# Flood Resilience As A Process:

# Understanding the Role of Learning in the Implementation of Green Infrastructure


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# Abstract

This study explored how Green Infrastructure (GI) is implemented in the different contexts of China and England to enhance flood resilience, examining the learning of professionals in the process. Specifically, it investigated the challenges facing GI in both China and England, before unpacking how professionals operate in the face of predicaments, what their learning outcomes are, and whether the outcomes advance flood resilience. By addressing the under-researched roles of professionals in the context of GI and flood resilience, it sheds light on the nuanced power dynamics amid the actors' operation in the distinct social and political contexts. The central role of learning is highlighted, not only in enhancing resilience but also in facilitating the socio-technical transition embodied by the application of GI.

The research employed a qualitative approach: semi-structured interviews were conducted with professionals from the two countries who have knowledge of GI, aiming to gain an in-depth understanding of their perspectives; whereas documents from online sources, such as media reports and interviews, were also collected and examined using Foucauldian discourse analysis, to generate more insights into experts' operations in China's context.

Although GI projects in both countries face some shared challenges, such as a lack of quantitative data for measuring the performance, the research study found that most challenges are specific to the contexts in which the projects are delivered. The ways that professionals respond to, and rise above the predicaments, indicate their situated wisdom derived from learning and embody the essence of evolutionary resilience.

This research study formulated diagrams to capture the various ways of learning and learning outcomes, showcasing how learning can enhance flood resilience through improved preparedness, adaptability and transformability. Meanwhile, non-learning scenarios including resistance, tensions, and learning failures were also mapped to illustrate how these seemingly unrelated elements are indeed interconnected, and in some cases, contribute to advancing resilience. Hereby, the research offers the conceptualisation of self-reinforcing learning loops in the context of implementing GI, demonstrating that flood resilience is fundamentally a process of constant learning.

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## List of Abbreviations and Acronyms

ASLA: American Society of Landscape Architects

CaBA: Catchment-based Approach

CIRIA: Construction Industry Research and Information Association

CIWEM: The Chartered Institution of Water and Environmental Management

EA: Environment Agency

EU: European Union

FDA: Foucauldian discourse analysis

GI: Green Infrastructure

GDPR: The General Data Protection Regulation

IFLA: International Federation of Landscape Architects

LID: Low Impact Development

MHURD: Ministry of Housing and Urban-Rural Development (China)

MLP: Multi-level perspective

NBS: Nature-based Solutions

PPP: Public Private Partnership

RSPB: The Royal Society for the Protection of Birds

SCPs: Sponge City Programmes

SDGs: Sustainable Development Goals

SuDS: Sustainable Drainage Systems

UN: United Nations

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# Declaration

The thesis is the result of my own work, except where otherwise stated, and has not been submitted for the award of a higher degree at any other institution.

# Chapter 1. Introduction

Urban floods are becoming increasingly severe and unpredictable due to climate change, wreaking havoc in many countries every year (Thieken, Zenker, Bubeck, 2023; Willner, Otto, Leverman, 2018; Ferdous et al. 2019; Dai, Wörner, van Rijswick, 2018). For example, in western Europe, Germany, Belgium and the Netherlands were surprisingly hit by record rainfall in 2021, more than 200 lives were lost due to the devastating floods (Bosseler, et al. 2021; Pot, Ridder, Dewulf, 2024; BBC, 2021b). The UK also experienced a number of floods in the past decade, damaging tens of thousands of households and the economic loss in the winter of 2019/2020 alone was estimated to be around £333 million (Sefton, et al. 2021; Environment Agency, 2020). In China, a historic rainfall in 2021 ravaged the central province of Henan, more than 10 million people were affected and hundreds lost their lives as a result (Wang, et al. 2023; The Guardian, 2022)

These flooding events pose a great threat to the status-quo of how cities function, and raise concerns about the existing urban infrastructure to address the increasing flood risk in future (Green, et al. 2021). As a response to the climate change-induced natural hazards, resilience thinking has risen to prominence in recent years because it helps to tackle the unexpected perturbations in complex systems (McClymont, et al. 2019). There are primarily three different strands of thinking behind the concept of resilience and each argues different measures for cities to enhance resilience (Zevenbergen, Gersonius, Radhakrishan, 2020). The engineering and ecological resilience, as have been studied by numerous scholars, have their merits but I will argue the most suitable for this research study is the evolutionary resilience that sees cities as the dynamic and complex socio-ecological systems which require constant transformations powered by learning (McClymont, et al. 2019).

When it comes to addressing flooding in urban areas, resilience thinking is now embedded in many innovative and sustainable approaches to managing flood risk (Staddon, et al. 2018; Lee, et al. 2021). These relatively novel projects challenge the status quo of conventional schemes and are given various names in different countries. However, in this thesis I use the umbrella term Green Infrastructure (GI) to refer to the

wide range of practices because GI captures the essence – replicating the natural processes of water infiltration, storage and evaporation, as well as providing other benefits (O'Donnell, et al. 2020; Lennon, Scott, O'Neill, 2014). The embedded resilience thinking in GI sees urban flooding events as complex issues that are interconnected with the wider socio-ecological systems of which humans are also a component (Fenner, et al. 2019; Staddon, et al. 2018). Hence, the implementation of Green Infrastructure (GI) is not just an effective means to enhancing flood resilience, it also represents a socio-technical transition that utilises more sustainable approaches to tackle the uncertainty and demands transformations on many fronts (Diep, Dodman, Parikh, 2019; Pauleit, Andersson, Anton, 2018).

Utilising GI to tackle flood risk in China has been in the limelight for the past decade, as a result of a nationwide policy to promote programmes termed as "Sponge City". The Sponge City Programmes (SCPs) initially received generous funding from the central government and have been rolled out in dozens of cities, as a highly top-down attempt to address the increasingly serious urban flooding (Griffiths, et al. 2020). However, research on SCPs usually centres on quantitative assessments or proposing models using a range of parameters (Nguyen, et al. 2019; Jia, et al. 2017), while very little is known about the key agents' perspectives on their work in relation to enhancing flood resilience and how they respond to the challenges in the process.

GI projects in England, in contrast, despite being studied and tested for a longer period, have not received as much political or social attention as SCPs have in China (Griffiths, et al. 2020; Lashford, et al. 2019). The seemingly different attitudes from the authorities towards GI in the two countries render it interesting and necessary to examine in detail how the distinct social and political contexts affect the implementation of GI. The existing literature that compares GI projects in England and China mainly focus on summarising policy documents or drawing conclusions from previous research (Zevenbergen, Fu, Pathirana, 2018; Chan, et al. 2018; Lashford, et al. 2019), whilst there is not enough empirical evidence from exploring the views of the professionals involved in the delivery of GI. In addition, the socio-technical transition perspective in relation to GI leads to the other focus of this research study: how the professionals shape and facilitate this transition.

Therefore, this study is proposed to fill the research gap by examining how GI is implemented in the two different contexts from the professionals' perspectives, and in doing so, it sheds light on the professionals' learning experience and how such learning shapes the transition. In this research study, professionals are defined as those who have acquired codified knowledge through formal education and received extensive training at work, and have since been specifically involved in various stages of GI projects, including the formulation of policy or strategy, design, community engagement, and construction phases (Sullivan, 2005; Tapper and Millett, 2015; Beauchamp and Childress, 2009; Cruess, Johnston and Cruess, 2004). To be specific, the views of professionals on their work experiences and GI in general are crucial, because they reveal the nuances in the power relations between the professionals. How such nuances impact the implementation of GI and the related flood resilience is mostly overlooked in the existing literature. This investigation will also highlight the learning process demonstrated by the participants in their work and thus foreground the connections between knowledge creation and evolutionary resilience in the context of GI.

The overriding aim of the thesis, therefore, is to examine how Green Infrastructure is implemented by professionals to embody the concept of resilience in flood risk management. In doing so, the thesis makes two primary contributions to the study of flood resilience and socio-technical transitions in the context of implementing Green Infrastructure. First, the thesis makes the empirical contribution of examining the professionals' perceptions and experiences of dealing with GI, adding a wide range of views to the debate about how GI impacts flood resilience and shapes the socio-technical transition. Through the lens of the key agents involved, this study scrutinises the challenges in the different social and political environments of China and England. This research study thus provides an in-depth examination of the actors' situated wisdom and the subsequent learning outcomes, which is lacking in the existing literature.

Furthermore, a theoretical contribution is that I link the learning of the professionals to both flood resilience studies and transitions studies, arguing that learning is the centrepiece, or the bridging concept, that connects the two different bodies of knowledge. I also create a conceptual model of learning (i.e. vis-à-vis improving urban flood resilience) at the end of this research study, demonstrating that resilience is a

process rather than a state – consisting of continuous learning loops, connecting multiple components such as flood experience, resistance, and learning failures together.

### 1.1 Research questions

This thesis asks the overriding research question:

> *How is Green Infrastructure implemented by professionals to embody resilience in flood risk management?*

I will argue that the conclusion to this question is, in brief, that professionals' learning and knowledge-sharing in the process of delivering GI projects are crucial for building evolutionary resilience to flooding, and the way such key actors operate and interact is a demonstration of their learning and strategic wisdom.

