



Policy design to incorporate sustainability in the urbanisation process of China's metropolitan cities - The case of Shanghai

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Abstract

China's economic reform has resulted in drastic economic growth in key special economic zones and the formation of major metropolitan cities with high volumes of foreign direct investments, accelerating economic growth and urbanisation rates from rural regions into urban cities. This study critically explores the rapid urbanisation experienced in the city of Shanghai, drawing upon major environmental and sustainability challenges caused by urban developments to accommodate the surging economic growth of the city in recent decades. This study critically explored empirical/secondary data and identified sustainability driven policies introduced by the Shanghai government in recent years to integrate sustainability into the urbanisation process of the city. Based on the major themes identified in the environmental/ sustainability challenges of Shanghai and recent sustainability driven policies, this study proposed practical recommendations for improving future policy designs that integrates sustainable development across six sustainability city lenses in urban development.

Keywords: urbanisation; Shanghai; sustainability challenges; environmental policy; sustainable development; metropolitan growth

1. Introduction

Since China's economic reform in 1978, the opening up of the Chinese economy has attracted substantial foreign direct investments, resulting in the drastic growth of its economy, particularly in first tier Chinese metropolitan cities where urbanisation has become a key trend in recent decades. According to Statista's (2021) report, the degree of urbanisation in China has grown from 19.39% in 1980 to 63.89% in 2021, demonstrating a rapid popularisation shift from rural to urban areas of China. However, empirical academic studies have often associated urbanisation to environmental issues such as inadequate water supply, generation of wastewater and solid waste, high

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consumption of fossil fuels, loss of green and natural spaces, urban sprawl and various forms of pollution in air, traffic, noise and soil (Pugh, 2014). Therefore, it is of vital research importance to understand how the accelerated rates of urbanisation in Chinese metropolitan cities such as Shanghai can be managed with sustainability driven policy designs, understanding how sustainability can be incorporated and maintained to overcome the environmental damages of urbanisation.

1.1 Research rationale

The importance to address and alleviate the environmental problems from urbanisation has received increasing research attention in recent years, identifying the challenges of sustainability and how sustainability can be successfully achieved for urbanisation. According to Berghall & Konvitz's (1998), urbanisation plays an important role behind sustainable development OECD policy approaches in the 21st century, recognising its influence on both environmental and economic development as cities can adopt more efficient energy and natural resource consumption initiatives in policy designs to channel investment, innovation and development on urbanisation in a continuous and sustainable manner. However, Berghall & Konvitz's (1998) raises the practical challenge for policy makers to effectively incorporate sustainability in the management of urbanisation, particularly due to the unique nature of economic, social and political environments of each distinctive region, requiring a case specific approach to evaluate the situation of each city as opposed to a generic approach. Furthermore, despite numerous studies conducted to explore the urbanisation developments of China, there has been limited attempts conducted with a city specific focus on Shanghai, especially when addressing the emerging research trends of sustainability and policy design on urbanisation. Therefore, this research will contribute to the identified research gap with practical new insights that aids the understanding of designing policies with integration of sustainable developments in Shanghai's urbanisation.

1.2 Research aims & objectives

This research aims to critically explore the policy design guiding Shanghai's urbanisation, emphasising on sustainability driven initiatives to understand how policy designs can contribute to the sustainable development of Shanghai's urbanisation, recognising apparent environment problems caused by urbanisation and how sustainable urbanisation can be achieved. In order to fulfil the proposed research aim, the following research objectives will be achieved:

1. To critically explore the environmental and sustainability problems currently faced in Shanghai's urbanisation.

2. To critically analyse the effects of current sustainability driven policies designed by the Shanghai government to reduce the environmental problems caused in urbanisation.
3. To develop practical recommendations for the Shanghai government to further improve and integrate sustainability initiatives in future policy designs on urbanisation.

1.3 Outline of study

This study is broken down into six key chapters, the first chapter provides an introductory background setting that discusses the aims and objectives of this project. The second chapter critically reviews empirical literature conducted in urbanisation literature, discovering major research trends, concepts and theories used when exploring urbanisation under policy design and sustainable development. The third chapter discusses the chosen research methods across the entire research project from the philosophy, approach, strategy, choice, time horizon, data collection and analysis. The fourth chapter presents the key themes identified in secondary data, discussing with application to academic knowledge to address research objectives. The fifth chapter summarises the key themes identified in the policy design behind Shanghai's sustainable development-led urbanisation programmes, addressing the final research objectives and developing practical recommendations to further improve and integrate sustainability initiatives in future policy designs on urbanisation from the examples of other countries. The final chapter concludes key findings and discusses limitations with implications for future studies.

2. Literature review

This chapter critically reviews empirical studies conducted in urbanisation literature, identifying major research developments, theories and concepts to obtain in-depth understanding on current research knowledge. The purpose of this chapter is to analyse empirical academic knowledge and research trends, identifying potential research gaps in order to shape the design of this study with specific contributions to the academic field. The first section explores empirical academic attempts at conceptualising urbanisation, discussing the framework of urbanisation in China by (Yang et al, 2019) and the holistic urbanisation conceptual framework developed by Schlesinger (2013). The second section explores the causes and pressures driving urbanisation, drawing upon the apparent research scope divide amongst developed and developing countries, discussing how the motives to engage urbanisation differs with the application of Kanith's (2009) push and pull factors model for urbanisation.

The third chapter critically reviews the emerging research field of problems, challenges and concerns of urbanisation, discussing generic problems and remedies of urbanisation from Arise's (2021) framework. The different natures of problems and challenges faced in developed and developing countries are discussed, emphasising on the distinctive impacts of urbanisation upon

the varying infrastructures of more and lesser advanced countries. The fourth section critically explores the relationship between sustainability and urbanisation, further expanding on the problems experienced in the process of urbanisation and how sustainability can be integrated across the triple bottom line dimensions of environmental, social and economic (Somanje et al, 2020).

The European Environment Agency's (2021) conceptual framework for urban environment sustainability in six lenses is discussed, analysing how sustainable urban ecosystems can be achieving by fulfilling six enabling factors. The fifth section reviews the role of policy design and government control on China's urbanisation development, critically discussing the range of exogenous and endogenous factors that impacts China's urbanisation development (Hu, 2013). The final section summarises empirical literature knowledge, addressing major research trends and identified research gaps for this research to contribute to.

2.1 The conceptualisation of urbanisation

The concept of urbanisation has received widespread research attention in recent decades, particularly in developing countries where the rate of urbanisation has been accelerated due to economic growth, increasing middle class and international competitiveness of major cities in developing countries (Bhattacharya, 2002). According to Yang et al (2019), the concept of urbanisation is defined as the process where a country's population is increasingly concentrated in urban, city regions in proportional to the decreasing concentration in rural, countryside regions. Moreover, Yang et al (2019) proposed a framework that attempted to conceptualise urbanisation within Chinese cities based on the theory of spatial production, arguing that urbanisation is influenced by three preliminary factors including capital, power and class as shown in figure 1 below. According to Yang et al (2019), the process of urbanisation is characterised by a surging influx of capital, as money is transferred from rural to urban regions due to rising volumes of economic activities accompanied by the movement of people. Similarly, this attracts powerful and higher socio-economic class to capitalise on the economic growth of urbanised regions (Yang et al, 2019).

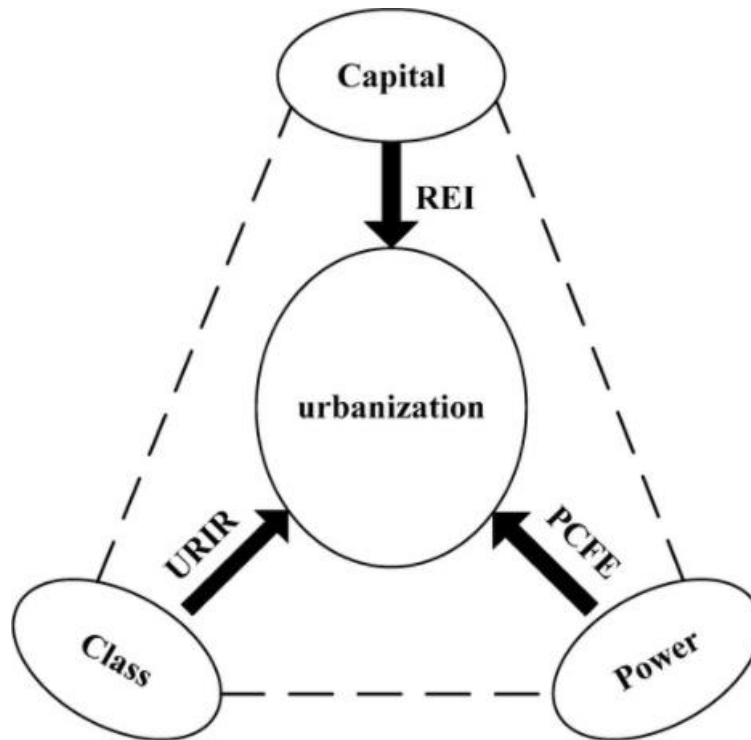


Figure 1: Conceptual framework of urbanisation in China (Yang et al, 2019)

Nonetheless, despite numerous empirical studies attempting to define the concept of urbanisation, Godfrey & Julien (2005) argues that there exists no agreed definition on what accurately constitutes an urban environment, highlighting the large variations in the perception of the term “urban”. McGranahan & Satterthwaite (2014) also reinforced this argument when exploring several definitions of urban in the publications of the United Nations Population Division, recognising a lack of an international consensus on how the boundaries of urban areas should be determined. According to McGranahan & Satterthwaite’s (2014) findings, many countries determine urban boundaries beyond the basis of physical features alone, as it is common to include measurement factors such as land size, density and administrative levels, whilst some countries have gone to include the measurement of urban employment levels, social welfare facilities and public infrastructures. Furthermore, Zhang (2016) argues that the definition of urban and urbanisation has evolved over time, especially when determined as a demographic phenomenon as the rate of urban population growth has accelerated in the 21st century for most large, metropolitan cities.

Zhang (2016) also argues that many empirical studies have fallen attempted to define urbanisation as the process of rural-urban migration and urban population growth, suggesting that this approach fails to adequately conceptualise the dynamics of urbanisation. Alternatively, Zhang (2016) further illustrated that the urbanisation should not be only focused on its outcome in relation to net migration changes from rural to urban areas, but to incorporate the entire process that involves the

cause and effects of urbanisation, requiring the expansion of recognised boundaries for urbanisation. Schlesinger’s (2013) study also adopted a holistic approach to define urbanisation with consideration of its spatial, social, ecological, political/ administrative and demographic causes, mapping the subsequent socio-economic and land use changes on the effects of social and land use patterns, ultimately affecting households, employment and agricultural land use of the urban region as shown in the urbanisation conceptual framework in figure 2 below.

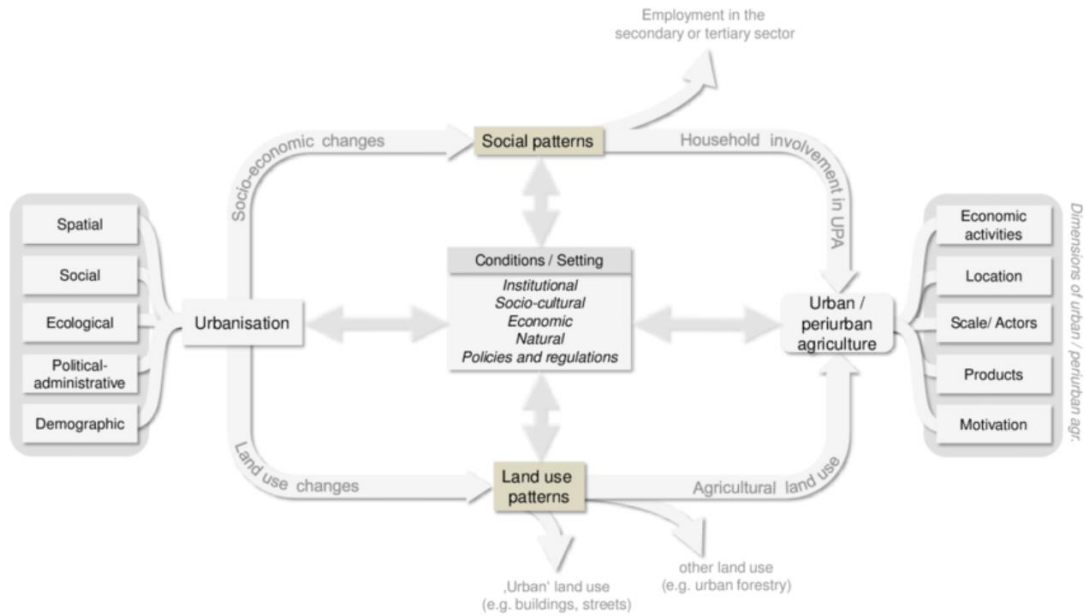


Figure 2: Holistic urbanisation conceptual framework (Schlesinger, 2013)

According to Okamoto (2019), increasing academic attention dedicated to conceptualise urbanisation has reached a common census in literature over its broad and far-reaching dynamic nature, focusing on the cause and effects of how an urban location is created, transformed and appropriated by the movement of people.

2.2 The causes and pressures driving urbanisation

According to Thomas (2008), there has been two waves of urbanisation driven by distinctive causes and pressures in relation to migration, reclassification and development of urban regions. The first wave of urbanisation is widely documented to have occurred in a two-century long period between mid-18th and mid-20th centuries, as an apparent demographic transition from less developed regions to more developed regions in search of better economic opportunities was evidential in Europe and North America (Thomas, 2008). Brindzaite (2020) also explored the

causes of urbanisation in the first wave 18th century, indicating that higher levels of industrialisation, modernisation on human health and trade opportunities were key drivers for urbanisation from less developed regions to cities. During the 19th century, mega cities were being created as the number of “million-cities” grew from only two in year 1800 (London & Beijing) to four in year 1900 with the inclusion of Tokyo and Delhi, further increasing to over 200 by year 2000 (Thomas, 2008). Defined by Hall & Pfeiffer (2013) as the global urban future, the second wave of urbanisation began in the 21st century as the post-industrial era is transitioned into knowledge-based economies, representing a paradigm shift as urbanisation occurs due to pressuring drivers in areas of environmental impact, sustainability and quality of living.

