration projects, it might lead to more effective and sustainable outcomes.

Conclusion

Although China is aware of its environmental challenges, including the need to adapt to climate change, and is willing to play a leading role in a green transition, it must surmount several obstacles before it can realize its ecological objectives. There are discrepancies in the definition, appreciation, and valuation of ecological assets such as wetlands. Greening is frequently used as a means of beautifying real estate projects. Terms like "eco-civilization" and "green eco-network" sound promising and create high expectations, but seem primarily aimed at creating benefits for people, such as making cities more desirable places for people to live. There also seems to be a tendency to under-value eco-system services and the use and protection of wetlands. Going forward, Shanghai and other Chinese cities would do well to create clearer definitions for assets like wetlands and terms like ecological restoration or eco-system services, and to communicate these definitions with all stakeholders.

China, with Shanghai leading the way, is shifting from a production economy towards a consumption society. In a process of trial and error, there is a search for a new balance. Although the newly implemented public spaces along the Huangpu River are visually attractive, there are still shortcomings in their daily-life functionality,[54] as well as their functionality as an ecological corridor. Eco-civilizations need to serve people, of course, but also other species, if they are to effectively combat climate change and restore ecosystems.

China is also in a different phase of development than many established Western cities and must therefore deal with a different audience of stakeholders and end-users, usually with different educational backgrounds, experiences, and lifestyles. Environmental pressure rose quickly during recent decades due to extreme urbanization, and consequently, there are

other priorities and expectations that must be considered in urban planning and societal transformation.

Despite all these challenges, Shanghai has commenced a journey toward an eco-civilization that will make big impact on the daily life of its inhabitants. Hopefully, more thoughtful experiments will follow in Shanghai to establish this metropolis further as a world-leading lab for sustainable transition and urban innovation. Shanghai, and China as a whole, can play a leading role in sustainable transitions and be a role model for other cities and countries, such as in developing countries in the Global South, but perhaps also in developed countries in the Global North.

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