I take a qualitative research approach to address the primary research question, applying different data collection and analysis methods based on the differing contexts of England and China. The justification for the research design and methodologies is detailed in Chapter 3. Before going into the details, the overarching research question is further parsed into sub-questions as follows:

1. *What are the challenges facing professionals in the process of implementing GI projects in the two countries?*

This research question is to find out the political and social backgrounds of the GI related practices in the two different contexts. First and foremost, I will identify the difficulties facing GI projects in the literature, before I acquire detailed information from collecting documents and interviewing participants. In doing so I will develop a better understanding of how the differing political and social structures shape policymaking and impact the uptake of novel practices like GI.

2. *How do professionals operate in the face of predicaments to overcome the difficulties and deliver GI projects?*

Following the first question that examines the challenges and difficulties hindering the uptake or application of GI projects in two countries, I then look deeper into the

professionals' perceptions and experiences, as they are the pivotal agents involved in the process. By conducting in-depth interviews with the participants, I intend to find out their views on what measures are needed to enhance resilience and what the prominent obstacles are hindering the adoption of GI on the ground compared to findings in the literature. More importantly, I will be able to highlight the agency of the professionals in pushing for changes and facilitating a socio-technical transition that also resonates with evolutionary resilience to flooding.

3. *What is (not) learnt in the process of delivering GI projects, and how do the learning outcomes impact overall resilience?*

After examining how the key actors operate to address the challenges and facilitate the implementation of GI projects, I then focus on learning and knowledge production as reflected by respondents, intending to find out how the predicaments facing the professionals have stimulated their learning and sharing knowledge with others. More specifically, I want to know what the learning outcomes are and how the outcomes influence flood resilience from an evolutionary point of view.

### 1.2 Outline of the thesis

Shaped by the research aim and specific research questions, the thesis outline is as follows:

Chapter 2 reviews the literature that will be setting out the background for the research questions. I will first bring in the concept of resilience and explore the different strands of resilience thinking before I identify why evolutionary resilience, in particular, is a suitable framework for studying resilience discourse in cities that are complex systems with multiple interconnected and interdependent elements. Then, I will look more specifically at Green Infrastructure as a novel approach to combat flood threat and advance flood resilience, with a particular focus on the practices that are promoted in China and England. The aim here is to ascertain the connections between evolutionary resilience and GI projects, but also present how the different political and social contexts can manifest in the policies and practices in the two countries. Furthermore, I will argue that the adoption of GI is a socio-technical transition by exploring transitions literature.

From a transition perspective, I will be able to underscore the pivotal role of learning in empowering more actors and creating momentum for enabling the social-technical transition. Then, I will make a connection between evolutionary resilience and socio-technical transition, demonstrating that actors' learning is also a significant component of evolutionary resilience that values continuous evolvement and adaptation.

Chapter 3 establishes the methodologies for conducting this research study. This chapter will first showcase that a qualitative research design is best suited for answering the research questions. As the data collection is conducted during COVID-19, I will explain how the pandemic has impacted my research plan and how I adapt to the challenges by changing the types of data used for this study and the ways I collect such data. Regarding the three specific research questions, I resort to two different ways of collecting the data: semi-structured interviews with professionals from both countries and, to compensate for the shortage of respondents from China, collecting online documents, such as publications and media interviews of prominent figures in China. As for data analysis, I apply grounded theory with thematic analysis to examine the textual materials gathered from interviews; whilst for scrutinising the media interviews of and publications from key figures in China, I rely on Foucauldian Discourse Analysis (FDA) to tease out the power dynamics embedded in the policymaking and implementation of GI. Justifications for methods used for collecting and analysing data will be elaborated in this chapter, with a particular focus on how the different political and social contexts of the two countries shape my decisions in a time when lockdowns and travel restrictions posed an enormous challenge to my research.

Chapter 4 and 5 aim to answer the first research question about the GI policies and practices in the two countries and the challenges facing the GI projects. Specifically, chapter 4 will target the context of China, whilst chapter 5 will focus on GI projects in England. Chapter 4 examines, through the remarks of high-profile figures as well as research participants, how Sponge City Programmes (SCPs) are promoted as part of the Chinese government's discourse of achieving 'Ecological Civilisation', revealing the inherent flaws and accompanying challenges that are associated with the political and social context of China. Chapter 5 investigates the context of England in which Sustainable Drainage Systems (SuDS) are employed, with interviewees' accounts

showing the difficulties they have to encounter in the process. In doing so, the predicaments facing these actors in two countries are identified and analysed, indicating how distinct social and political structures influence GI projects.

Chapter 6 follows the challenges identified in the preceding two chapters and aims to address the second research question about how the professionals utilise their situated wisdom to overcome the challenges. In this chapter I will first focus on the work of Kongjian Yu, a key figurehead in conceptualising and championing 'sponge' cities in China, demonstrating how his practical wisdom leads him to contribute to the national scheme of SCPs. Also in the focus are the participants in England as their accounts showcase how they operate strategically to confront different predicaments.

Building on the findings of the three previous chapters, chapter 7 explores the learning outcomes of the professionals and how such outcomes represent the socio-technical transition and impact flood resilience, addressing the last research question. Specifically, I will first summarise the various forms of learning, such as learning from flood experience, learning by doing, and learning through stakeholder interactions. Then, I will attempt to link the different learning outcomes back to the attributes of evolutionary resilience – preparedness, adaptation, and transformation, in order to showcase how the experts' learning impact flood resilience. Moreover, I also investigate the non-learning manifesting in the process of implementing GI.

In chapter 8, I will conclude the research study by first summarising the findings from the data analysis, connecting the findings to the three specific research questions. Then I will address the overriding research question on the basis of the findings before making comparison to the literature, further elaborating the contributions of this research study as well as pointing out the areas for future research.

# Chapter 2 Literature Review

## 2.1 Introduction

The world today has witnessed an unprecedented rate of population growth, with the projection of reaching 9.8 billion in 2050 (United Nations, 2018). Alongside the population increase is the massive urbanisation process across the globe: there were around 30% of the world's population living in cities in 1950, a steady increase from 10% in 1900, but as of 2014 the figure already reached 54% and it is predicted to further rise to 68% by the first half of this century (Roseland, Spiliotopoulou, 2016; Ribeiro, Gonçalves 2019). Despite only accounting for 3%--4% of the total land area on earth, urban areas in 2018 are home to over 55% of the world's total population (World Bank, 2020; Roseland, Spiliotopoulou, 2016).

This rapid urbanisation process represents a substantial concentration of human capital, economic activities and consumption of resources in cities (Ribeiro, Gonçalves, 2019). As a result, cities have become the hubs where most economic growth takes place, where critical policies are implemented that can have profound impacts on social structures, and where numerous international dialogues and cooperations are achieved that can shape the world's political landscape (Paddison, 2001, p.1). Meanwhile, the increasing significance of cities in societies means disruptions happening in cities would cause more and more severe damages, nationwide or even globally. One of the imminent global challenges is extreme climate events to which cities are increasingly susceptible (Roseland, Spiliotopoulou, 2016), not just because 90% of urban areas are located on coastlines (Elmqvist, et al., 2019) but because the increasing size and population diversity of cities, among other factors, lead to a higher degree of systemic complexity (Ribeiro, Gonçalves, 2019; Tumini, Villagra-Islas, Herrmann-Lunecke, 2017). Moreover, although urban areas merely account for around 4% of the Earth's surface they contribute to nearly three quarters of the overall consumption of resources in the world (Elmqvist, et al., 2019; Meerow, Newell, Stults, 2016). Hence, in the face of the current climate crisis, it becomes vital that cities need to be equipped with strategies and policy responses to address challenges, to adapt to changes and to recover from potential negative impacts (Naphade, et al., 2011; Jabareen, 2015).

Against the advancement of human societies is the growing likelihood of flood hazards. First and foremost, the continuing urbanisation worldwide will see a massive influx of people residing in urban areas, ending up turning green areas into impervious built areas and increasing urban runoff (Hammond, et al. 2013). Also, as a result of people migrating to cities, more and more informal urban settlements would emerge on flood plains and low-lying coastal areas, which are more exposed to flooding (Liao, 2012; Hammond, et al. 2013). On top of the urban sprawl, climate change has led to more frequent and extreme flooding events over the past few decades (Driessen, et al. 2018). Climate change-induced issues such as more precipitation, intensive rainfall, rising sea levels, high peak discharge of rivers. are all posing new challenges for urban flood risk management (Bertilsson, et al. 2019; Driessen et al. 2018; Restemeyer, Woltjer, Brink, 2014). Particularly, the average annual precipitation of a region will be more variable and with greater extremes, leading to unpredictable extreme floods that may happen more frequently (Djordjevic, et al. 2011). In a nutshell, urban areas accommodate a high density of population and increasing amounts of surfaces are turned impermeable, leading to urban areas becoming more susceptible to flooding hazards and the consequences can be grave.

As a response to the challenges facing urban areas, there is a rise of applying resilience thinking in urban governance and management, because researchers and decision-makers found out mitigation approaches alone were not enough due to the lack of flexibility and adaptivity (Spaans, Waterhout, 2017). Resilience thinking provides a new holistic perspective for understanding climate-induced challenges, adjusting institutional structures and generating suitable solutions (Elmqvist, et al., 2019; MacKinnon, 2015; Leichenko, 2011; Spaans, Waterhout, 2017). On the other hand, urban areas have become increasingly important for resilience studies as well, serving as the laboratories for resilience-related policies and practices (Meerow, et al., 2016).