In modern research studies conducted on the current second wave of urbanisation, Laruelle (2019) proposes a three-factor model that explains the causes and drivers of modern urbanisation in areas of economic, social and resources/ environment. Furthermore, Lareulle (2019) drew upon the theory of agglomeration, linking urbanisation drivers to the improvements of education, employment and business opportunities due to the rising competitiveness of the agglomerated region. Geyer (2003) also applied agglomeration theories on urbanisation, claiming that it becomes easier for social developments and organisation due to the establishment of a agglomerated network of key resources, alleviating potential impacts on the environment and contribute to climate change as resources are optimised. However, empirical academic knowledge holds differing school of thoughts when exploring the causes of urbanisation, as Pieterse & Parnell (2014) argues that the drivers of urbanisation remain distinctively different amongst developing and developed countries. Pieterse & Parnell’s (2014) study on Africa’s urbanisation identified three major drivers including population growth, poverty and financial exclusion. Under the perspective of population growth, it is founded that the natural increase of urban population has resulted in the reclassification of areas which have traditionally been classicised as rural into urban regions, directly contributing to urbanisation growth with limited influence from rural-urban migration (Pieterse & Parnell, 2014).

Under the dimension of poverty, it is argued that vast regions of rural Africa are still suffering from extreme poverty where human needs cannot be met, endangering the health conditions and infant survival rates as people in lesser privileged poverty regions are pressured to migrate tor urban regions where water supply, sanitation and health care facilities are more sophisticated (Pieterse & Pamell, 2014). In terms of financial exclusion, rural regions of developing countries are found to have lower education levels, subsequently resulting a low skilled labour force but also a lack of interest for financial service firms to enter rural markets. This has resulted in the financial exclusion of rural populations who are unable to breakout from the toxic cycle of poverty, as limited education levels, employment opportunities and lack of financial service (investment) opportunities have driven urbanisation rates, as the rural population migrates in search for better opportunities due to push factors as shown in the push and pull factor model in figure 3 (Kanith, 2009). Alternatively, a large bodies of urbanisation literature conducted on developed countries have highlighted the pressures of natural population increase, attractiveness of push factors behind

rural-urban migration including safety, opportunity, stability, freedom and improvements across environmental, social, economic and political environments (Godfrey & Julien, 2005; Bertinelli & Strobl, 2007; Myers, 2021).

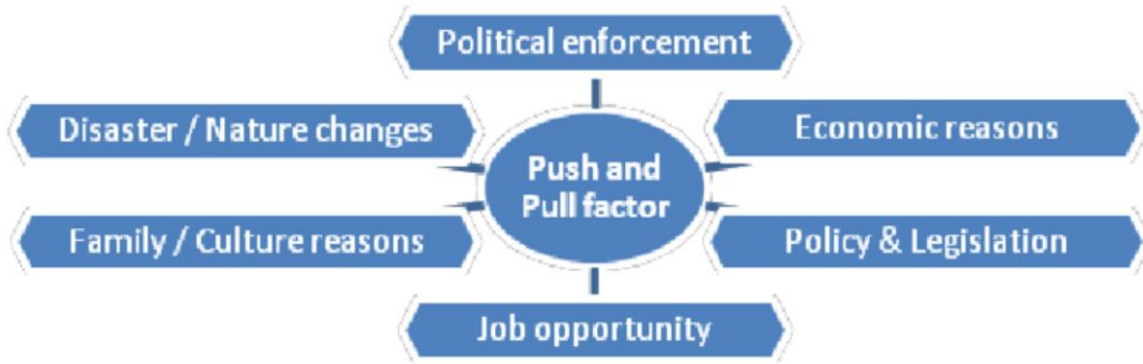


Figure 3: Push and pull factors of urbanisation (Adopted from Kanith, 2009)

2.3 Problems of urbanisation

A large body of empirical studies have been conducted to explore the environmental problems associated with urbanisation. According to Dewan et al (2012), it is founded that urbanisation causes a variety of environmental degradation problems due to the nature of spatial expansions and the remarkable rise in urban population. Subsequently, this is found to have profound impacts on the natural resource base of urban cities, as increasing land use with limited land space would elevate the risks of natural hazards such as flooding during monsoons, on top of the generation of air, water and noise pollution that poses negative impacts on the physical and psychological wellbeing of nearby inhabitants (Dewan et al, 2012). Arise's (2021) problems and remedies of urbanisation framework as shown in figure 4 below attempts to summarise the relationships and nature of problems from urbanisation. The problems of migration is argued to originate from the direct relationships with the creation of slums, overcrowding and increasing unemployment levels, an influx of lower skilled rural population with limited disposable income would likely cause an urban sprawl, resulting in far reaching problems such as communicable & non-communicable diseases and rising illiteracy levels, halting the development of major urban locations (Arise, 2021).

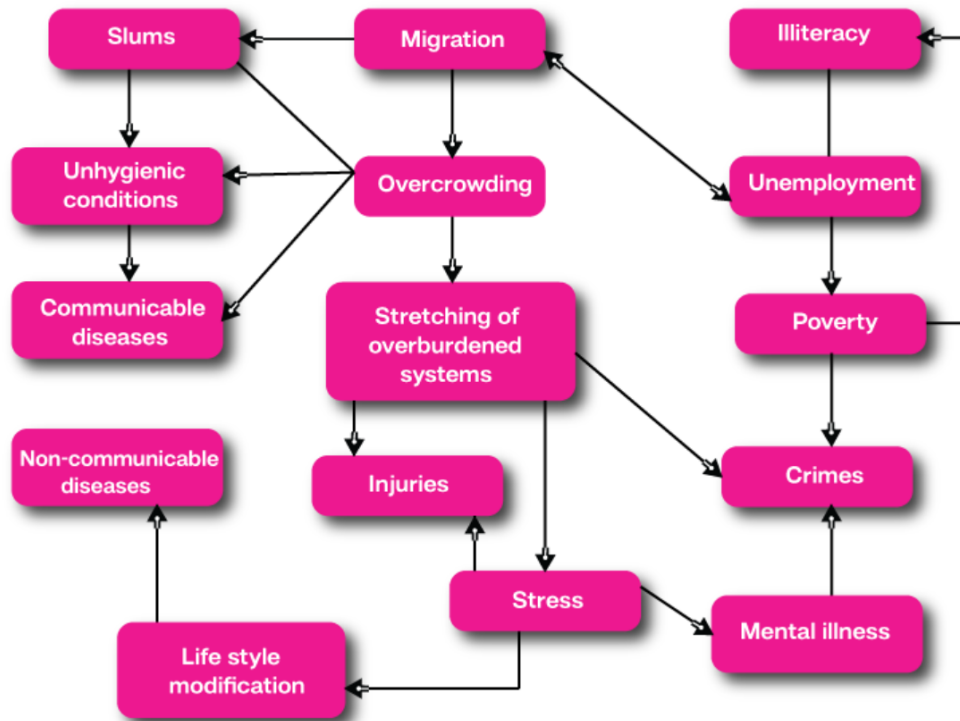


Figure 4: Problems and remedies of urbanisation framework (Adopted from Arise, 2021)

According to Pieterse & Parnell (2014), the distinctive differences in urbanisation motives across both developed and developing countries are reflected in the different types of problems created. In terms of developing countries, it is argued that the consequences of an ever-expanding population would result in overpopulated urban centres, attracting unfavourable and complex social, political and economic concerns due to need to establish better infrastructures and market regulations. Furthermore, overpopulated urban centres is found to directly contribute to environmental degradation due to the rise of slum households, a shortage of housing supply, insufficient public utility and welfare services, rising rates of pollution and poverty in the urban regions as shown in the case of India (Ahluwalia, 2016). The challenge of urban transport in developing countries is also raised in Rode's (2013) study, arguing that many urban cities lack sufficient transport infrastructures to facilitate the daily commute needs of an overpopulated urban society, resulting in capacity overloading, increasing the rates of traffic jams and accidents as shown in the case of Beijing which has been struggling with the highest rates of traffic jams due to over population (Yang et al, 2013).

Increasing urban population has resulted in high usage of energy, natural resources and consumption levels, particularly in supply limited industries like the transportation where drastic increases of public transportation has been evidential (Arise, 2021). Rising rates of young talents leaving for urban cities have resulted in major demographic problems in developed countries, as

old age occupants dominate rural regions causing labour shortage and negative economic growth in rural regions across Europe (ESPON, 2021). Similarly, the problems associated with urbanisation in developed countries also include the lack of available infrastructure to accommodate high population density levels, the lack of spatial capabilities and functions are highlighted, causing substantial rise in housing prices (unaffordable housing), vulnerability to disaster management, lack of jobs available in the market and higher rates of social unrest/ crime (ESPON, 2021).

2.4 Sustainability and urbanisation

The recognised problems and challenges of urbanisation across both developed and developing countries raise the need to identify suitable solutions to alleviate negative urbanisation impacts, whilst accompanying the ever-increasing demands for rural-urban migration (Ooi, 2009). Van Ginkel (2008) argues that the continuing climate change crisis, lagging of key developments, poor integration and lack of dignity experienced in 21st century urbanisation raises the need to develop more resilient, socially inclusive and efficiency organised urbanisation systems and processes. According to Somanje et al (2020), sustainability can be achieved in urbanisation across the triple bottom line levels of environmental, social and economic as shown in the conceptual framework for sustainable urbanisation in figure 5 below. Somanje et al (2020) proposed the need to sustainable initiatives across rural-urban linkages, requiring a collective effort between urban and rural development to establish a sustainability driven culture and social values. This is further driven by the sustainable utilisation of natural resources and ecosystem services, development of long-term governance and partnerships between public and private sectors and to effectively integrate sustainability to eliminate current inefficiencies and problems.

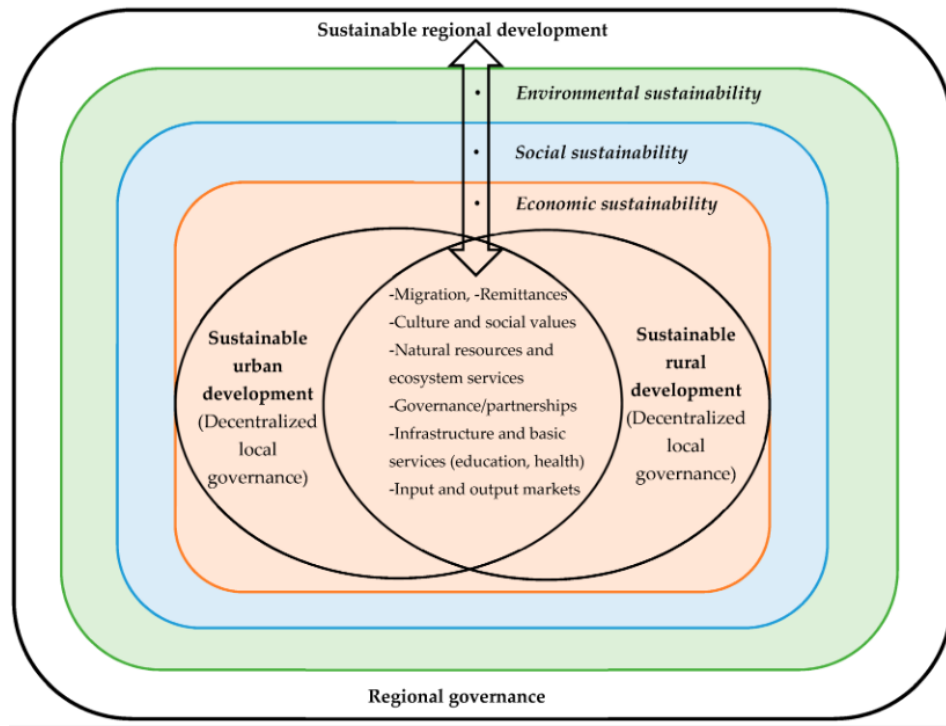


Figure 5: Conceptual framework for sustainable urbanisation (Somanje et al, 2020)

According to Pugh (2014), sustainable urbanisation across cities, suburbs, exurbs and other urbanised regions requires the design of an effective social-ecological system, planning, governing and providing services to create employment opportunities, reduce carbon footprints and to improve the quality of life in a holistic approach. This is also reinforced in EAA's (2021) conceptual framework for urban environmental sustainability as shown in figure 6, adopting six urban "city lens" perspectives in areas of green, low carbon, resilience, circular, healthy and inclusiveness to achieve a sustainable urban ecosystem. The incorporation of these six lenses in the design of sustainable urban ecosystems stimulate corresponding enabling factors including knowledge, data & information, technology, finance, culture and governance that combines to aid the building blocks of a sustainable urban ecosystem (EAA, 2021). Anarfi et al (2020) argues that it is important to continuously monitor and improve the urban ecosystem to ensure new sustainability needs are addressed, partly due to the adversely changing conditions of the environment and the decreasing capacity of urban land that becomes increasingly scarce.