### 2.2 Theoretical narratives about resilience

The term resilience first emerged as a concept in ecological studies by Holling (1973, p. 17): “Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving

variables, and parameters, and still persist. In this definition, resilience is the property of the system and persistence or probability of extinction is the result." Since then, it has been applied to a wide range of disciplines, such as engineering, psychology, and environmental sciences (Hudson, 2010). However, so far there has been no universally accepted definition for resilience, for it is usually discipline-specific and thus highly depends on the research context. In different domains, there are a wide range of attributes that are related to the concept of resilience, such as reconfiguration, recovery, adjustment, resistance. (Martin, 2012; Bocchini, et al. 2014; Rus, Kilar, Koren, 2018; Gao, Barzel, Barabasi, 2016).

Nevertheless, these varied definitions share the commonality that resilience refers to the ability of a system to withstand/absorb disturbance and/or adapt to changes while maintaining its functioning or state of balance (Brown et al., 2012; Simmie and Martin, 2010; Ribeiro, Gonçalves, 2019).

Resilience as a concept was gradually introduced to urban studies and planning in the 1990s due to the similarities between urban systems and ecological systems (Meerow, Newell, Stults, 2016). For example, Edger (2000) contends that, after studying a mangrove ecological system in relation to nearby communities' livelihoods, there is a clear link between the resilience of communities and that of the mangrove system, especially in areas where communities rely on the environmental resources to make a living. Evans (2011) believes that urban systems can exhibit resilience just as ecosystems do because the social-ecological systems of cities are similar to ecosystems where an array of elements are interlinked through many feedback loops.

In the field of urban resilience, there are three contrasting broad perspectives of resilience: engineering, ecological and evolutionary (also known as socio-ecological) resilience (Meerow, Newell, Stults, 2016; Davoudi, 2012). The concept of engineering resilience is often used and adopted in many resilience studies and policies, which sees resilience as the societal capacity to resist and adapt to disruptions whilst maintaining security and stability, and to return to the pre-existing equilibrium state in a short period (Chelleri, et al., 2015; Davoudi, 2012). However, critics of this concept argue that it assumes the system would bounce back to its pre-existing state without taking into

account the changes in the economic structure and functions of regions (Boschma, 2015; Martin, 2012). By highlighting bouncing back to the pre-disruption status quo, engineering resilience also risks normalising the pre-existing socio-economic dynamics that could be unjust and unsustainable and thus hinders the potential to transform the old equilibrium (Coaffee, et al.; 2018; Ziervogel et al., 2017).

In contrast, ecological resilience believes that there are many new equilibria for a system to bounce forward to after adapting to changes and adjusting old socio-economic structures (Davoudi, Zaucha, Brooks, 2016; Cerè, Rezgui, Zhao, 2017). However, ecological resilience tends to overlook the impacts of human agency, institutions and structural change that are of crucial significance to urban studies (Boschma, 2015; MacKinnon and Derickson, 2012). Christopherson, Michie, and Tyler (2010) also contend that this ecological resilience concept usually depicts regions as an independent spatial unit, separating them from their links to external elements that can have a huge impact on shaping the social and ecological systems of these regions. This point resonates with what Gandy (2002, 2004) argues: ecological thinking in a way accentuates the image of cities being self-contained while, in reality, urban systems consist of multiple interconnected and interdependent elements that help the systems to function.

Nevertheless, what both the engineering and ecological conceptualisations have in common is that they believe in an equilibrium state for a system after disruptions, either a pre-existing state that a system can return to (engineering resilience) or a new one that a system maintains through reconfiguration and self-organisation (ecological resilience) (Matyas, Pelling, 2014; Davoudi, Zaucha, Brooks, 2016), because they both view resilience as a static, result-oriented concept (Rus, Kilar and Koren, 2018).

Evolutionary resilience, or socio-ecological resilience, instead questions the traditional equilibrium thinking, as the complex socio-ecological systems may not keep a stable state over time (Boschma, 2015; Davoudi, Zaucha, Brooks, 2016; Folke, 2006), and this concept champions that people and nature are interdependent systems (Folke, et al. 2010). What is fundamentally different about an evolutionary perspective from the above two is that it places resilience as the approach for long-term systemic transformation instead of a return to normalcy (Meerow, Newell, Stults, 2016; Davoudi,

Zaucha, Brooks, 2016), and the future growth path in this case is being taken into account as opposed to an equilibrium state (Chelleri, et al., 2015; Davoudi, et al., 2012). In other words, it is a dynamic and process-oriented concept that emphasises the ability of a system to reconfigure the institutional structure so that long-term growth and development can be ensured (Rus, Kilar, Koren, 2018; Boschma, 2015; Christopherson et al., 2010; Simmie, Martin, 2010), or as elaborated by Simmie and Martin (2010), it is "an ongoing process rather than recovery to a (pre-existing or new) stable equilibrium state" (p. 31). Additionally, compared to the equilibrium perspective that tends to put focus on where, when and how the disruptions occurred, evolutionary resilience sees the question of "why" as crucial because this would allow for a review of what has gone wrong in the old socio-economic system so that adaptions and transformations can be made (Welsh, 2014; Christopherson et al., 2010).

Under the evolutionary perspective, cities should be able to adapt to changes and adjust economic structures and policies to facilitate such adaptations (Christopherson et al., 2010). This evolutionary perspective necessitates the importance of reflexivity, social learning and knowledge sharing, as they eventually contribute back to the cultivation of preparedness, adaptation, and adjustment of urban systems, further reinforcing resilience (Davoudi, Zaucha, Brooks, 2016; Boschma, 2015).

### 2.3 Flood resilience under the evolutionary perspective

Resilience theory is commonly used in generating frameworks for urban flood risk management, because it considers the possibility of flooding, aims to minimise the consequences, and facilitates the idea of living with uncertainty (Bertilsson, et al. 2019; Liao, 2012; Restemeyer, Woltjer, Brink, 2014). In contrast to the traditional thinking that cities cannot live without flood control measures, Liao (2012) argues that under resilience thinking, living with periodic floods can create an opportunity for learning to prepare cities for extreme ones, increasing flood adaptation as the means to mitigate flood hazards. Flood management strategies in the EU also call for flooding to be seen as a natural phenomenon that cannot be completely prevented; what is more important is to reduce the impacts of flooding on people's livelihood, the wider economy and the environment (Priest, et al., 2016).

As aforementioned, engineering and ecological resilience both are unsuitable for an urban system that many researchers see as a complex socio-technical-ecological system with human and nature interactions (Zevenbergen, 2020; Bertilsson, et al. 2019; Nunes, Pinheiro, Tomé, 2019). Within the complex system that is dynamic, nonlinear and unpredictable, factors such as climate, socioeconomic activities and built areas all play a part in influencing flooding events, so there are unlikely some equilibria where urban systems could remain at or bounce to (Boschma, 2015; Christopherson, Michie, Tyler, 2010; Bertilsson, et al. 2019). In addition, urban systems also differ from ecosystems in the sense that individuals' safety and security in cities cannot be compromised and long-term sufferings post shocks must be avoided (Liao, 2012). A city could still function and operate well after floods whilst vulnerable residents are suffering from the consequences – a scenario that should be avoided, as the safety and well-being of citizens matter significantly in this case (Liao, 2012).

As it becomes clear that seeking an equilibrium should not be the ultimate goal of flood resilience, I therefore argue that evolutionary resilience is best suited for examining the increasing flood risk and contributing to policymaking for future, because evolutionary perspective symbolises transformations and requires constant learning and reflexivity, whilst the currently dominant approach of managing flood threat largely derives from the equilibrium thinking that proves to be outdated in the face of climate change related uncertainty and volatility (Zevenbergen, 2020; Nunes, Pinheiro, Tomé, 2019; Boschma, 2015). I believe evolutionary flood resilience can take a holistic view over multiple phases in confronting a flooding event: urban systems should firstly be able to resist floods, then to absorb the impacts if flooding happens, and to resume functions after flooding, and crucially, to recover and undergo reconfigurations and transformations, to ensure future growth and constant adaptation to the every-changing environment (Vamvakeridou-Lyroudia, et al. 2019; Bertilsson, et al. 2019; Dieperink, et al. 2018; Hegger et al. 2016).

For evolutionary resilience, a common emphasis is on the ability of actors to learn from past disasters and to improve mitigation methods accordingly (Dieperink, et al. 2018; Heggar, et al. 2016). The ability to learn is critical as it facilitates further adaptation and systemic transformation (Priest, et al. 2016). In this learning cycle, adaptation and adaptive capacity help cities prepare for future uncertainties, especially in the context

of climate change where the safety of urban residents needs to be ensured and economic development needs to be guaranteed (Boschma, 2015; Priest, et al., 2016; Dieperink, et al. 2018; Heggar, et al. 2016), whereas the adjustment and transformation of socio-economic and institutional structures on the basis of learnt experience would reduce damages from future flooding events (Dieperink, et al. 2018; Hegger et al. 2016; Priest, et al. 2016). The mindset of completely relying on flood control infrastructure to protect cities should therefore be changed, not only because the conventional schemes have their limits, but because flood resistance alone undermines resilience due to non-learning (Kuang, Liao, 2020; Liao, 2012). Dealing with mild floods rather than preventing every flood may serve as an opportunity for cities to learn and accumulate knowledge (Liao, 2012; Haque, Azad, Choudhury, 2022).

Taking into account the ability of learning, a resilient flood risk management approach should acknowledge periodic floods as inherent environmental dynamics that would inevitably affect socioeconomic activities in urban areas, and also see periodic floods not just as a threat to be resisted but as an opportunity for enhancing resilience of cities, so that cities are able to learn from addressing these periodic flooding events and thus are better equipped with knowledge and experience needed for extreme floods (Haque, Azad, Choudhury, 2022; Liao, 2012; Folke, 2006).

### 2.4 Key attributes of evolutionary flood resilience

Based on a wide variety of definitions of resilience, for this research study I include a few common attributes to describe evolutionary flood resilience: robustness, preparedness, adaptability and transformability (Mehmood, 2016; Restemeyer, Woltjer and Brink, 2014; Ribeiro, Gonçalves, 2019). Robustness means that cities are strong enough to withstand a flood event by reinforcing grey infrastructures, e.g. floodwalls and dams, which in essence is the ability to resist flooding (Spaans, Waterhout, 2017; Godschalk, 2003). Robustness acknowledges that resistance measures are needed to be the first response to flooding, indicating that flood control facilities are worth investing in and maintaining (Ribeiro, Gonçalves, 2019). However, as aforementioned, merely being robust or resistant cannot keep floods away in the long run, because there will always be extreme floods caused by climate change to overtop the physical protection of flood control

facilities. From an evolutionary point of view, relying on existing grey infrastructure should not remain the primary focus of resilience thinking.

So this is where the rest of the attributes of resilience come into play. Preparedness refers to the various precautionary measures taken by stakeholders, e.g. communities, institutions, to brace themselves for flooding. Preparedness activities may include making flood emergency plans, conducting flood evacuation drills, maintaining emergency supplies. (Abunyewah, et al. 2023). Being prepared for flooding events means that stakeholders can take actions to reduce the initial disruptions caused by flooding and enable them to quickly respond to the predicament (Forrest, Trell and Woltjer, 2019; Haque, et al. 2002; Mishra, Mazumdar, Suar, 2009). There are a wide range of factors that may influence the level of preparedness, such as flood risk awareness, flood experience (Fox-Rogers, et al. 2016; Maidl, Buchecker, 2015; Mishra, Mazumdar, Suar, 2009; Terpstra, 2011). Researchers find out that higher level of risk awareness usually lead to better preparedness, which then foregrounds the importance of flood risk education and communication, especially between the authorities and communities (Maidl, Buchecker, 2015; Fox-Rogers, et al. 2016). As for flood experience, researchers argue that flood victims are usually shaped by their negative experience in the past and tend to be better prepared for future flooding events (Terpstra, 2011; Fox-Rogers, et al. 2016).

Adaptability demonstrates the capacity to adjust to the impacts of flooding so that damage is minimised (Boschma, 2015; Restemeyer, Woltjer and Brink, 2014; Sharifi, 2023). With heightened adaptability, urban systems are able to choose alternatives, and take different or new approaches to adapt to flooding events (Davoudi, Zaucha and Brooks, 2016), such as choosing Green Infrastructure rather than remaining dependent on traditional flood defence, individuals changing their mindset and behaviour to better adapt to flood risk (Takin, Cilliers and Ghosh, 2023; Sharifi, 2023; Mehmood, 2016). Another dimension of adaptability entails flexible and efficient mobilisation of human resources and social capital, such as building connections between institutions and individuals, encouraging knowledge sharing, and creating strategies in problem-solving and self-organising (Davoudi, Zaucha and Brooks, 2016; Janssen, et al. 2006).

Transformability is the final and yet critical element of a resilient urban system (Davoudi, et al. 2013; Restemeyer, Woltjer and Brink, 2014; Mehmood, 2016). Transformability refers to the innovative changes on cognitive, behavioural and institutional fronts (Davoudi, et al. 2013; Mehmood, 2016). For instance, the authorities are able to shift from the old attitude of preventing floods to embracing the reality that not every flood is preventable and starting to learn from flood experiences (Liao, 2012). Importantly, the transformation phase denotes the critical role of learning in knowledge creation and sharing, and such learning outcomes ensure a sustained and continuous development for the urban systems in the face of dynamic challenges (Schneider, et al. 2021; Mehmood, 2016; Sharifi, 2023).

### 2.5 Applying Green Infrastructure for advancing flood resilience

In the face of climate change, the number of extreme flood events is on the rise. A great deal of research highlights that it is inadequate to merely depend on traditional flood control measures to address increasing flood risks because of climate changed induced uncertainty and unpredictability (Bertilsson, et al. 2019; Liao, 2012; Restemeyer, Woltjer and Brink, 2014). The traditional schemes aim to reduce the probability of flood hazards by keeping water away from land (Restemeyer, Woltjer and Brink, 2014; Green, et al. 2021). Such flood resistance measures that rely on grey infrastructure such as dams and levees, however, cannot continue serving their purposes as they used to, because extreme floods that exceed the design capacity of flood-control facilities would considerably disrupt cities and lead to damages (Green, et al. 2021; Liao, 2012; Staddon, et al. 2018). More holistic approaches for sustainable urban water management are therefore being introduced, reflecting a shift from fragmented measures to integrated thinking (Restemeyer, Woltjer and Brink, 2014; Green et al. 2021; Staddon, et al. 2018).

There are different terms used to describe approaches for sustainable urban water management but the commonalities these different terms share are the hydrological principles of detention and conveyance, retention, and infiltration of rainwater and runoffs, largely integrated into both designed and nature-based facilities, including green roofs and walls, swales, rain gardens, street trees, ponds, urban wetlands, restored watercourses, reconnected floodplains, and re-naturalised rivers (Esmail, Suleiman,

2020; Ghofrani, Sposito, Faggian, 2017; O'Donnell, Thorne, 2020; Fletcher, et al. 2015; Lashford, et al. 2019). In contrast to conventional grey infrastructure that is managed under centralised systems, these new systems are more decentralised (O'Donnell, et al 2021), e.g. runoff and rainwater in communities can be disconnected from the main drainage systems. The terms often used include Green Infrastructure, Nature-based solutions, Low Impact Development. (Esmail, Suleiman, 2020). These ideas centre on living with water and making space for water, and they are widely adopted across the world as a way to managing urban water as well as improving the environment through the provision of multiple co-benefits (Ghofrani, Sposito, Faggian, 2017; Gulsrud, Hertzog, Shears 2018; O'Donnell, et al., 2021). In this research study, I will use the term Green Infrastructure (GI) to refer to the various kinds of projects that enshrine sustainable water management in England, China, and beyond.

Green Infrastructure represents a strategy that addresses flood risk on multiple fronts as opposed to the sole resistance provided by grey infrastructure (Green, et al. 2021). This is how I see resilience as being deeply embedded in the employment of GI: urban systems will first rely on the existing flood defence and pipes to deal with the floodwater, and on occasions where floods overwhelm the existing grey infrastructure, GI are in place to attenuate the flow, absorb and store the excessive floodwater, and channel the floodwater into a river course (Staddon, et al. 2018; Green, et al. 2021; O'Donnell, Thorne, 2020). In doing so, GI provides adaptability and flexibility. Additionally, the policy shift to GI also advocates for transformations, i.e. the society cannot simply rely on grey infrastructure to solve flooding issues and a new thinking is needed to increase adaptation and facilitate change. This shift is an embodiment of transformability that is critical to evolutionary resilience.

### 2.5.1 Sustainable Drainage Systems in England

England started trials of Sustainable Drainage Systems (SuDS) in the late 1980s, with the aim to change the traditional perspective of seeing surface water as a problem and to focus on an 'opportunity-centred' approach that provides more benefits than merely managing water quantity and quality (Woods-Ballard et al., 2007; Ashley, et al 2015; Lashford, et al. 2019). SuDS includes a wide range of drainage systems that can be

categorised into four types: storage systems (e.g. retention and detention ponds), infiltration systems (e.g. infiltration trench), conveyance systems (e.g. swales) and permeable surfaces (Ellis, Lundy 2016).

Challenges confronting the application of SuDS are myriad. A widely researched issue is that there is no local authority approval body for effective regulatory control in none of the design, construction, or operation phases, thus discouraging the uptake of SuDS at the local scale (Ashley, et al. 2015). Furthermore, the regulatory framework does not clarify the relative roles of planning authorities, local governments and water companies in taking the responsibility for adoption and maintenance (Ellis, Lundy, 2016). As such, unclear ownership of SuDS and undefined responsibility for long-term maintenance hinder the roll-out of SuDS, especially retrofitting SuDS in existing drainage systems (Lamond, Rose, Booth, 2015; Everett, et al. 2016; Melville-Shreeve, et al., 2018). Yet, the retrofitting of SuDS is critical for making an impact on flood resilience because of the old housing stock in England – old builds account for 99% of the buildings in the country (Committee on Climate Change, 2012).

Another related issue is the fragmented legislation in relation to promoting SuDS. There are different pieces of legislation in England, e.g. the Flood and Water Management Act (2010), that recommend the application of SuDS, but the SuDS standards and guidance in England, at the time of completing the chapter, were non-statutory (although new legislation has come in since April 2024 that requires SuDS to be built in any new development (CIWEM, 2023). Therefore, many developers are in favour of conventional piped drainage systems that they are familiar with regarding costs and maintenance (Ellis, Lundy 2016).