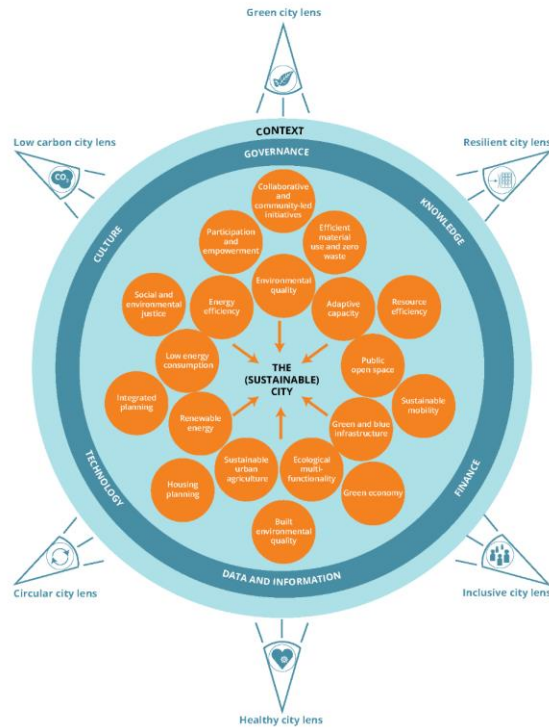


Figure 6: Conceptual framework for urban environment sustainability (EEA, 2021)

According to Anarfi et al (2020), despite increasing recognition over the importance of addressing the sustainability implications of urbanisation, empirical literature provides only generic frameworks to conceptualise the necessary areas of sustainability integration, lacking sufficient practical guidelines or protocols to put into practice. Furthermore, Cobbinah et als' (2015) attempt at framing sustainable development of urbanisation in developing countries founded that the priority to develop urban areas overwhelms the limited focus given on the protection of the environment, proposing the need for an effective balance between environmental, social and economic sustainability dimensions. Rezai & Allahkarami's (2021) study reiterated on the necessity for both developed and developing country urbanisation to adopt waste management initiatives to enhance the financial and environmental performance of sustainable urbanisation, designing primary and secondary waste streams in circular approaches to reduce wastage across energy, financial and environmental perspectives. Kumar (2022) proposed the concept of sustainable urban development on a wider spectrum of social principles, addressing sustainability in areas of futurity, equity and participation that influences the direct involvement of public citizens in urban regions. The multifaceted nature of sustainable urbanisation remains an emerging research field as this study will aim to address and contribute to this research gap, particularly in the developing city context of Shanghai.

2.5 The role of policy design in China's urbanisation development

There is a widespread belief in the academic field that sustainable urbanisation development has not been given sufficient priority by many policy makers worldwide, particularly in the collective efforts across economic, social and environmental dimensions according to Tonne et al (2021). Hu (2013) explored the drivers of China's rapid urbanisation rates, identifying two fundamental causes including the exogenous globalisation factors including increasing foreign direct investments, technological advances and knowledge diffusion. The second type of driver refers to the local environment endogenous policy factors, associating major policy reforms, governance decentralisation and marketisation to have drastically accelerated urbanisation rates (Hu, 2013). Similarly, Dai (2015) reiterated the substantial importance of endogenous policy factors on China's rapid urbanisation rates, emphasising on the decentralisation of the central government's control and governance of land and housing ownership, highlighting the important role of China's 1988 housing reform which fostered the privatisation of the real estate sector, enabling the purchase of houses in urban locations which attracted an influx of rural migrants.

Other empirical studies from Quan (1991); Hong et al (2021); Cheng (2021) also explored the endogenous political factor influence of China's urbanisation, finding that the policy designs to govern economic decision making and public finance developments have encouraged rural-urban migration, as the development of special economic zones (SEZ) in major urban cities has opened up substantial economic opportunities and attracted a large influx of rural migrants (Hong et al, 2021). Similarly, Quan (1991) founded a clear relationship between policy design and urban development in land use, as the government has strategically prioritised China's urban development through promoting the real estate market, encouraging the private sector to purchase land through a series of land policy reforms. Cheng et al (2021) argues that less policy incentivisation in the land development of rural regions have further accelerated the rate of urbanisation, as private companies opt for the higher financially incentivised urban land developments and retail investors are also encouraged to invest in properties in urban regions due to anticipated future growth. Hu's (2013) study provided a wider approach to understanding China's urban development scene, incorporating the relationships between exogenous and endogenous factors as shown in the China's urbanisation factor framework in figure 7 below.

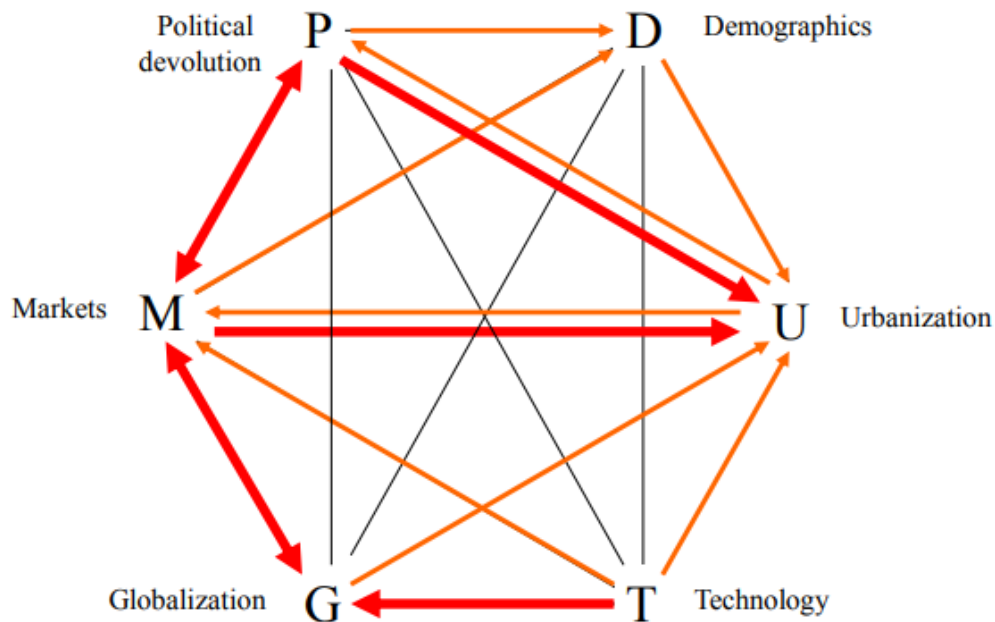


Figure 7: China's urbanisation factors framework (Hu, 2013, p162)

Hu's (2013) approach to conceptualise the factors contributing to China's urbanisation highlights the key relationship between political devolution, markets, globalisation, urbanisation, demographics, technology and market factors. According to Okamoto (2017), China's political agenda to transition into a market driven economy governed by a socialist approach has created a strong exogenous casual chain, linking the market driven elements of technology, globalisation and market trends into the policy design of urbanisation. It is acknowledged that China's urbanisation process represents a multidimensional phenomenon with unique facets, accompanied by other cultural, historical, political and institutional factors (Zhou, 2014). However, insufficient academic studies have been conducted to take in-depth investigations over the effects of political factors on urbanisation, especially how policies are designed and how urbanisation is governed, representing an apparent research gap to address (Okamaoto, 2017). The majority of empirical studies conducted on China's urbanisation demonstrate strong focus on exogenous market driven factors, neglecting the overarching influence of policy designs as current literature commonly adopts non-institutional research scope (Hu, 2013). Therefore, it is of research importance to explore the institutional and endogenous factors impacting China's urbanisation process, as other empirical studies have adopted when exploring urbanisation in other developing country context of India (Batra, 2009), South Africa (Ruhliga, 2014) and Nepal (Bakrania, 2015).

2.6 Summary of literature

The concept of urbanisation has received substantial research attention in the academic field, particularly in the recent decades where accelerated rates of urbanisation has occurred worldwide. However, despite numerous attempts at conceptualising urbanisation as a process, it is widely recognised that urbanisation represents an overarching ecosystem that requires a holistic approach to incorporate the causes, the process and effects of urbanisation (Schlesinger, 2013). Furthermore, given the unique characteristics of urbanisation for each city or country, it is acknowledged that there exist no unified paradigms to accurately measure the full dynamics of urbanisation, requiring a case specific approach to evaluate the unique social, cultural, political and economic environment of the urbanising region (Berghall & Knovitz, 1998). Similarly, the need for a case specific research focus is carried across to analysing the causes and pressures driving urbanisation for a particular region, this can be achieved with the support of available frameworks designed to measure the level of push and pull factors for urbanisation (Kanith, 2009), as well as measuring the nature of problems resulted from urbanisation (Arise, 2021).

The distinctive differences between urbanisation in developed and developing countries have been widely recognised in literature, as increasing research attention has been dedicated on the rapid urbanisation experienced in developing countries, focusing on the push factors for urbanisation including population growth, poverty and financial exclusion (Pieterse & Parnell, 2014). However, it is apparent that modern developing countries should no longer be grouped and studied in a generic manner due to the vast differences in economic and social infrastructures that are known to affect urbanisation. The case of urbanisation in China represents strong research importance as the experienced economic and societal developments in recent decades upon its 1978 reform has rapidly revolutionised its major urban regions, representing the country with the most urban cities with over 1 million population (Statista, 2021). Nonetheless, despite numerous research studies attempting to explore China's urbanisation (Tonne et al, 2021; Hu, 2013; Hong et al, 2021), the majority of studies are conducted under a nation-wide approach, failing to anticipate and consider the unique urbanisation environments of this study, representing a research gap as studies conducted on the urbanisation of Shanghai remains inadequate.

Additionally, the emerging academic focus on integrating sustainability on urbanisation raises the research importance to understand how sustainable developments can be achieved in Shanghai's urbanisation process/ ecosystem. Two schools of thoughts exist in literature when exploring the influential drivers to urbanisation, as Hu (2013) argues that exogenous globalisation factors and local endogenous policy factors contribute to the design and execution of urbanisation developments. Whilst substantial empirical studies have attempted to explore the exogenous globalisation factors, focusing on market driven and non-institutional factors that drive and affect urbanisation development, limited numbers of studies have actively explored the policy driven, institutional factors especially in China's urbanisation development (Okamoto, 2017). Therefore,

this research is designed to address the identified research gap, exploring the role of policy design in the urbanisation of Shanghai, emphasising on the emerging research trends in areas of sustainability and environmental problems with specific focus on Shanghai’s unique social, cultural, political and economic environment. This study will offer practical insights to the academic field as there are currently no studies conducted on this chosen research scope and case study.

3. Methodology

This chapter discusses the design of the methodology system for this research project, emphasising on the chosen research methods across each of the methodological system layers according to Saunders et al’s (2009) research onion framework as shown in figure 8 below. According to Goddard & Melville (2004), the methodology system of a study refers to the specific procedures, tools and methods used to identify, select, process, collect and analyse information about the chosen research topic of interest. Furthermore, Goddard & Melville (2004) argues that it is vital for the researcher to effectively analyse the needs of each research study, identifying suitable research tools and methods that offer distinctive functions to fulfil the research needs given the extensive range of available research tools and methods. Therefore, this chapter critically discusses the rationale behind the chosen research tools, methods and techniques across all layers of the research onion framework, adopting Saunders et al’s (2009) systematic approach to dissect the methodological system in chronological layers beginning from the research philosophy, to approaches, strategies, choices, time horizons, data collection, data analysis and potential ethical concerns.

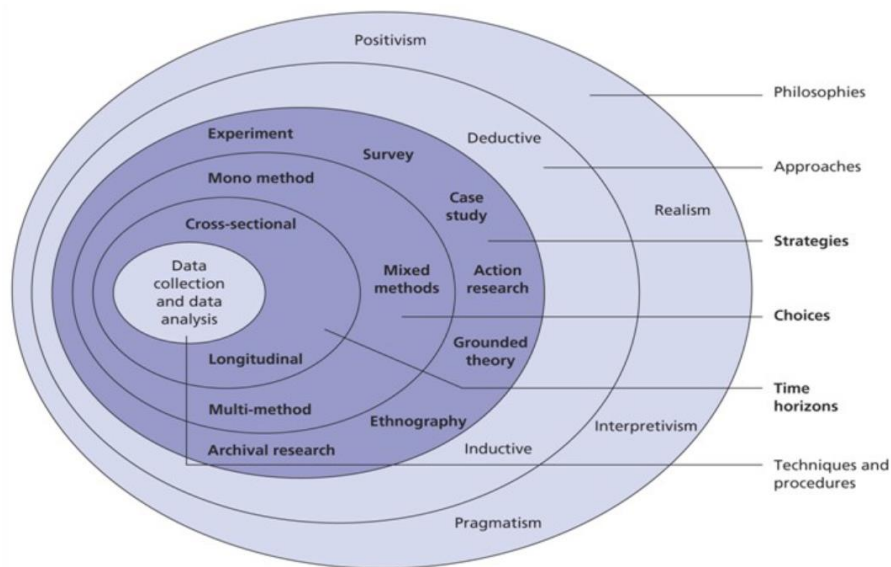


Figure 8: Research onion framework (Saunders et al, 2009)

3.1 Research philosophy

According to Saunders et al (2009), the research philosophy refers to a system of beliefs and assumptions about how knowledge can be developed and how realities should be perceived. This research attempts to explore the reality of the current real-life urbanisation process and ecosystem in Shanghai, interpreting and observing the objective realities of how sustainability driven policy design has been implemented and governed in Shanghai's urbanisation. Therefore, an ontological philosophy branch is adopted as it allows the interpretation of real-life objects about what constitutes as the reality, accepting that multiple realities exist as the nature of urbanisation differs between all countries due to unique social, cultural, political and economic factors. Furthermore, an ontological branch of pragmatism research philosophy is adopted as it offers high levels of flexibility for the researcher to choose the most suitable research methods to address research goals, anticipating that the ever-changing urbanisation landscape of Shanghai would require a dynamic research design to address practical problems.

3.2 Research approach

According to Saunders et al (2009), there are two major types of research approaches in academic studies including inductive and deductive studies, guiding the planning procedures from broad assumptions to data collection in order to formulate meaningful findings as shown in figure 9 below. The fundamental differences between the two research approaches lie in sequence of which data is collected and the underlying motives behind conducting the research study (Soiferman, 2010).

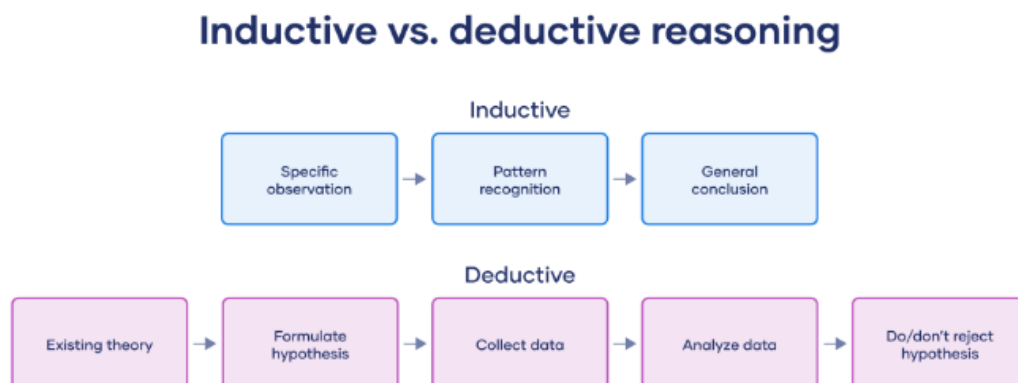


Figure 9: Inductive and deductive reasoning processes (Adopted from Saunders et al, 2009)

This research addresses an apparent research gap where there has been no empirical studies conducted to examine the sustainability of policy design in Shanghai's urbanisation, thus requiring an inductive research approach to identify key trends and patterns from observed data, providing case specific findings with focus on the sustainability and environmental challenges of Shanghai's urbanisation policy design, formulating new practical insights and contribute to the literature gap.

3.3 Research strategy

This research proposes a secondary data collection approach that extracts relevant qualitative data from empirical academic studies and practitioner reports (government, industry, news, media and company reports conducted on sustainability driven policies introduced in Shanghai, particularly with relevance to urbanisation. According to Vartanian (2010), a secondary data research strategy provides a cost-effective approach to collect data, particularly in research fields where surplus volumes of studies have been conducted and data can be easily accessed. However, Vartanian (2010) also argued that secondary data research studies are vulnerable to inaccuracies due to the collection of inaccurate and illegitimate data, inaccessibility to data and poor interpretation of data meanings. Johnston (2017) further expanded on the potential limitations of secondary data, claiming that a lack of relevance, accuracy, accessibility and research specific focuses of available secondary data would limit the reliability and validity of produced research findings. Therefore, this study will collect only secondary data from authentic and credible sources such as government, industry news and company reports, accessing secondary data from online databases with keyword searches on “environmental problems”, “sustainability programmes”, “urbanisation developments”, “policy design” and “Shanghai”.

A case study approach is adopted to focus on the Chinese metropolitan city of Shanghai, representing the city with highest rate of urbanisation in China. The case specific research strategy adopted helps to contribute to the recognised research need to study urbanisation in individual city context, as the distinctive social, cultural, political and economic environment of each city differs and would subsequently impact urbanisation differently (Berghall & Knovitz, 1998). According to Gagnon (2010), a case study research strategy enables the researcher to avoid the formulation of generic findings that lack practical and meaningful values, especially for inductive research studies where the formulation of new insights require specific research focuses. Furthermore, case study allows the collection of in-depth data that can capture the dynamic context of realities of a real-life phenomenon, facilitating a multi-faceted approach to observe the complexity of real-life settings (Gagnon, 2010). However, Krusenvik (2016) argues that the limitations of a case study approach relate to the lack of generalisability and applicability of research findings on other case studies, the findings of sustainable policy design for Shanghai may not be applicable to other Chinese cities due to its distinctive social, cultural, political and economic environment. Nonetheless, this study is performed as a desk-based research project where only secondary data

will be gathered and analysed in a pragmatism research philosophy, focusing on the case study of shanghai in order to fulfil the proposed research objectives.

3.4 Research choice

This research study adopts a mono research choice as only qualitative data is gathered and analysed throughout the research process, enabling a rich, in-depth analysis on the chosen research topic with high levels of flexibility. According to Thomas (2003), the collection of qualitative data compliments inductive studies where new theories and insights are formulated from research findings, therefore the collection of in-depth textual data would help to potentially open up previously unknown knowledge, contributing to research gaps where insufficient studies have been conducted. However, Thomas (2003) also argues that the collection of qualitative data requires the researcher to taken upon an objective approach, avoiding potential personal bias and subjective judgements in the interpretation of qualitative data given its open and flexible nature, which could potentially result in a lack of objectively and inaccurate research findings. In order to overcome the limitations of secondary data, the researcher will conduct an extensive review of available secondary data, gathering multiple perspectives and anticipating potential differences in opinions with equal importance (Liu, 2016).

3.5 Research time horizon

This research study collects and analyses secondary data within a five-year period between 2018 and 2022, ensuring that only the most up to date and relevant data on Shanghai's recent urbanisation policy plans are used. Furthermore, a cross sectional time horizon is adopted as data is collected at a single point in time, there will be no repeated collection of data from the same source given the lack of existing longitudinal data conducted to measure Shanghai's urbanisation across a period of time.

3.6 Data collection and analysis

This research collects qualitative secondary data from empirical academic studies and practitioner reports conducted in relation to Shanghai's urbanisation, emphasising on policy design, sustainability and environmental problems caused throughout the urbanisation process. All secondary data will be collected on online libraries and databases including the Birmingham university online library, Google Scholar, Mintel, Statista, IBIS World industry reports, government, news and media reports, ensuring that only credible and reliable data sources are used. All in-depth, textual qualitative data gathered will be analysed using a thematic analysis method, whereby key themes will be identified from qualitative data sets, observing common trends and evaluating their implications with critical thinking and academic knowledge. Thematic analysis

will be conducted in accordance to Terry et als' (2017) SAGE handbook of qualitative research guidelines, following a six-step process that begins with familiarization of gathered data, followed by coding, generation of themes, reviewing themes, defining themes, renaming themes and the final write up. A thematic analysis approach enables the researcher to combine key themes (qualitative data) from a range of data sources, capturing key trends that are previously unknown and drawing values in a transparent structure in the development of new insights/ knowledge.

3.7 Ethical considerations

In order to address apparent ethical concerns when collecting, analysing and utilising secondary data, all gathered secondary data must be from sources that have acknowledged their consent for the reuse of generation data, all outcomes of conducted analysis must not re-identify participants to protect ethical concerns in relation to anonymity and confidentiality. Moreover, the use of the gathered data must not result in any damage or distress to the reader as the research will ensure that there will be no collection of sensitive data, ensuring the readers are protected without harm.

4. Shanghai's policy-led sustainable urbanisation

This chapter presents and analyses the key qualitative themes identified from empirical academic studies and practitioner reports conducted in relation to the urbanisation process of Shanghai, focusing on the sustainability and environmental problems encountered throughout the urbanisation process. The recent policy designs to incorporate sustainability-driven policies to reduce environmental problems during urbanisation are critically explored, addressing current weaknesses with recommended improvements to better facilitate sustainable developments in urbanisation policy design. The first section provides a background of Shanghai's urbanisation process and the remaining chapter is structured in accordance to the order of research objectives.

4.1 Shanghai's urbanisation

As the most populated Chinese city with over 23 million local residents, Shanghai is located in the mouth of the Yangtze River in East China, covering over 6340.5 square kilometres and is home to the world's largest seaport that drives the city's thriving economic developments (Britannica, 2022). Upon China's economic reform in 1978 that opened-up the previously restricted Chinese economy for foreign trade and market deregulations to stimulate economic developments (foreign investment), Shanghai was granted the status of a special economic zone in 1984 for overseas investments as the surge in urbanisation rates in Shanghai began throughout the 1980s, transforming the city into sprawling megapolis (Fei & Zhao, 2019). Since 1984, Shanghai's population grew from 6.8 million to over 23 million, as the degree of urbanisation surged from

21.2% to 89.3% between 1984 and 2020, representing the highest degree of urbanisation rates in China in comparison to the national average of 63.8% as shown in figure 10 below (Statista, 2021).

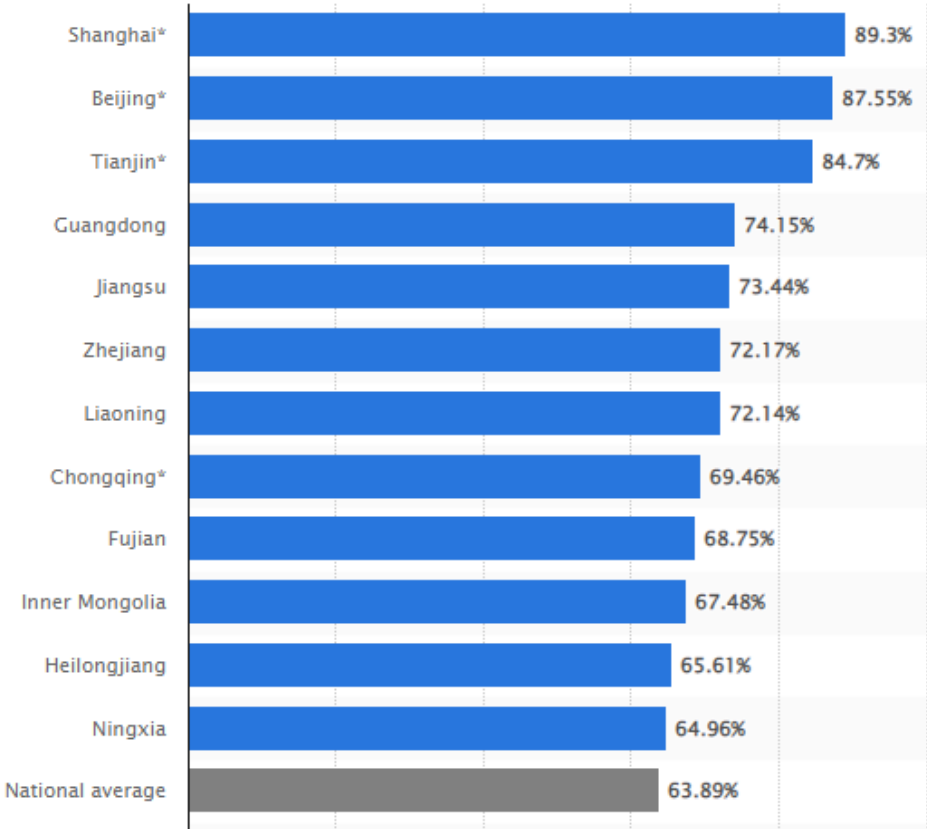


Figure 10: Highest degrees of urbanisation rates in China in 2020, by region/ province (Statista, 2021)

In the early 1990s, the former leader of the People’s Republic of China Deng Xiaoping chose Shanghai as the designated “dual centre” to lead economic development across the country’s main Yangtze River Delta region, introducing an extensive range of new policy initiatives to increase export tax rebates, attract talents and foreign investments through deregulation in the financial and shipping sectors (brook, 2013). According to the World Bank (2022), foreign direct investment net inflows rates in Shanghai surged from 1% of total GDP in 1990 to 6.2% in the space of three years (1993), stimulating high levels of urban development and played a significantly positive role in the development of Shanghai’s urbanisation (Wu & Chen, 2016). This is evidential in the prominent change in Shanghai’s urban spatial structure before its granted special economic zone

status in 1984 and sixteen years after key “dual centre” policy reforms as shown in figure 11 (Wu & Chen, 2016).



Figure 11: Evolution of Shanghai's urbanisation between 1984-2016 (Wu & Chen, 2016)

According to Wu et al (2017), Shanghai's transition from a city to a megapolis has witnessed continued rapid urban growth and the construction of new buildings in urban regions to house almost 90% of its population living in officially defined urban areas within its municipal boundaries. This is reflected in the ultra-high building density levels particularly in the city centre of Shanghai, achieving a 1-3.8 building-area-ratio in comparison to the 0-0.1 building-area ratio in rural regions of Shanghai as shown in figure 12 below (Wu et al, 2017). Shanghai's rapid urbanisation since the mid-1990s driven by surging rates of economic development has resulted in vast investments on the spatial infrastructure of urban regions, as both market forces and extensive government intervention have contributed to the shaping of urban development in Shanghai, reinforcing Hu's (2013) Chinese urbanisation factors framework where market force factors (globalisation, technology) and political devolution have collectively influenced the process of rapid spatial transformation and the design of urban development strategies.