On top of the fragmented regulation is the fact that SuDS projects can be initiated by a variety of actors, such as local authorities, planning authorities, property developers, and water companies (O'Donnell, et al. 2021). A contentious relationship between the multiple stakeholders may also stand in the way of implementing SuDS, as a consequence of non-statutory status and unclear responsibility. One example is that the relations between local councils, highway authorities, and water companies can be

strained and complicated when the former two exert their right to connect SuDS to the existing drainage systems that are owned by water companies (Ellis, Lundy, 2016).

### 2.5.2 Sponge City Programmes in China

Sponge City Programmes (SCPs) emerge as the Chinese government's top-down environmental policy to address the increasingly disruptive large flooding events threatening densely-populated urban areas (Liu, Jia, Niu, 2017; Lashford, et al 2019). National guidelines for SCPs were created in 2014, indicating that the programmes will be state-funded for the initial three years and 80% of surface water is expected to be dealt with through Green Infrastructure (Nguyen, et al. 2019; Li, et al., 2017; Lashford, et al 2019). This bears a great difference to the status of SuDS in England, as SuDS is not a national policy and was not enforced by legislation until recently. Rather, SuDS is a piecemeal, bottom-up approach depending on local actors to support and promote (Lashford, et al 2019).

SCPs are implemented at the city-scale in a number of pilot cities, aiming to form guidance for further promotion across China (Li, et al., 2017; Nguyen, et al. 2019; Griffiths, et al. 2020). A 'sponge' city, as illustrated in Figure 2.1, refers to the one that adopts a resilient and sustainable way of managing rainfall and urban floods, including a range of projects in both retrofitting old facilities and building new infrastructure, and the primary design principles include utilising permeable paving for runoff to infiltrate at the source, creating green space to store excessive rainwater, to integrate natural water-bodies with the designed GI projects. (Chan, et al. 2018; Nguyen, et al. 2019; Griffiths, et al. 2020)

Admittedly, the ideas championed by SCPs are not original, as the SCPs draw inspiration and lessons from a wide range of practices across the world, including the Low Impact Developments (LID) in the US and SuDS in England (Chan, et al. 2018; Nguyen, et al. 2019). However, this borrowed idea can be a potential disadvantage that restrains the benefit realisation of SCPs, because, as literature notes, the guidelines from the central government lack a thorough consideration of the specific spatial and climatic variability across China (Li, et al., 2017; Lashford, et al 2019).

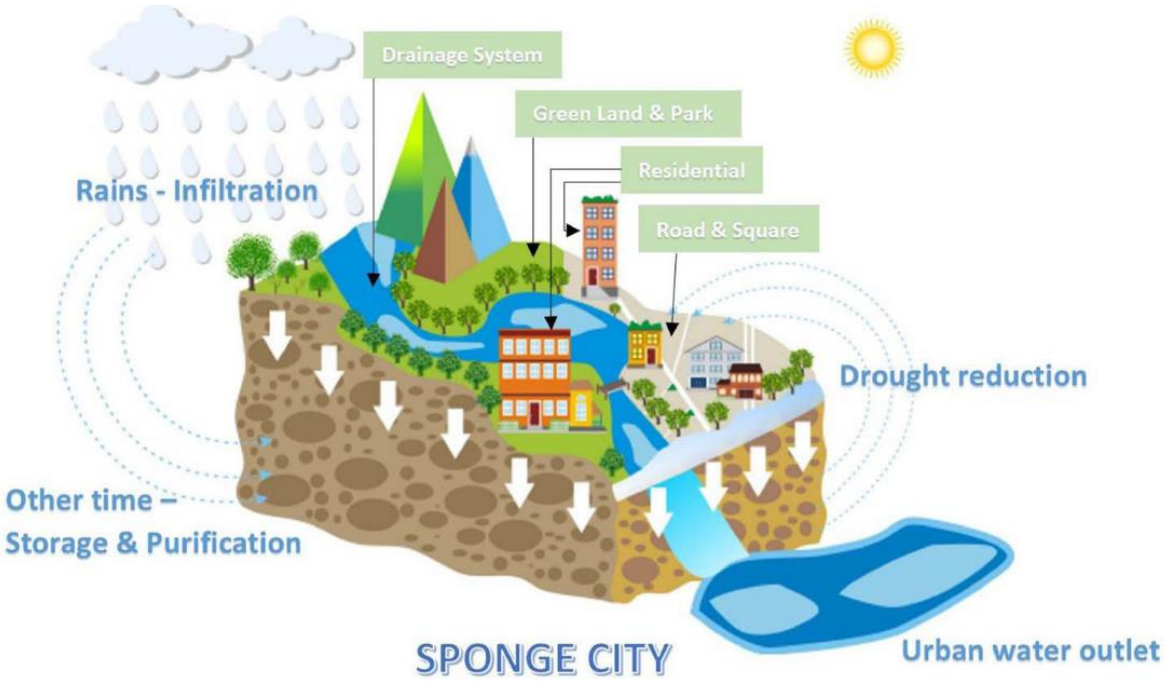


Figure 2.1 Illustration of a “sponge city” (Source: Chan, et al. 2018)

Funding schemes of SCPs often become another barrier that could potentially lead to failures. Although cities are funded by the national government to implement GI projects, a city’s administrative level determines the amount of funds it can receive, and state funding lasts only five years, after which cities have to seek partnerships with private sectors (Xia, et al. 2017; Lashford, et al 2019). These cities will have to establish a public-private-partnership (PPP) model for continuous funding to support further projects and long-term maintenance, but the reality is that there is little motivation for private sectors to get involved due to a lack of clear guidance in total costs and financial risks (Dai, et al., 2017; Lashford, et al 2019).

In contrast to the multiple stakeholders involved in the SuDS projects in England, the central government of China plays a key role in leading and driving the implementation of SCPs, because the Chinese governance system is highly hierarchical (O’Donnell, et al 2021). The national government selects candidate cities, sets up guidelines and mandatory standards, and provides funding, but local government is still seen as the

primary driver of implementing the individual projects (Xia, et al. 2017; Nguyen, et al. 2019; O'Donnell, et al 2021). This governance model highlights the pivotal role of the national government in deciding priorities and the equally important role of local governments in coordinating and monitoring work on the ground. (O'Donnell, et al 2021).

The existing literature provides some contexts about the situation of GI projects in England and China, but lacks details about the viewpoints of professionals implementing projects on the ground, especially in China's case. I therefore conceptualise the first sub-question *"What are the challenges facing professionals in the process of implementing GI projects in the two countries?*" in order to further examine the difficulties facing the implementation of GI, from professionals' viewpoints. Targeting this sub-question in Chapter 4, I will further introduce literature on the legitimacy of knowledge (whose knowledge matters) and experts' cognitive entrenchment, to critically analyse how experts in China respond to public doubts. In doing so, I will utilise this research question to find out how these key actors see the challenges based on their work experience and expertise, offering valuable insights into the power dynamics between multiple stakeholders and amid policymaking process.

### 2.6 Green Infrastructure as a socio-technical transition

The evolutionary resilience perspective, which sees human society as an interdependent and interconnected part of the wider ecological system, is also a key component of urban sustainability (Wendling, et al. 2018; Tan and Solangi, 2024). The Sustainable Development Goal 11, "Make cities and human settlements inclusive, safe, resilient and sustainable", shows that implementing Green Infrastructure not only contributes to building up resilience but increases sustainability as well (SDG11, United Nations General Assembly, 2015). To achieve many of the Sustainability Development Goals (SDGs), and to tackle climate change induced problems particularly, wider diffusion and application of technological innovations and new infrastructures are crucial, requiring shifts on all fronts: infrastructure, mobility, energy, governance. (Thacker, et al. 2019; Markard, Geels, Raven 2020; Kivimaa, et al. 2021). Technological and social innovations are seen as the enablers for such shifts, and these shifts are understood and studied as socio-technical transitions (Kivimaa, et al. 2021; Markard et al., 2012). In socio-technical transitions,

changes take place not just in technology but in policies, institutional practices, citizen behaviours, cultural meanings, and business models (Geels, 2018; Smith, Stirling and Berkhout, 2005). The context in which such transitions take place can be conceptualised as socio-technical systems (Markard, Raven, Truffer, 2012), and these systems "consist of networks of actors (individuals, private firms, research institutes, government authorities, etc.), the knowledge that these actors possess as well as the relevant institutions (legal rules, codes of conduct, etc.)" (Soderholm, 2020, p.2). Transitions literature acknowledges the often disruptive and nonlinear nature of such transitions, and emphasises the importance of taking into account the complexity of the interdependencies between different actors with various backgrounds (Smith, Stirling and Berkhout, 2005; Köhler et al., 2019; Geels, 2018; Soderholm, 2020).

GI represents sustainable ways of managing urban development and optimised resource use, enabling the urban system to "successfully navigate the water-energy-climate relationship, thus enhancing urban resilience" (Wendling, et al. 2018, p.1). GI contributes to enhanced resilience of urban systems through not just flood risk management, but a wide range of social, economic, and environmental elements (Wendling, et al. 2018).

The implementation of GI is as much a technical shift as it is a societal, organisational, political and economic endeavour (Soderholm, 2020). Installing infrastructure such as swales, rain gardens, permeable paving, retention ponds requires the technical skills and knowledge that are fundamentally different to those associated with conventional schemes, placing the knowledge creation and circulation at the central stage in this process (Frantzeskaki and Rok, 2018; Rauschmayer, Bauler and Schäpke, 2015). Meanwhile, implementing GI also necessitates changes that shape society in multiple domains, e.g. through lawmaking and legal amendments, distribution of funds, citizen practices, and changed business models (Wendling, et al. 2018; Chini, et al. 2018). Moreover, delivering GI projects is more than the mere application of new technologies and the improved governance and financing, it also symbolises a new attitude towards flood risk, which requires the institutions and urban residents to change their mindset about the relations between humans and nature, and re-evaluate the prospect of living in an era of climate change and the associated uncertainties (Staddon, et al. 2018; Liao, Le, Nguyen, 2016). It now becomes clear that the promotion and application of GI

necessitates shifts on many fronts, which then foregrounds the importance of learning in the transition process (Pauleit, et al. 2019; Stam, Van Ewijk and Chan, 2023). The significant role of learning here resonates with what evolutionary resilience emphasises: learning and reflection that ensures continuous adaptation to the ever-changing systems (Boschma, 2015; Davoudi, Brooks, Mehmood, 2013). Learning is therefore the central element, the bridging concept connecting evolutionary resilience to the socio-technical transition in the context of employing GI.

### 2.6.1 Transitions literature and the multi-level perspective (MLP)

Some prominent approaches for studying socio-technical transitions include transition management, strategic niche management, technological innovation systems, and the multi-level perspective (MLP) (Markard, Raven, Truffer, 2012). The multi-level perspective in particular is a commonly used framework for examining transitions in systems (Smith, Voß and Grin, 2010). Many scholars apply it for studying various transitions in socio-technical systems such as renewable energy transitions (Osunmuyiwa, Biermann, Kalfagianni, 2018), low carbon mobilities (Köhler, Turnheim, Hodson, 2020).

The MLP distinguishes three analytical levels of variables that can effect a transition: niche developments or novelties at a micro-level, socio-technical regimes at a meso-level, and exogenous landscapes at a macro-level (Smith, Voß and Grin, 2010; Geels, Schot, 2007; Geels, 2012). A systemic transition happens as a result of three different analytical levels aligning with each other (Geels, 2018). Radical innovations emerge in niches, which are “protected spaces” in the sense that special support, demand or subsidies are in place for novelties to develop and mature (Geels, 2012), whereas a socio-technical regime is “the configuration of technology, knowledge, infrastructure, symbolic values, and role division that has emerged around social practices” (Van Mierlo, Beers, 2020). Experimental or demonstration projects are often carried out in niches, within which some social processes also taking place, such as learning processes about problems of technologies, policy instruments, market demand, and the process of building social networks and the inclusion of more actors (Markard, Raven, Truffer, 2012; Geels, 2012). Technological innovations may gain momentum in niches if various learning processes

generate stable configurations, or if powerful actors join the innovations to add legitimacy or bring in more resources (Raven, Schot and Berkhout, 2012; Geels, 2012; Smith, Voß and Grin, 2010). The momentum created can destabilise the regime, and when the changes at the landscape level impact the regime level, windows of opportunity can be opened up in the regime for niche innovations to break through (Kern, 2012; Geels, 2012).

A central focus of transitions research is the inertia exhibited by the existing socio-technical systems, or the lock-in mechanisms (Seto, et al. 2016; Isaksson and Heikkinen; 2018; Klitkou, et al. 2015). High degrees of inertia stall the progress of transition or even suppress the niche innovations from breaking through (Markard, Geels, Raven, 2020; Seto, et al. 2016). In the MLP, the inertia is understood as the self-reinforcing lock-in mechanisms or path-dependency that are inherent to the socio-technical systems (Wilson, 2014; Frantzeskaki and Loorbach, 2010; Van Mierlo, Beers, 2020). Geels (2019; 2012) conceptualises three varieties of lock-in mechanisms: 1) techno-economic lock-in mechanisms, such as sunk investments in infrastructure and technological know-how that create vested interests against a transition; 2) social and cognitive lock-in mechanisms, an example is the mutual dependence between actors make them blind for innovations outside their scope or impede their attempts to make changes; 3) institutional and political lock-in mechanisms, such as existing rules and regulations favour the incumbents and creates barriers for niches breakthrough.

### 2.6.2 The research gaps in the MLP

If applying the MLP framework to examine the transition brought about by GI, at the micro-level, the niche innovations would be the technologies, including swales, retention ponds, rain gardens, green roofs that are novel in addressing urban flood risks as opposed to grey infrastructure made of cement or concrete. Then, at the macro-level, the socio-technical 'landscape' in MLP is understood as a relatively 'stable' exogenous environment that is not shaped by actors in a niche or regime level (Geels and Schot, 2007). A transition happens as a result of alignments of the interactions between the three levels (Næss, Vogel, 2012). However, the applicability and validity of the MLP framework are questionable due to many flaws, especially when studying transitions in

China. As Tyfield (2014, 2018) argues, the MLP theories struggle to articulate the dynamics between the alignments of the three levels and tend to omit the power relations that are at play between actors at different levels, which could be key to facilitating transitions. The understanding of 'landscape' in the MLP implicitly denies the agency of diverse actors that could be critical to pushing through a transition. Tyfield (2014) further contests that, when examining automobility policymaking in China, sustainable transition is very much a joint effort of political will of the party, businesses and nationalists; these actors are not 'exogenous variables' that stand out of the landscape while the landscape evolves slowly on its own. The social, cultural and political structures of China tend to be misrepresented in MLP or other frameworks that originate from Western democracies with market economies (Huang, Westman, Broto, 2021a). Since China is undergoing a rapid and profound social change that impacts the rest of the world, to assume the landscape level is 'stable' is problematic (Huang, Westman, Broto, 2021a; Tyfield, 2014).

Moreover, the lack of understanding of actors' roles in the MLP is another problem that has been critiqued by scholars (Beers and Van Mierlo, 2017). O'Neil and Gibbs (2014) argue that the actors in socio-technical systems can shift institutional arrangements, lobby for regulatory change, create new partnerships and transform sectoral practices to promote sustainability transition. The MLP also believes in the direction of transitions starting from niches and going up to the higher levels, but Van Mierlo and Beers (2020) give the example of governments financing transition-oriented innovation programmes, demonstrating how these regime-level actors can initiate and influence paradigm shift – setting agendas for or against change.

Overall, the flaws in MLP means that it is not directly applicable to assist my data analysis in later chapters, but instead I will make use of the concepts of "lock-in" mechanisms and path dependency in the MLP framework to scrutinise the inertia and various challenges in the socio-technical transition brought about by GI projects.

Understanding the implementation of GI as a transition helps me to establish the second sub-question: "How do professionals operate in the face of predicaments to overcome the difficulties and deliver GI projects?". This question builds on the previous question

that explores the professionals' viewpoints on the challenges, and therefore takes a step further to investigate how they respond to challenges and overcome barriers to deliver GI projects. This question also aims to bridge the research gap that actors' roles and power relations are understudied in transitions research.

### 2.7 The role of learning in resilience and transitions literature

In this research study, learning is the bridging concept connecting the two separate bodies of knowledge: flood resilience and socio-technical transition. As I have examined above, learning is the key component to ensure future growth paths for building up flood resilience, which is the essence of evolutionary resilience. The following section is on the role of learning in shaping socio-technical transitions.

Although the transitions literature acknowledges the significant part that learning plays in the acceleration and governance of socio-technical transitions (Bos and Brow, 2012; Singer-Brodowski, 2023; Van Mierlo, Beers and 2020; Raven et al., 2008), Van Mierlo and Beers (2020) argue there is a gap between transition studies and studies on learning, in that the learning process is understudied – more discussions and conceptualisations are needed for bridging the gap.

Through the lens of the multi-level perspective (MLP), learning is seen as the translation of experiences in pilot projects into enriching general knowledge, thus creating knowledge flows and shaping rules for later pilot schemes (Geels, Raven, 2006; Geels, Deuten, 2006; Van Mierlo and Beers, 2020; Vinke-de Kruijf and Pahl-Wostl, 2016). The MLP sees learning take place in niche innovations, including among actors located within a pilot project, between different pilot projects, from pilot projects to an emerging niche, and in interactions between pilot projects and niche (Hekkert et al., 2007; Geels, Raven, 2006; Van Mierlo and Beers, 2020). Van Mierlo and Beers (2020) identify two types of learning in transitions: discursive interaction and reflective action. Discursive interaction refers to the exchange of knowledge, information, and experiences among actors, signalling the learning on the cognitive front (Van Mierlo, Beers, 2020). This learning in multi-actor settings occurs when actors with different outlooks and goals discuss common problems and seek solutions – the interaction in social networks is key (Schreiber-Barsch, Mauch, 2019; Stam, Van Ewijk, Chan, 2023). Whilst reflective action

refers to multiple stakeholders generating a shared understanding of a problem and forming a collection basis for action (Stam, Van Ewijk, Chan, 2023; Van Mierlo and Beers, 2020). It is an iterative process of action and reflection that involves activities of planning, action, and aggregating experiences that stem from the action (Van Mierlo and Beers, 2020).