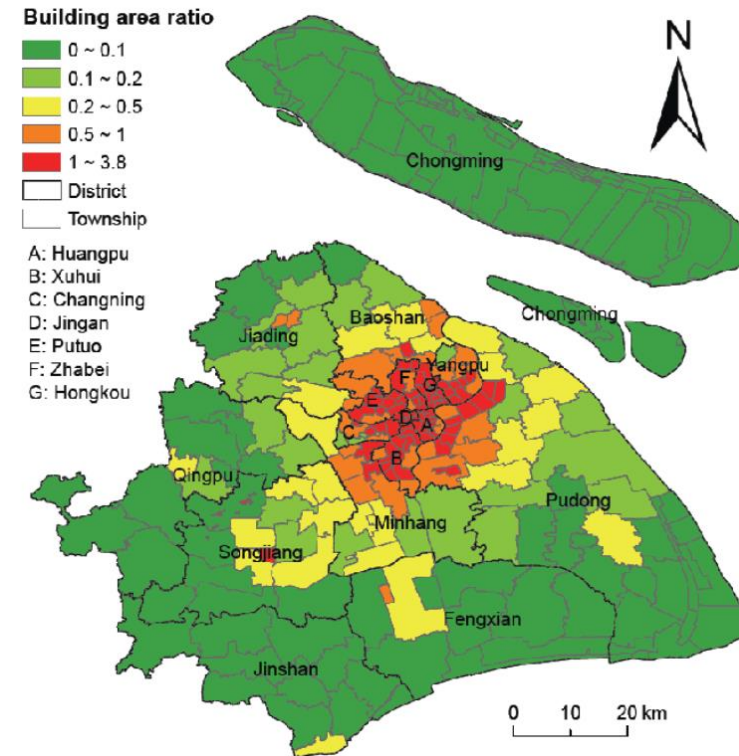


Figure 12: Building-area-ratio (building density distribution) in Shanghai (Wu et al, 2017)

4.2 Environmental and sustainability problems caused by urbanisation in Shanghai

The environmental and sustainability challenges caused by Shanghai’s rapid urbanisation has received substantial research attention in literature, a range of key themes related to the negative environmental/ sustainability impacts is summarised in table 1 below.

Table 1: Environmental and sustainability problems (themes) from Shanghai’s urbanisation

Key themes	Authors/ Sources	Description
Land surface temperature increase	Chen et al (2016)	The intensity of diurnal surface urban heat island levels (SUHI) has significantly increased between 1989 and 2013 along the north/ south dimension, inline with the key regions of urban developments (Appendix A).
	Cui & Shi (2012)	Substantial areas of cultivated lands have been replaced with the continues increase of buildings in urban areas of

		Shanghai, resulting in the growth of urban heat island (UHI) levels (Appendix B)
	Nasa's Earth Observatory (2019)	Shanghai's urban region have experienced an 81% increase in temperature levels between 1984 and 2014, triggering consequential sea rise, erosion and dredging problems
Induced land subsidence increase	Xu et al (2012)	Induced land subsidence increase in Shanghai between 1980 and 2010 is positively correlated with the increase of urban constructions, strong correlation between cumulative subsidence and increased railway track infrastructure is found (Appendix C)
Groundwater level decrease	Xu et al (2012)	Groundwater level decrease in Shanghai between 1980 and 2010 is positively correlated to the increase in underground structure construction including foundation engineering and construction of tunnels which results in decreased groundwater recharge from urban surroundings (Appendix D)
Increased waterlogging	Wu et al (2012)	Rapid urbanisation and associated land cover changes have contributed to increased waterlogging, increase in runoff coefficient due to conversion of lands from agricultural to urban developments have increased the risk of waterlogging.
Lower density of green vegetation (moisture stressed vegetation)	Cui & Shi (2012)	The mean annual normalised difference vegetation index (NDVI) shows that regions with previously high NDVI levels have decreased (85.5% to 76.2% between 1991 and 2010) and the number of regions with lower NDVI has substantially increased (12.5% to 22.6%), occurring predominantly in urban regions (Appendix E)
Increased nitrogen (reactive) emission	Gu et al (2012)	The long-term urbanisation of Shanghai between 1952 and 2004 has seen the rise in per capita nitrogen input from 13.5 to 43.7 kg N per year, particularly due to transformation of agriculture land-use to industrial land-use and increasing human inhabitation (Appendix F)
	Sammarchi & Yang (2021)	The urban population of Shanghai has contributed to 93% of nitrogen increased in the increased consumption of animal food products, especially in densely populated urban agglomeration regions of Shanghai

Increased energy consumption levels	Li & Yao (2009)	The drastic increase in the development of new office buildings in Shanghai has substantially increased building energy consumption levels, as the level of office building energy consumption of Shanghai exceeded the whole of Japan in 2009
	Zhao & Zheng (2018)	The urban households of Shanghai consume more than the 50% higher energy consumption levels than rural household counterparts, as each 1% increase in urban population relative to the total population is translated into 1.4% in energy consumption increase.
Longer vegetation phenology	Qiu et al (2017)	In the period between 1984 and 2015, urban vegetation has experienced longer vegetation phenology of 10 to 21 days in comparison to rural regions, as rapid urban landscape development is found to negatively influence the phenology of urban vegetation (Appendix G)
Increased household waste generation	Zhou et al (2022)	The increasing density of Shanghai's urban population is substantially increased waste generation from surging numbers of households, stimulating higher risks in health, safety and environmental pollution
Increased carbon emission rates	Li et al (2020)	The dynamic change in Shanghai's urban population structure is characterised by major developments in industrial structure and consumer markets, representing a positive elastic coefficient with the growth of carbon emission rates.
	OECD (2020)	Urban conglomerates and economic clusters in the city centre of Shanghai have seen the rise in the emissions of PM, VOCs, O3 and NH3, as the Yangtze River Delta region is shrouded in persistent haze for 30% of the year
Weakened soil microbial diversity and composition	Liu et al (2022)	The physicochemical environment of Shanghai has been greatly affected by urbanisation, especially on the biodiversity of soil microbial communities which has been substantially weakened in positive relation to rising urbanisation (Appendix H).
Wetland environmental damages	Nasa's Earth Observatory (2019)	Extensive developments in the construction of water storage infrastructures to cater for the growing urban population of Shanghai has resulted in the increasing demand for new

		coastal land (reclamation), destroying wetlands along its eastern peninsula
Water pollution & shortages of clean water	OECD (2009)	The Yangtze River Delta region has been severely impacted by urban developments in Shanghai, as 69% of water quality are classified as class V or lower.
Increase in substandard living conditions & social tensions	OECD (2013)	The influx of people from rural regions into urban regions of Shanghai has been reflected a clear gap between housing & essential infrastructure and urbanisation growth, resulting in rapidly increasing crime rates and broader social inequality tensions
	Bronner & Reikersdorfer (2016)	Increasing demands/ levels of migrant worker to support the urban development of Shanghai and the rapidly increasing costs of living has caused an apparent inequality divide, as many migrant workers live in sub-par conditions (six in one small room) due to inability to afford accommodation in urban areas.
Increase chronic disease levels	LSE Cities (2021)	The rapid urban restructuring of Shanghai is positively correlated to the shift in disease patterns, high population density, reduction of non-agriculture population and urban green space have seen the death rates caused by chronic diseases to overtake acute diseases.

The major theme of “land surface temperature increase” is identified in the studies of Chen et al (2016), Cui & Shi (2012) and Nasa’s Earth Observatory (2019) report, drawing to the consensus that urban developments have accelerated the increase of urban heat island levels (SUHI), particularly when large areas of cultivated lands are replaced with tall skyscrapers in urban regions, resulting in a drastic 18% increase in temperature levels in the space of three decades with wide reaching environmental challenges such as rising sea levels, erosion and dredging (Nasa’s Earth Observatory, 2019).

Other major themes identified including “induced land subsidence increase”, “groundwater level decrease” and “increased waterlogging” highlight the environmental damages caused by increased levels of urban constructions. According to Xu et al (2012), the widespread development of road infrastructures and underground structure constructions have increased the level of cumulative land subsidence, damaging land infrastructures, increasing risks of waterlogging (Wu et al, 2012) and decreasing groundwater recharge from urban surroundings (Xu et al, 2022).

Another major environmental problem is identified in the “lower density of green vegetation”, reducing by 9.3% between 1991 and 2010 as many urban regions have lost large areas of natural vegetation/ greenspace, resulting in higher risks of flooding, heatwave and climate change impacts (Cui & Shi, 2012).

Similarly, Qiu et al (2017) found that urban vegetation has experienced an increase in vegetation phenology between 10 to 21 days, indicating that the biological life cycles of vegetation have been disrupted due to poorer climate conditions in urban regions. The identified themes of “increased nitrogen (reactive) emission” and “increased carbon emission rates” highlights the direct environmental pollution caused by Shanghai’s rapid urbanisation.

Gu et al’s (2012) study found an almost tripling increase in per capita nitrogen input due to the increase in industrial land-use, as the urban population alone contributes to 93% of surplus nitrogen created from food consumption (Sammarchi & Yang, 2021). Alternatively, the growth of emission rates showcases a clear positive correlation to Shanghai’s rapid industrial structure and consumer market growth (Li et al, 2020), especially in urban conglomerates and economic clusters where the rise of PM, VOCs, O₃ and NH₃ have resulted in persistent haze for almost 30% of the year, affecting, increasing risks of sickness and air pollution levels (OECD, 2020).

In Li & Yao (2009) and Zho & Zheng’s (2018) studies, the common theme of “increased energy consumption levels” is identified as Li & Yao (2009) addressed the rapid construction of new office buildings in urban regions of Shanghai, indicating that the level of energy consumption of Shanghai has already exceeded the energy consumption of the entire Japan as of 2009.

Additionally, Zhao & Zhang (2018) found that urban households in Shanghai to consume 50% more energy than rural households, drawing upon the environmental impacts such as thermal, water and waste pollution and the unsustainable nature where 1% increase in urban population is translated into 1.4% increase in energy consumptions. The rise in the number of urban households is found to “increase household waste generation”, stimulating higher levels of risks in health, safety and environmental pollution (Zhou et al, 2022).

The rapid urban restructuring of Shanghai over the past few decades is also found to positively correlate to the shift in disease patterns, as high population density, loss of agriculture and vegetation has “increased chronic disease levels”, surpassing acute disease to contribute to the most deaths in the urban population caused by increase in slums, insufficient access to sanitation and high levels of air pollution from high numbers of vehicles (LSE Cities, 2021).

Similarly, OECD’s (2013) report found that the rapid inflow of people into urban regions of Shanghai has widened the gap between housing & essential infrastructure and urbanisation growth, this has resulted in “increase substandard living conditions and social tensions” as shown in higher crime rates, poor living conditions and wide-reaching social inequality challenges/ tensions between local stakeholder groups.

Bronner & Reikersdorfer's (2016) study also founded that Shanghai's rapid urbanisation developments have increased the demands of migrant workers to support the development and construction of urban projects, living in sub-par conditions as they are unable to afford accommodation in urban areas, illustrating a clear inequality divide and increases the number of slums in urban regions.

Another major theme is identified in the physiochemical environmental impacts of Shanghai's urbanisation under "weakened soil microbial diversity and composition", as the biodiversity of soil microbial communities are found to have been substantially weakened due to high density urbanisation developments (Liu et al, 2022).

Furthermore, the construction of water storage infrastructures to provide sufficient clean water for the growing urban population is found to have inflicted "wetland environmental damages", increasing demands for reclamation needs have destroyed the wetlands along Shanghai's eastern peninsula which has traditionally been home to high volumes of sea-agriculture (Nasa's Earth Observatory, 2019).

High levels of infrastructure developments to support the increasing demands of the surging urban population has seen the Yangtze River Delta region severely polluted by construction waste, as it is founded that 69% of water quality in the region is classified as class V or lower, posing health and safety threats to both local residents and other cities along the Yangtze River (OECD, 2009).

Overall, the major themes identified over an extensive range of empirical data reinforces academic knowledge over the potential environmental and sustainability impacts of urbanisation, supporting many areas of Arise's (2021) problems and remedies of urbanisation framework, demonstrating clear sustainability challenges in aspects of slum creation, overcrowding, burdened infrastructure systems, non-communicable diseases, mental illness, crimes, poverty and unhygienic conditions etc...

4.2 Current sustainability driven policies designed and implemented

Since 2016, a total of six major policies and masterplans have been designed and implemented by the Central Chinese or Shanghai government to actively govern and encourage sustainable urban developments as summerised in table 2 below. In 2017, the Shanghai Water Bureau introduced an \$43 billion urban draining masterplan to help overcome the current water drainage and water pollution challenges caused by the high density of buildings and high numbers of major urban development projects (CIWEM, 2022). The unprecedented growth of Shanghai's urban development projects has gradually increased the catchment's impermeable area and the stormwater run-off in urban regions, this has resulted in the substantial decrease of urban flooding protection. This masterplan saw the construction of new major underground tunnels, facilitating greater protections against urban flooding, as well as reducing water pollution through enhanced water storage (detention tanks) and storm water treatment plants (CIEWM, 2022).

Table 2: Sustainability driven policies in Shanghai (themes)

Key themes	Authors/ Sources	Description
Water drainage/ anti-water pollution masterplan 2017	CIWEM (2022)	Shanghai's Water Bureau announced an urban drainage masterplan in 2017 to address the inefficient drainage system problems, as unprecedented growth and urban development has increased Shanghai's catchment's impermeable area and the city's stormwater runoff, as the system attempts to reduce urban flooding and water pollution of watercourses/ canals via the creation of new underground tunnels, detention tanks and storm-water treatment plants costing \$43 billion (Appendix I)
	Hu et al (2019)	The urban drainage masterplan aims to ease the ongoing problems with Shanghai's rapid urbanisation specifically to reduce land subsidence, urban rain island effects and improve urban drainage capacity, the improved drainage system is expected to increase absorbing capacity of excess water by 30% and reduce future inundation risks by 85% (+/-8%)
Waste segregation policy 2019	Zhou et al 2022	On 1 st July 2019, Shanghai became the first Chinese city to introduce a compulsory waste segregation policy for all residents and commercial establishments to segregate waste into four categories at the point of origin including residual waste, wet waste, recyclable waste and hazardous waste. This has resulted in the reduction of trash buried in landfills from 41.4% to 20%.
	Green Initiatives (2020)	Over 5,200 tons of daily waste have been recycled or treated to minimise its environmental impacts, the treatment for hazardous waste has gone up by 504%, collecting of recyclable waste (432%) and residual waste has reduced by 31%, substantially reducing costs and pollutions related to handling toxic wastes. (Appendix J)
	Li et al (2021)	Recycling over 9,600 tons of clean food waste per day that is still maintained two years later, achieving immediate and sustained growth in clean food waste collection fed biogas production (0.1-1.9 GWh/ day) and the production of energy

		from waste (5.4-8.6GWh/ day), reducing environmental impacts and contributing to energy production
Peak carbon 1+N policy (14 th Five-year plan period 2021-2025)	China Briefing (2022)	The establishment of a working policy guidance for carbon neutrality and reaching carbon dioxide peak before 2030, emphasising on key improvements on the production system, circulation system, consumption system, acceleration of green space development, integration of innovative technologies and improving the systems of laws and policies (Appendix K)
	Wu & Xu (2022)	Committed to achieving peak carbon by 2030 and carbon neutrality by 2060, Shanghai has implemented new limits on the importation of coal-fuelled electricity, introducing peak carbon action plans across major industries to incentivise the use of green power imports and green industries (renewable energy, waste treatment)
Policy ban on supertall skyscrapers in 2020	Lu (2022)	Growing urban populations, land shortages and surging land prices in urban regions of Shanghai has contributed to the development of skyscrapers. The banning of “supertall skyscrapers (500m+)” is designed to reduce heat attracted by tall metal buildings, air pollution, changing in wind direction and the high levels of energy consumption to maintain the operations of skyscrapers.
	Safarik (2021)	On June 2020, China’s National Development and Reform Commission (NDRC) imposed a ban on the development of supertall buildings over 500m in major cities like Shanghai, posing major restrictions on the development of buildings over 250m to reduce environmental pollution including heat islands, preventing of temperature from cooling and minimising natural ventilation under the valley effect.
Shanghai urban green space masterplan (2017-2032)	Wu et al (2019)	The Shanghai government proposed in 2016 to achieve the proportion of green spaces (ecological land) in the city to exceed 50% of its land area by 2020, resulting in the drastic increase of urban green spaces with more than 60 squared kilometres.
	Li et al (2020)	Shanghai’s urban green space action plan has seen the rapid constructions of parks, waterfront areas and utilisation of urban green spaces in urban developments, this has

		substantially improved visual aesthetics (48%), spatial comfort levels and green space utilisation (Appendix L)
Population planning regulation policy in 2016	Cornell Policy Review (2019)	In accordance to the 13 th Five-year plan, Shanghai must meet the control target of 24.8 million permanent residences by 2020, especially targeting rapid urban population growth to relocate urban migrants into nine adjacent towns/ cities
	The Guardian (2018)	The urban planning policies to control the inflows of the urban population with a population cap attempts to force out lower skilled populations, addressing ongoing resource, healthcare and employment shortages for the growing urban population
	Yin & Wang (2021)	Rising urban populations of Shanghai has stimulated complex interactions among the population, posing clear barriers for the city to achieve environmental, social and economic sustainability development. An implemented population cap helps to reduce the pressures of population growth, substantially reduce energy consumption and environment pollution

Furthermore, Hu et al (2019) founded that the urban drainage masterplan had alleviated Shanghai’s ongoing environmental challenges caused by rapid urbanisation including land subsidence, urban rain island effects and poor drainage capacities, this system is designed to improve the absorbing capacity of excess water by 30% and to reduce subsequent future inundation risks by an estimated 85%.

In 2019, Shanghai became the first Chinese city to introduce a compulsory waste segregation policy, imposing a punishment system that fined local residents (200RMB) and commercial establishments (50,000RMB) for failing to segregate waste into four distinctive categories (residual waste, wet waste, recyclable waste and hazardous waste) at the point of origin, allowing the government to effectively collect, recycle and treat wastes according to their offered recyclability/ damages to the society (Zhou et al, 2022). In the space of two years, this policy has achieved a substantial reduction of trash buried in landfill sites by 21.4%, reducing subsequent environmental impacts including toxins, leachate and greenhouse gas emission (Zhou et al, 2022).

According to a report from the Green Initiatives (2020), Shanghai’s waste segregation policy has resulted in over 5,200 tonnes of daily waste being transferred to recycling or treatment facilities, as the separation of hazardous waste has resulted in an increase of 504% in hazardous waste treatment, recyclable waste has increased by 432% and residual waste has reduced by 31%, alleviating the associated costs and environmental pollutions caused urban waste generation.

Furthermore, over 9,600 tons of clean food waste is recycled per day, facilitating short and long-term growth in clean food waste collection fed biogas production (0.1-1.9GWh/ day) and the production of energy from waste (5.4-8.6GWh/ day), contributing to energy production and minimising environmental impacts (Li et al, 2021).

As a part of the whole nation's commitment to peak carbon discussed in the 14th Five-year plan period between 2021 and 2025, Shanghai led the movement under the peak carbon 1+N policy which saw the establishment of a working policy guidance to achieve carbon dioxide peak before 2030 and carbon neutrality by 2060 (China Briefing, 2022). This policy guidance saw major changes to improve the production system, circulation system, consumption system, acceleration of green space development, development/ integration of innovative sustainable technologies and to improve the current systems of laws/ regulations/ policies (China Briefing, 2022).

Shanghai has imposed new regulations to limit the importation of electricity that has been traditionally fuelled by burning coal, as a city that relies on importing electricity for over 50% of its electricity consumption, the new peak carbon 1+N policy has inflicted major impacts on major industries as they must oblige to the new limits of coal-fuelled electricity consumed (Wu & Xu, 2022). Additionally, the Shanghai government has actively incentivised the use of green power imports and the development of green industries including the generation of renewable energy, related green energy technologies and waste treatment innovations with tax incentives and interest-free grants available to assist research & development processes (Wu & Xu, 2022).

In 2020, the Shanghai government followed suit on the policy ban on supertall skyscrapers implemented in Beijing in 2016, according to the China's National Development and Reform Commission (NDRC) all new construction plans for buildings over 500 metres tall will be banned, as the design of buildings over 250 metres have become restricted with the need to integrate energy efficient and sustainable systems (Safarik, 2021). It is founded that supertall buildings made with heavy metal, iron and aluminium would attract substantial levels of heat, as the banning of skyscrapers would help to reduce further temperature increase caused by the design of urban buildings, reducing air pollution, minimising the impacts of changing wind directions and the high levels of energy consumption required to maintain the daily operations of supertall skyscrapers (Lu, 2022). Additionally, Safarik (2021) founded that the control of skyscraper density would contribute to reducing environment pollution, as major heat islands are formed by high density of skyscraper which also prevents temperature from colling after sun set, as well as reducing the natural ventilation building tall buildings under the valley effect of urban regions filled with high density skyscrapers.

The Shanghai government introduced a twenty-five years long urban green space masterplan in 2016 with key milestones such as achieving the proportion of green spaces and ecological land in its urban regions to exceed 50% of land area by 2020 (Wu et al, 2019). This is influenced the design of major urban projects to incorporate high levels of green spaces, many new buildings (office, residential and shopping malls) have been the incorporation of sustainable landscape

design and green space planning to maximise green spaces, contributing to the improvements on health, biodiversity and to reduce air pollution (Wu et al, 2019).

Between 2017 and 2032, the milestone to increase urban green spaces with more than 60 square kilometres in size is set and applied for all urban development projects, as shown in the rapid constructions of new parks, waterfront areas and the utilisation of urban green design on skyscrapers (Li et al, 2020). This is found to substantially increase visual aesthetics, spatial comfort levels and green space utilisation, promoting active outdoor lifestyles, improving social interactions/ exchange and facilitating healthy urban conditions to maintain positive physical and mental well-being (Li et al, 2020).

During China's 13th Five-year plan that aimed to reduce overcapacity of urban infrastructures and control urban development rates, the population planning regulation policy was introduced in 2016 to strictly limit the permanent residence population of Shanghai to 24.8 million (Cornell Policy Review, 2019). This population planning policy is designed to specifically target the rapid urban population growth of major Chinese metropolitan cities like Shanghai, attempting to alleviate social problems caused by rising levels of migrant population in urban regions as they are relocated to nine adjacent towns/ cities in Zhejiang and Jiangsu provinces (Cornell Policy review, 2019).

According to the Guardian (2018), the population planning policy attempts to force out lower skilled populations, addressing the ongoing challenges with rapid urbanisation where insufficient resources, healthcare and employment opportunities have raised the levels of substandard living conditions, creation of slums and intensified social inequality tensions amongst local residents. This is reinforced in the study of Yin & Wang (2021), as rising urban populations contrasted with top talents and poorly education migrants have stimulated complex and toxic interactions amongst the Shanghai population, this has resulted in clear barriers for the city to achieve sustainable environmental, social and economic development, as the imposed population cap would also contribute to reduce the ever-increasing rates of energy consumption and environment pollution accompanied by a growing urban population.

5. Overview of problems and policies

The environmental and sustainability problems caused throughout Shanghai's rapid urbanisation covers a wide range of factors illustrated in Arise's (2021) problems and remedies of urbanisation framework, especially in environmental and societal dimensions where increasing influx of migrant workers have caused the creation of slums, overcrowding, crimes, poverty, mental illness, non-communicable diseases and burdened infrastructure systems. These problems reflect both short term and long-term challenges for locals and migrants as the standard of living has been substantially impacted. Furthermore, water pollution from construction wastes (OECD, 2009), wetland environmental damages (Nasa's Earth Observatory, 2019) and increased carbon emission rates (Li et al, 2020) from Shanghai's urbanisation has triggered environmental damages toward

other cities across the Yangtze River delta region, illustrating the far-reaching consequences that are indirectly caused by Shanghai's urbanisation. The environmental and sustainability problems identified from empirical studies illustrate insufficient government intervention on integrating sustainable development on Shanghai's urbanisation from the perspective of the city and to the Yangtze River delta region.

However, since 2016 the local government has intensified its efforts to better integrate sustainable initiatives throughout the urbanisation process of the city, prioritising the sustainable development of Shanghai across all Yangtze River region cities. The Water drainage/ anti-water pollution masterplan (CIWEM, 2022), Waste segregation policy (Zhou et al, 2022), peak carbon 1+N policy (Wu & Xu, 2022), policy ban on supertall skyscrapers (Lu, 2022), Shanghai urban green space masterplan (Wu et al, 2019) and population planning regulation policy (Yin & Wang, 2021) illustrate increasing policy design efforts to tackle the current environmental and sustainability problems. Nonetheless, it is apparent that the nature of these policy designs represents reactive approaches to address predominantly environmental sustainability challenges caused by Shanghai's rapid urbanisation, neglecting the integration of social and economic sustainability development initiatives that combines to drive sustainable regional development according to Somanje et al's (2020) sustainable urbanisation framework. This indicates substantial room for improvement for Shanghai's government to effectively driven sustainable urbanisation developments in a fully integrated and effective social-ecological system that actively incorporates all three elements of environmental, social and economic sustainability in urbanisation policy design (Somanje et al, 2020).

5.1 Recommended improvements to facilitate sustainable developments in urbanisation policy design

The aforementioned sustainability driven policies and masterplans implemented in Shanghai demonstrate a reactive government response to integrate sustainable initiatives in the policy design for urbanisation, fulfilling only environmental sustainability dimension proposed by Somanje et al's (2020) sustainable urbanisation framework. However, it is recommended that the Shanghai government can further improve on facilitating sustainable development in urbanisation policy design and establish a sustainable urban ecosystem under all six urban lenses proposed by the European Environmental Agency (2021) which integrates environmental, social and economic sustainable initiatives. Therefore, the following recommendations are proposed through drawing upon successful cases from the sustainable urban developments of other metropolitan cities across six urban lenses.

Green city lens:

- To enhance its current urban green space masterplan with incorporation of green spatial zoning designs, learning from Vancouver’s “Vancouverism” sustainable zoning and urban planning, emphasising on sustainable forms of transit with tall slim buildings in high density urban regions that is separated by low rise buildings and green parks as shown in figure 13 below (Walsh, 2013). The application of the Vancouverism sustainable urban development model can address the current overcrowding, heat island and Induced land subsidence increase problems in Shanghai.



Figure 13: Vancouverism spatial zoning (Walsh, 2013)

Resilient city lens

- To design policy guidelines that incorporates expertise knowledge, innovation and leadership commitment to build a culture of safety and resilience, educating on the underlying risks of rapid urbanisation in areas of land-use planning, environmental social and economic measures. Shanghai can learn from Denmark’s “five finger plan” in the urban planning of its capital city Copenhagen, controlling urban growth with the separation of key urban hubs into the creation of urban suburb regions, linked together with convenient transportation infrastructure, assigning space open for recreation and agriculture on the land between the fingers, developing a culture with urban planning integrated into local education that emphasis on people and strong environmental social governance system in urban life (BBC, 2019).

Inclusive city lens

- It is recommended that the Shanghai government should adopt a more inclusive approach to actively engage with local stakeholder groups, identifying their needs and incorporating them into future urban development plans to overcome the current divide where local stakeholder urbanisation needs are not actively addressed. Furthermore, the Shanghai government must build and maintain stakeholder relationships in urban regions, incorporating policies that is aimed at reducing the current social and economic inequality faced by disadvantaged populations, learning from the most socially inclusive city of the world (Zurich) and its “Luchswiese” programme that offers adorable housing to disadvantaged migrant families in urban locations, involving local communities to participate in “fit for the future” campaign to socially integrate disadvantaged populations via needs assessments and direct contact with residents through doorstep engagement (Glaser & Hugentobler, 2020).

Healthy city lens

- It is recommended that the Shanghai government can fulfil the sustainability development needs under the healthy city lens by investing in health care facilities and education, increasing inclusiveness and reducing barriers to social welfare. Furthermore, Shanghai can learn from the world’s healthiest city (Valencia), supporting local agricultural industries by developing sustainable gastronomy based on locally produced food, actively promoting a peaceful and health lifestyle accompanied by health-oriented policies across commercial and social activities (Visit Valencia, 2022).