However, much of the transitions literature, including those on MLP in particular, focus on the learning that is associated with niche innovations, whilst a research gap appears when it comes to other aspects of learning (Johannessen, Mostert, 2020; Ingram, et al. 2015; Hoes et al., 2016; Stam, Van Ewijk, Chan, 2023). Little research focus is placed on learning taking place at the regime-level, learning by and amongst the incumbent actors, learning that hinders socio-technical transitions, and the non-learning and unlearning of actors (Van Mierlo, Beers, 2020; Van Poeck et al., 2020). The incumbent interests, in particular, tend to possess more financial and social resources and wield more influence on public policy (Imbert, et al., 2019). The incumbents can potentially control the knowledge flow within a network, through shutting down opportunities for regimes to accommodate and adapt to the niche innovations, thus blocking a transition pathway and maintaining a lock-in for learning that may go beyond the dominant paradigm (Medema, et al., 2015; Avelino, Wittmayer, 2016; Van Mierlo, Beers, 2020). To examine the under-researched aspects of learning, such as regime-level learning and learning by the incumbents, is likely to deepen the understanding of how learning contributes to transition. In the context of this research study, investigating the learning among incumbents helps to address how the learning impacts the implementation of GI and the overall flood resilience.

Furthermore, in literature about learning in sustainability transitions, there is insufficient attention on attributes such as social networks, conflicts and power, which are crucial elements of learning (Avelino, 2017; Stam, Van Ewijk, Chan, 2023). For example, a positive relationship between learning and transitions is often assumed, but researchers struggle to analyse and articulate the correlation (Stam, Van Ewijk, Chan, 2023). This assumed positive relationship dismisses the possibility that learning may not be conducive to transitions, and overlooks the complex dynamics of social interactions and potential conflicts between actors (Van Mierlo, Beers, 2020; Stam, Van Ewijk, Chan,

2023). In addition, conflicts at various levels are common in transitions but are often neglected as a possible environment for generating learning (Cuppen, et al., 2016). Moreover, a socio-technical transition is expected to be filled with power struggles that resist change and obstruct transitions, and yet power relations are understood to be critical in shaping learning and thus transitions (Avelino, Wittmayer, 2016; Van Mierlo, Beers, 2020). To investigate the complex power dynamics is crucial for forging a better understanding of how actors operate to facilitate or hinder transitions (Barrie et al., 2019; Imbert et al., 2019).

In this research study, as the incumbent interests are dominant – grey infrastructure and its associated expertise and institutional set-up are still the mainstream in both England and China (Lashford, et al. 2019), I will therefore examine how professionals, including the incumbents, respond to the transitions and what their perspectives are regarding the emerging tensions, and also I will look into the power relations between actors and how the dynamics shape the implementation of GI. This is how I conceptualise the second sub-question: *"How do professionals operate in the face of predicaments to overcome the difficulties and deliver GI projects?".* To address this sub-question, I will further introduce the concept of 'phronesis' in Chapter 6 to emphasise that professionals' situated strategic wisdom is critical in enabling them to overcome barriers, laying the foundation for exploring the key role of learning in relation to 'phronesis' and resilience. I will also investigate literature about how the 'guanxi' networks influence socio-technical transitions in Chinese society, underlining how the different social and political contexts impact professionals' actions.

As aforementioned, the MLP provides a structured roadmap for breaking down the process of a transition. I will take into account the characteristics of niche and regime levels as a guide when investigating the complex dynamics within the multi-layered and multi-actor socio-technical systems in which GI is implemented. I do not intend to examine the learning at a certain level as the MLP would suggest, because I think that in practice the boundaries are often blurred between the levels in the transitions to GI. For example, some actors work at the regime level as incumbents but simultaneously want to push for radical changes at the niche level, which I further elaborate in the case of a "sponge city" pioneer called Kongjian Yu in chapter 4. Instead of highlighting the

distinctions of the different levels, I place my focus on the professionals themselves and investigate how they perceive and respond to challenges. In doing so, I aim to find out how they demonstrate learning in their dealing with GI, and how the learning outcomes shape the socio-ecological transition and impact flood resilience. Through investigating the learning by the professionals who can be at both niche and regime levels, I contribute to filling the gap that learning by the incumbents is currently understudied, and showcase that the boundaries between niches and regimes are in fact blurred.

This section on learning enables me to conceptualise the last sub-question: *"What is (not) learnt in the process of delivering GI projects, and how do the learning outcomes impact overall resilience?".* I will further explore literature in Chapter 7 on different types of learning, including learning triggered by flood experience, learning by doing, and learning through the interactions of actors, to allow for a detailed analysis of learning by the professionals.

The last sub-question is formed on the foundations of the previous two questions – after finding out professionals' viewpoints on the challenges and their actions to address the hurdles, I now turn the focus onto the central element of this research study. As I have argued, learning is of paramount importance in evolutionary resilience, and it is also a key catalyst for the socio-technical transition. This question aims to show that learning is the bridge linking flood resilience to a transition represented by GI. In doing so, I contribute to the lack of literature about actors' learning in transitions studies.

### 2.8 Chapter conclusions

This chapter started with reviewing the many conceptualisations of resilience. There are three prominent strands of resilience thinking that differ greatly when it comes to studying urban systems. The engineering and ecological perspectives of resilience both believe that urban systems after being disrupted can bounce to and remain at an equilibrium. Such views are criticised for normalising the idea of equilibrium and overlooking the complexities of an urban system that is dynamic and volatile. This is why I argue that a more suitable way for studying urban systems is evolutionary resilience, because it acknowledges the complex nature of an urban system and sees resilience as a dynamic process with constant adaptation and transformation instead of seeking an

equilibrium, placing the ability to learn and evolve at the centre of this conceptualisation. From the evolutionary point of view, to enhance resilience necessitates learning and knowledge sharing among actors to ensure the continuous adaptation to the dynamics and volatility inherent to complex systems. Hence, studying flood resilience in an urban system calls for evolutionary thinking with a focus on reflexivity, learning, and knowledge circulation. Although there is no universally accepted definition, I chose some common attributes for describing flood resilience in this thesis: robustness, preparedness, adaptability, and transformability, with the latter three being the particular focus of evolutionary resilience.

After the investigation of resilience thinking, I then introduced Green Infrastructure that is promoted as a novel approach to enhancing cities' resilience to floods. Green Infrastructure mimics the natural drainage functions in the forms of green roofs, swales, rain gardens, porous pavement. GI aims to retain, absorb, and attenuate water at the source, alleviating pressure on the existing grey infrastructure and offering flexibility and adaptability. In particular, I examined the different contexts of England and China in adopting and applying GI. The challenges facing GI projects in the two countries usually derive from the distinct political and social contexts, but what is largely missing in the literature is how these challenges play out in practice from the lens of professionals involved in the process. This gap enables me to form the first sub-question, which is to see what challenges are facing the professionals in the two countries.

I also reviewed transitions studies in order to provide a different perspective to scrutinise the impact of applying GI, as I argue that the implementation of GI policies and projects represents a socio-technical transition. Some important concepts, such as inertia and lock-in mechanism, emerge from the MLP – a widely employed framework. Although I believe these concepts will be of help in the data analysis chapters, the MLP itself overlooks the power dynamics of actors in the socio-technical systems and lacks explanation about the agency of these actors in pushing for a transition. On the basis of transitions literature, I propose the second sub-question about how professionals operate in the face of predicaments to overcome the difficulties and deliver GI projects.

I then focused on the transitions literature about learning and found that learning is the core element in both evolutionary resilience and the socio-technical transition in relation to GI, and hence I argued that learning is the bridging concept connecting the two bodies of knowledge together in the context of GI policies and projects. The gaps in literature related to learning stimulate me to find out what the professionals learnt in the process and how their learning outcomes manifest in changed mindsets or behaviours. Thus, the last research question – what is (not) learnt in the process of delivering such projects, and how do the learning outcomes impact overall resilience? – will be answered.

# Chapter 3 Research Methodologies

## 3.1 Introduction

This chapter first introduces the research strategies, my positionality as the researcher and how it influences me to undertake this study, before detailing the methods for data collection and participant selection, and methods for data analysis.

The overriding research aim is to examine how Green Infrastructure is implemented to embody the concept of resilience in flood risk management. There are three sub-questions:

- *What are the challenges facing professionals in the process of implementing GI projects in the two countries?*
- *How do professionals operate in the face of predicaments to overcome the difficulties and deliver GI projects?*
- *What is (not) learnt in the process of delivering GI projects, and how do the learning outcomes impact overall resilience?*

Guided by the research aim and specific research questions, this chapter introduces the theoretical and methodological frameworks upon which the study is built. After a brief discussion of the philosophical underpinnings, the chapter examines the methods selected to collect and analyse the empirical data and provides justifications for these chosen methods.

## 3.2 Research Strategies

First and foremost, the research design depends on the nature of the research questions, including epistemological and ontological considerations. Since the research I am conducting is focused upon people's understandings of the situations they are in, their perceptions of flood resilience practices, as well as their experiences in relation to Green Infrastructure, I believe this research study is interpretivist (Sandberg, 2005; Lin, 1998). So the actions and perceptions of professionals involved in the research will be interpreted subjectively – as Bryman (2008) explains, interpretivism understands "the

social world through an examination of the interpretation of that world by its participants" (p.366).