Circular city lens

- Shanghai’s future urban planning should be focused on reusing brownfield sites to address the current pollution and overcrowded problems, imposing limits on urban sprawl to accompany its population control policy. It is recommended that the Shanghai government should promote R&D in innovative circular urban systems and technologies with grants and loans offered by governing bodies, encouraging local businesses to innovate with sustainable circular systems, overcoming the current energy consumption challenges with environmentally-friendly cogeneration power technology installed in its buildings. Shanghai can learn from Berlin’s Potsdamer Platz as shown in figure 14 to overcome its waterlogging and poor storm water management challenges with inbuilt treatment ponds for handling storm water in urban regions that can be reused to generate electricity in a circular manner.

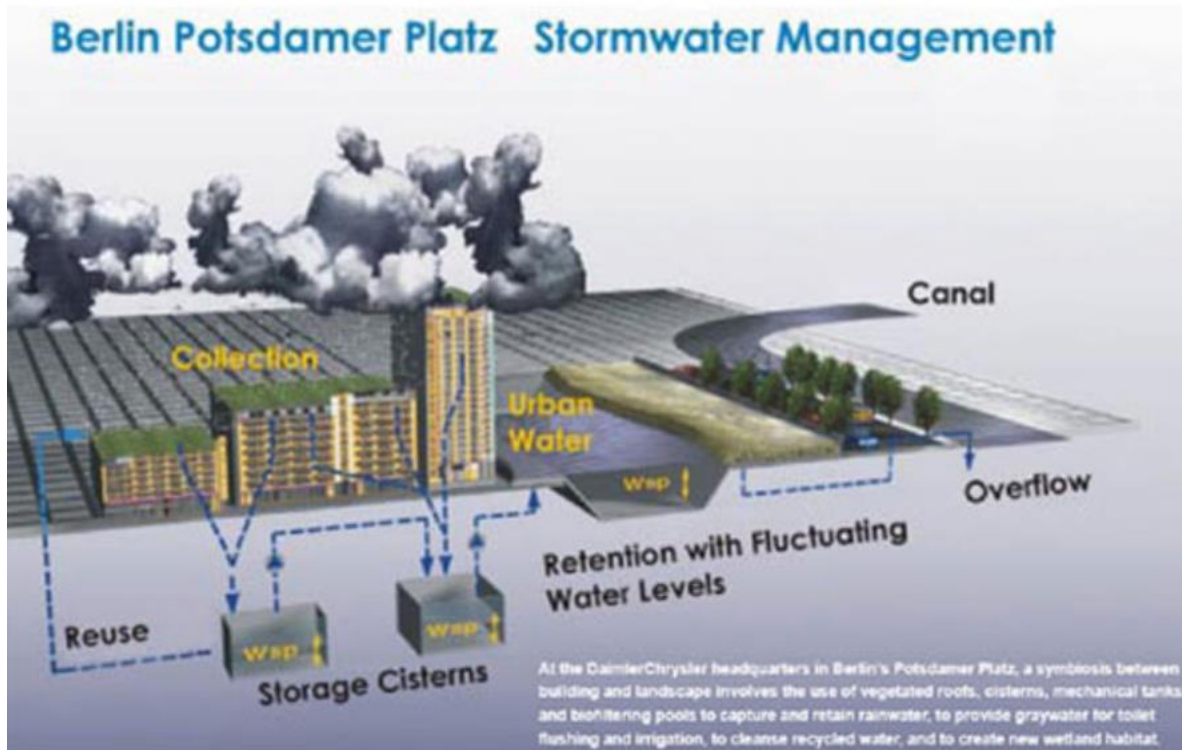


Figure 14: Berlin Potsdamer Platz – Circular-stormwater-management (Enviropaul, 2021)

Low carbon city lens

- The Shanghai government can learn from Rio de Janeiro's low carbon city development programme to establish frameworks and comprehensive requirements to guide the planning, implementing, monitoring and execution of low carbon projects designed to alleviate climate change impacts. This will control the levels of carbon emission from households and businesses in a 5-step process that identifies interventions, quantifies emission reductions, informed decision making, validating/ verifying emission reduction targets and to monitor, report and exercise programme quality control over the lifetime of the programme in a structural and transparent manner as shown in figure 15 (Climate Colab, 2021).

1. *Identify interventions*: The CME works with the MWG to identify interventions. An intervention must meet the intervention eligibility criteria to be included in the Program.
2. *Quantify Emission Reductions*: An estimate of the quantity of emission reductions that the intervention will produce is conducted by the TAE. The TAE determines the most appropriate methodology to use for calculations. Any existing carbon finance methodology approved for use by an ISO-14064 compatible carbon standard (such as the Verified Carbon Standard, or the Clean Development Mechanism) may be used. Should a methodology not exist under any carbon standard for the intervention, a new methodology may be suggested that fulfills the methodology assessment criteria.
3. *Decision-making (retire or sell)*: The CME works with the MWG to make a decision about whether to retire the intervention's emission reductions towards the city's target (in accordance with its climate change law) or to sell them to an outside buyer to generate revenue from climate finance. Each unit of emission reduction must have only one final destination to prevent double-counting.
4. *Validate/verify*: The intervention and its emission reductions must undergo validation to ensure quality and integrity. The VVE conducts the assessment, validating the intervention's compliance with the intervention eligibility criteria and the methodology used for calculations. The assessment verifies that the intervention is on track to produce emission reductions as planned. If the intervention seeks to generate carbon assets such as Certified Emission Reductions or Verified Carbon Units³, it must also fulfill all the criteria imposed by the relevant regulatory body.
5. *Monitor, report, and exercise quality control*: Every intervention and its emission reductions must be monitored over the lifetime of the Program. Monitoring, reporting, and quality control, as well as all the data collection, analysis, and storage, is conducted for each intervention, then bundled and managed by the IME through the Program's monitoring, reporting, and verification (MRV) system. Different municipal departments feed data about interventions and baselines into the MRV system, which performs the analysis for calculation of emission reductions. The CME and VVE can access the MRV system to track the implementation of interventions and monitor/verify emission reductions produced by the interventions.

Figure 15: Rio's low-carbon-programme process (Climate Colab, 2021)

In consideration of the current urbanisation challenges encounter in Shanghai, the above recommendations across six sustainability city lenses are evaluated in accordance to the expected fulfilments to Somanje et als' (2020) sustainable urbanisation framework dimensions as shown in table 3 below. Due to the fulfilment of all three sustainability dimensions, the resilient, inclusive and circular city lenses recommendations should be prioritised.

Table 3: Evaluation of recommendation across six city lenses

6 City lenses	Somanje et als' (2020) sustainable urbanisation framework		
	Environmental	Social	Economic
Green city	X	X	
<i>Resilient city</i>	X	X	X
<i>Inclusive city</i>	X	X	X
Healthy city	X	X	
Circular city	X	X	X
Low carbon city	X		X

6. Conclusion

This research critically explored the policy design around Shanghai's rapid urbanisation, drawing upon sustainability driven initiatives in recent policies that helps to overcome the environmental and sustainability challenges caused by urbanisation. In consideration of the key challenges identified across secondary data sources and six sustainability driven policies, this research proposed future improvements in the policy design of Shanghai's urbanisation across six sustainable lenses proposed by Somanje et al (2020), recommending prioritised focus on the resilient, inclusive and circular city lenses that help to contribute to all three areas of sustainability (environmental, social and economic). The findings of this study contribute to the identified research gap where insufficient studies have been conducted to explore the sustainable urbanisation developments of Shanghai, providing practical new insights that aids the understanding of policy design with integration of sustainable developments according to Shanghai's current urbanisation problems.

However, the findings of this study are limited to only the short-term future of Shanghai where increasing government efforts to integrate sustainability in policy design has been apparent since 2016, indicating further expected changes over the long term which requires future studies to gain more accurate and up-to-date understanding of upcoming new policies. Additionally, the research findings are limited to only the chosen case city of Shanghai as the different urbanisation conditions and policy environments differ between Chinese cities, raising the need for future studies to explore the urbanisation challenges, sustainable development policy initiatives and government intervention on other metropolitan Chinese cities like Beijing, Guangzhou, Shenzhen, Tianjin and Chongqing where urbanisation rates are also on the rise. Furthermore, future research studies can adopt a longitudinal time horizon approach to observe the long-term impacts of sustainability driven policy initiatives on the urbanization process of researched cities.

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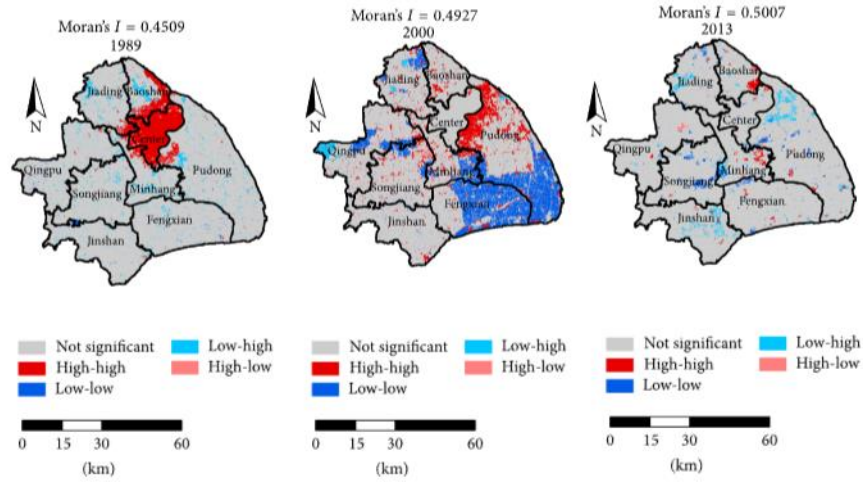
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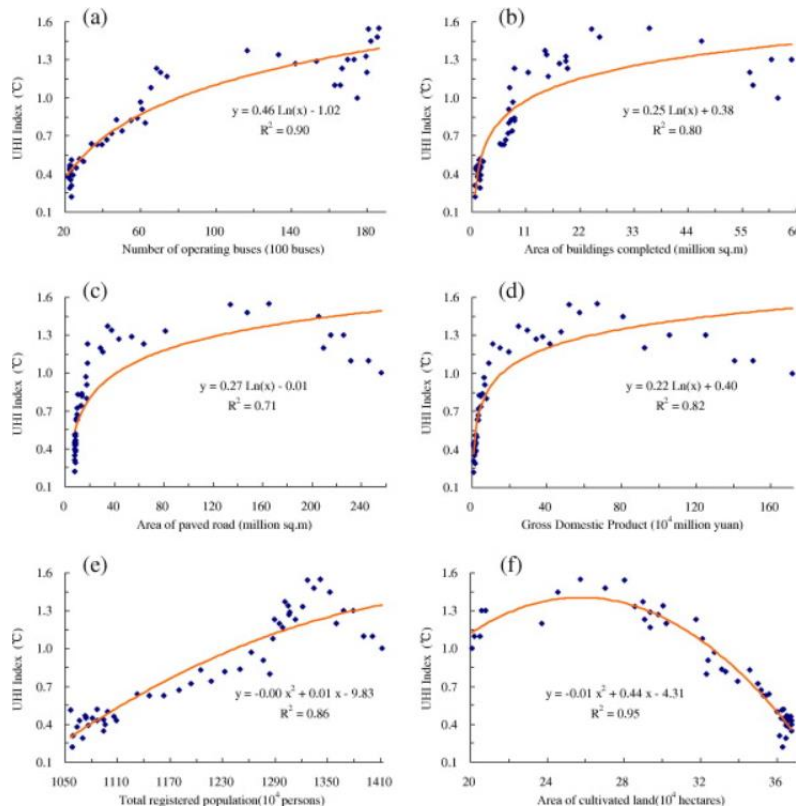
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Appendix

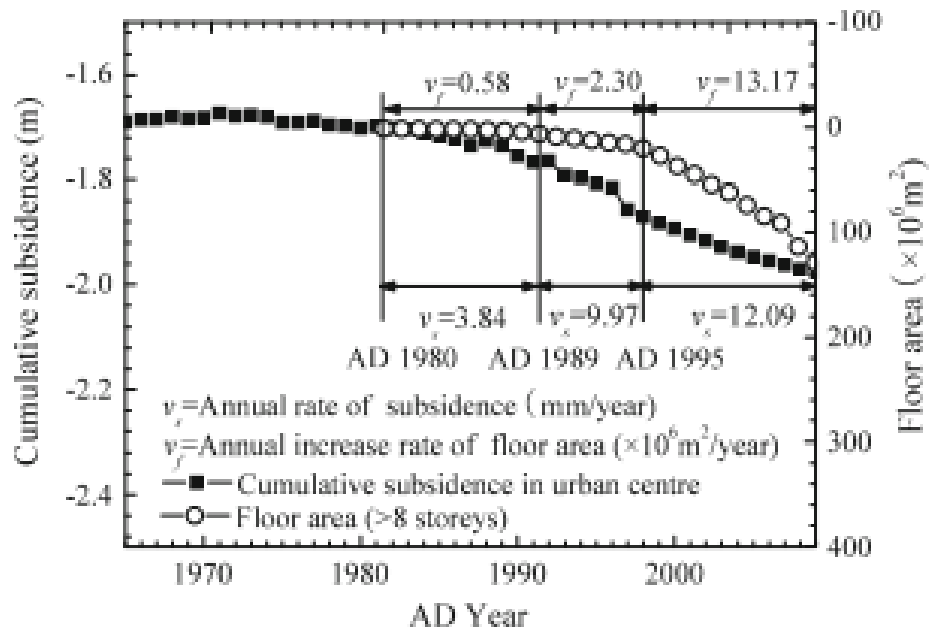
Appendix A: Spatial association of the thermal landscape pattern in Shanghai in 1989, 2000, 2013 (Chen et al, 2016)



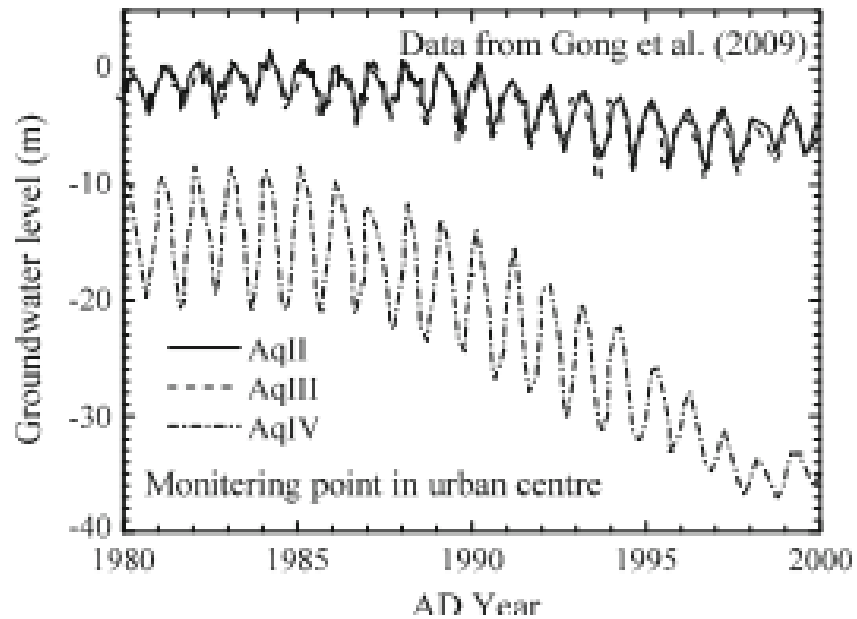
Appendix B: Urban development factors impact on UHI levels (Cui & Shi, 2012)



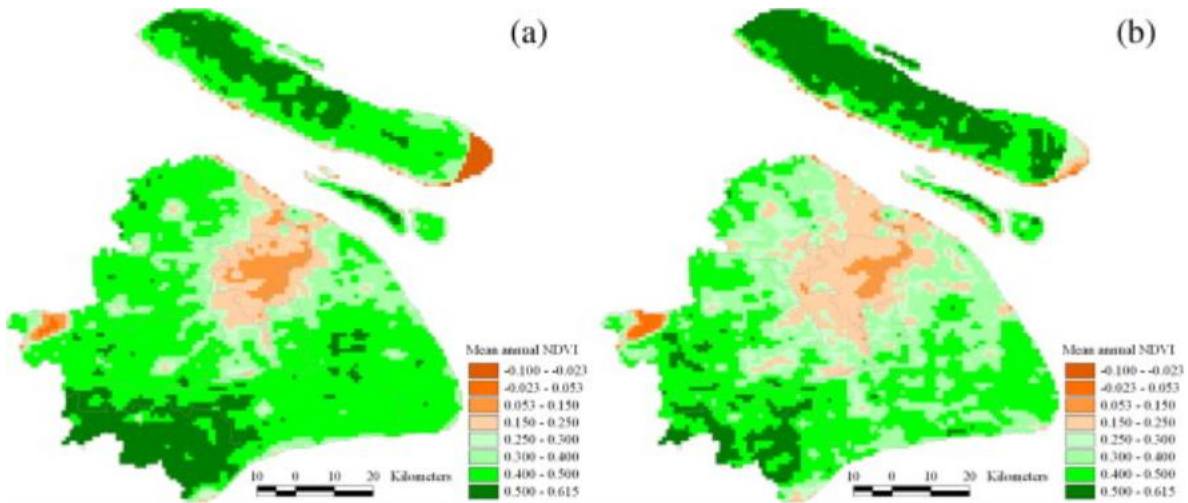
Appendix C: Relationship between floor area and cumulative subsidence (Xu et al, 2012, p1261)



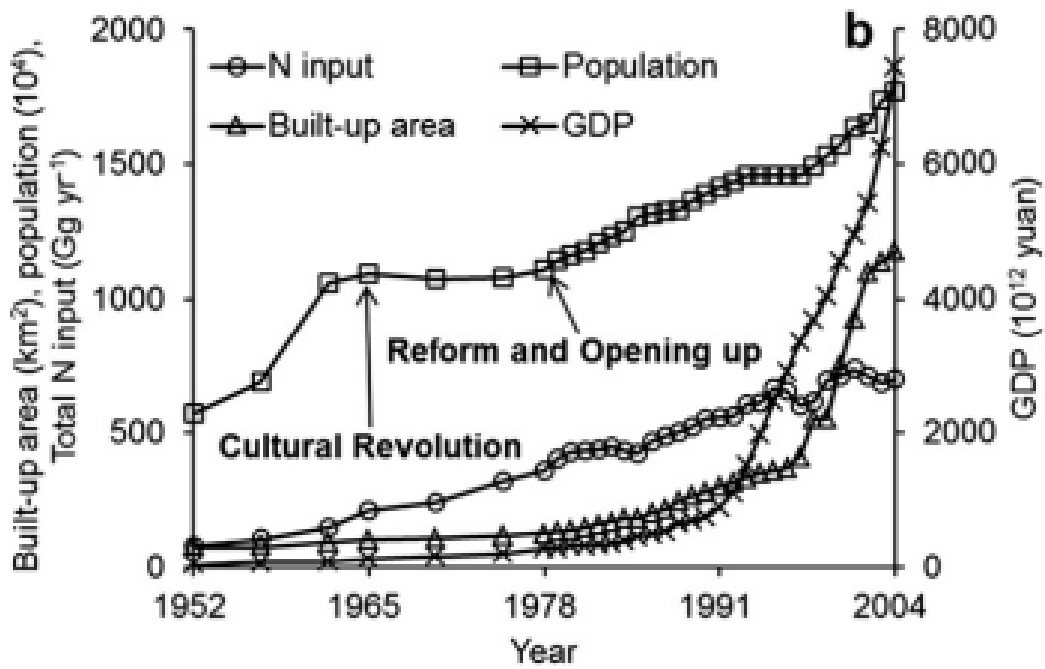
Appendix D: Groundwater levels across urban aquifers in Shanghai (Xu et al, 2012, p1259)



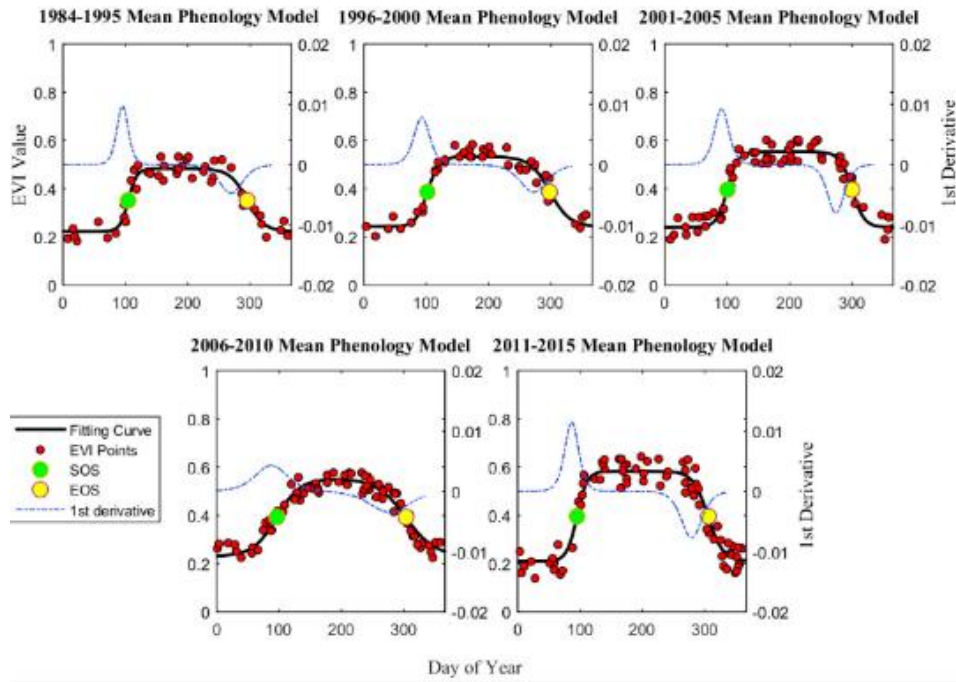
Appendix E: Annual NDVI rates between a (1999-2001) and b (2008 and 2010) in Shanghai (Cui & Shi, 2012)



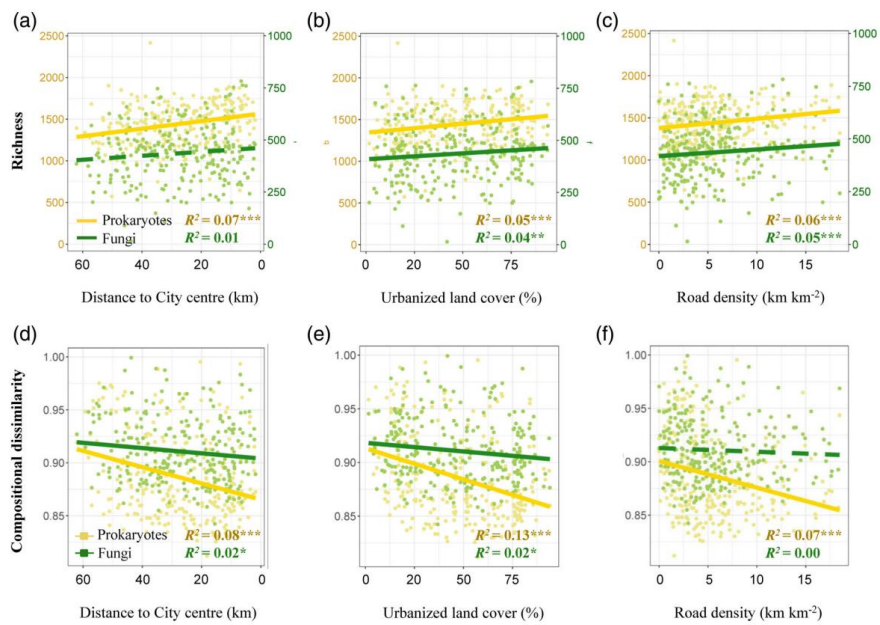
Appendix F: Nitrogen input and socioeconomic development from 1952 and 2004 (Gu et al, 2012, p33)



Appendix G: Mean urban vegetation phenology levels (Qiu et al, 2017)



Appendix H: The relationship between urbanisation factors and the compositional dissimilarity of soil and fungi in Shanghai (Liu et al, 2022, p6)



Appendix I: Shanghai's water drainage master plan configuration (CIWEM, 2022)

Integrated: working at basin-scale, taking into consideration existing plans and strategies across multiple different city departments, including the Shanghai City Masterplan 2017-2035, the Sponge City Strategy and flooding, water-management, infrastructure and development plans.

Systems-led: interventions implemented across the interconnected systems that make up the Shanghai water environment. The strategy was optimised across four systems:

- **Governance:** a critical over-arching system for strategy development and implementation involving no-build solutions such enforcing sponge-city planning guidance and design standards, regulation, incentivisation, information sharing and collaboration
- **Green infrastructure:** above-ground interventions to improve water quality and reduce flooding at or near to source, primarily using nature-based solutions. These included parkland, lakes and ponds, recreation areas, street trees, green roofs and walls, and sustainable urban drainage systems
- **Blue Infrastructure:** the network of hydraulically controlled urban rivers and canals including associated flood defences, pumping stations and tidal controls
- **Grey Infrastructure:** underground drainage infrastructure and pumps, storage and treatment.

Adaptive: interventions aligned with an adaptive management approach that provides flexibility to address future uncertainty and new insight, avoiding inefficiency and unnecessary spending and delivering better outcomes over time. This is based on a phased strategy that looks at small interventions that can be delivered quickly alongside planning large infrastructure.

SMART: The strategy included implementing a new, smart integrated model that will optimise the existing network, run sophisticated future planning scenarios and supports a monitoring programme to help understand stormwater pollution, constituents, concentrations, and particle size, based on local conditions.

Appendix J: Outcomes of Shanghai's waste segregation policy 2018 – 2019 (Green Initiatives, 2020)



Appendix K: China's transition to green, carbon dioxide peak by 2030, key tasks (China Briefing, 2022)

China's Transition to Green, Low-Carbon, and Circular Economy: Key Tasks	
Improving the production system	Promoting green upgrading of industries
	Accelerating green development of agriculture
	Improving the level of green development of the service industry
	Expanding green and environmental protection industries
	Improving the recycling level of industrial parks and industrial clusters
	Building a green supply chain
Improving the circulation system	Creating green logistics
	Strengthening the recycling of renewable resources
	Establishing a green trade system
	Promoting the consumption of green products
	Advocating a green and low-carbon lifestyle
Improving the consumption system	Promoting the consumption of green products
	Advocating a green and low-carbon lifestyle
Accelerating the green upgrading of infrastructure	Promoting the green and low-carbon transformation of the energy system
	Promoting the construction and upgrading of urban environmental infrastructure
	Improving the green development of transportation infrastructure
	Improving urban and rural living environment
Building a market-oriented green technology innovation system	Encouraging research and development of green and low-carbon technologies
	Accelerating the transformation of scientific and technological achievements
Improving the system of laws, regulations, and policies	Strengthening the support of laws and regulations.
	Improving the price mechanism for green charges
	Increasing fiscal and tax support
	Vigorously developing green finance
	Improving green standards, green certification system, and statistical monitoring system
	Cultivating green trading market mechanism

Appendix L: Correlations coefficients between green appearance percentages and landscape evaluation (Li et al, 2020, p4)