A central issue of ontology is "whether social entities can and should be considered objective entities that have a reality external to social actors, or whether they can and should be considered social constructions built up from the perceptions and actions of social actors" (Bryman, 2008, p.18). This research study is constructionist, because I believe that the perceptions and actions of social actors involved are shaping how they see the world around them, and it is the professionals' views that I seek to understand rather than standalone 'facts' about Green Infrastructure (Mills, Bonner and Francis, 2006; Esin, Fathi and Squire, 2014). Every individual's experience contributes to their understanding of social entities, and thus, in this study, I intend to explore the meaning-making process of the participants involved. As Bryman (2008) puts it, "social properties are outcomes of the interactions between individuals, rather than phenomena 'out there' and separate from those involved in its construction" (p.366). I believe there is no single 'truth' to what my research intends to find out, as the knowledge produced is the accumulation of each participant's account, which undoubtedly will be diverse and even contradictory. To side with one 'correct' answer inevitably means conforming to the dominating discourse and overlooking the intricate and interconnected power dynamics that shape professionals' viewpoints. It is the underlying power relations that stimulate me to conduct the research, after all.

After clarifying the epistemological and ontological position, it becomes clear that an inductive, qualitative study is what is needed to answer the specific research questions. An inductive approach focuses on theory generation rather than theory testing, with theory being the outcome of research, and "the process of induction involves drawing generalisable inferences out of observations" (Bryman, 2008, p.11). This study is inherently qualitative because it is concerned with elucidating social actors' views and experiences and analysing their remarks. As Gibson and Brown (2009) put it, qualitative research is intended for analysing how humans understand, experience, interpret and produce the social world. Denzin and Lincoln (2011) mention a number of attributes of qualitative research, including capturing individuals' viewpoints and securing rich

descriptions of the issue in question, all of which align with what this research strives to achieve.

Qualitative studies allow researchers to bring in their own insights and lived experience to shape the data collection and analysis, making qualitative research primarily interpretive, contingent, and grounded in individuals' lived experiences (Marshall, Rossman, 2014; Khan, MacEachen, 2021). This is the strength of qualitative research – discerning the social world and reality is a meaning-making process after all (Nowell et al., 2017). In this qualitative research, with my previous experience and gained knowledge of flood risk management, I will be able to explore in detail the perspectives of those involved and gain a deeper understanding of the perceptions and experiences of people (Merriam, 2009). Moreover, the qualitative research paradigm rejects a fixed and pre-determined social reality and regards notions of reality, together with knowledge, meanings, society, as contingent, dynamic, and socio-culturally constructed (Yilmaz, 2013; Khan, MacEachen, 2021), in line with the interpretivist and constructionist stance I set out earlier.

### 3.3 Author's Positionality

As this research study is interpretivist and constructivist, it is crucial for me as the researcher to be reflexive and to evaluate my own interpretation and construction of the data, so as to understand where I am situated in the power relations in the data collection, and how the dynamics between me and interviewees may influence knowledge production (D'silva, et al. 2016; Alvesson and Skoldbery, 2009; Sultana, 2007).

To be reflexive requires me to consider my positionality because "one's position within the social world influences the way in which you see it" (Temple and Young, 2004; p.164). Therefore, in the following section I consider my upbringing, level of education, ethnicity, personal values and experiences that may influence what data I choose to analyse and how I am able to interpret the data (Schiffer 2020; Berger, 2015).

I formed this research study on the basis of my previous study and work experience in the water engineering industry in China. I gained my bachelor's degree in water resources and hydropower engineering from a Chinese university, and afterwards I

worked as an engineer specialising in the design and construction of hydro-projects, e.g. dams, levees, to address water-related problems, especially floods.

During my undergraduate years (2012-2016), the novel term “sponge city” emerged as a buzzword in the field as the Chinese government looked for new approaches to addressing surface water flooding that blighted many major cities. My work experience enabled me to gain some knowledge of Sponge City Programmes (SCPs) – which had been promoted by the central government – from an engineering point of view, but I was left curious about the delivery and the subsequent impact of such projects on communities and flood risk management as a whole. Also, through interacting with colleagues at that time, I found that those who had delivered GI projects in the name of SCPs tended to give mixed feedback about the benefits of such projects. The professionals, with their expertise and experience, offered rare insights into some problems and challenges in the process that were inherent to the political and social context of China. Such conversations made me even more curious about whether SCPs were able to realise any of the intended benefits as the state propaganda claimed. Therefore, I decided to embark on this research study to specifically examine professionals’ viewpoints, because their professionalism and work experience can provide them with insights into the implementation of GI that are not known to lay people.

In addition, my upbringing made me aware of how authorities’ policymaking could cause the suffering of ordinary people and gave me a particular interest in social justice. I was born and grew up in Guizhou Province, one of the most deprived regions in China, and hence I witnessed and experienced the negative yet long-lasting impact of poverty and social injustice. Such an upbringing empowered me to question political motivations behind state policies and state-sponsored programmes such as SCPs, and to critically evaluate the official discourse about flood risk and GI. In particular, I cared about the controversies surrounding the delivery of SCPs in China, and I sympathised with people who still suffered flooding events despite the investment in SCPs. The inconsistency between the official endorsement and promotion of SCPs and my old work colleagues’ criticism of the programmes stimulated me to look into the politics and power dynamics between different actors.

Meanwhile, through incorporating the perspectives of professionals in England, I was able to examine GI projects that were implemented in a vastly different social and political environment, allowing for a deeper understanding of the barriers to the implementation of GI, how the professionals overcome the challenges, and how they operate to enhance flood resilience. I had come to believe that an investigation of GI in the two countries through a social science lens could generate intriguing findings.

Moreover, I was aware that positionality is not static but contingent on the basis of who I engage with (Schiffer, 2020; Ateljevic et al., 2005). In the investigation of the viewpoints of participants from the two countries, I remained actively reflexive – "engaging in the dynamic, continual, and fluid practice of interrogating" my positionality (Soedirgo, Glas, 2020; p.530). The active reflexivity aligns with the interpretivist and constructivist nature of the research, where my awareness of power dynamics and my interpretation of data are key to generating findings. In the following sections, there are further discussions where relevant about how my positionality influences the way I collected and analysed the data – for example, I collected documents with a focus on the controversies of SCPs in China and applied Foucauldian discourse analysis to examine the power/knowledge dynamics in these documents.

### 3.4 Data Collection Methods

The selected qualitative approach requires qualitative data for addressing the research questions. Specifically, I am seeking to explore the discourse of flood resilience, as accentuated in documents and understood by professionals, in order to examine the experiences of respondents in relation to flooding and delivering GI projects. With this aim in mind, I originally wanted to conduct fieldwork in several GI projects in China and England and use these projects as case studies to gain greater insights into how professionals work to overcome challenges and deliver projects. Ethnography and focus groups were the possible options for data collection. However, as a result of COVID-19 lockdowns, face-to-face contact and international travel were no longer viable. Faced with immense uncertainty, I decided to do what I could at the time: I chose to conduct in-depth interviews with respondents through Microsoft Teams as a means to collect the data I needed.

However, I encountered problems when it came to contacting Chinese respondents, as many of them were reluctant to take part in online video calls while being recorded, and those who agreed to participate only answered selective questions. A few of the Chinese participants were in senior posts, the power hierarchy in China's context means that they tended to dominate the interview process: often giving short answers and shutting down follow-up questions – similar phenomena have been observed by other researchers as well (Liu, 2018; Li, Harvey and Beaverstock, 2023). As a PhD student, I found it very difficult to ask for more details about the information they shared. Faced with the shortage of information from China, I then focused on collecting online documents about SCPs to acquire more data to complement the limited number of interviews. Such documents comprise official documents, e.g. government policy papers, and mass media outputs, e.g. press coverage of GI projects.

The diverse sources of data means that the data analysis chapters (chapter 4 -7) draw from different sets of data to answer the research questions. For example, in Chapter 4 which examines the challenges facing professionals in China, I lean more towards the documents collected online; whilst for Chapter 5 that explores professionals' views in the English context, I primarily draw the details from interview respondents.

### 3.4.1 Interviews

Interviews are employed as the primary means for gathering qualitative data for the research – I interviewed participants from both countries. In qualitative research, interviews are common because they enable researchers to collect a diversity of meaning, opinion, and experiences, and provide insights into not only the contrasting views but consensus amongst interviewees (Dunn, 2016, p.150).

Qualitative interviews are often categorised into structured, unstructured, and semi-structured. Forming a continuum, on one end is structured interviews that consist of fixed questions; on the other is unstructured ones that offer complete flexibility without pre-determined questions; whereas semi-structured interviews are in the middle (O'Reilly, 2012).

Before designing the interviews for this research study, I read a wide range of research papers to gain an understanding of how to conceive interview questions in relation to research goals and how to generate rich empirical data about resilience. Wyman, et al. (1992) employ qualitative interviews with children to understand the impact of major life stress on individual resilience. The in-depth interviews allow them to uncover multiple attributes that contribute to children's resilience to stress, e.g. caregiving environments, peer relationships, and positive expectations for their futures. The interviews are designed to be semi-structured, with "open-ended items for their idiographic richness and objective items for their psychometric precision" (p. 906). With the rich data collected from interviews, they are able to identify and evaluate the impact of some complex and interconnected factors, such as family relationships and discipline practices, peer relationships and activities, and behavioural styles.

Buikstra, et al. (2010) also adopt interviews as part of a participatory approach to understand community and individual resilience in rural Australia. Semi-structured interviews are used to explore participants' conceptions of resilience and to identify specific components of community and individual resilience. Forster and Duchek (2017) likewise apply semi-structured interviews to discern individual, situational and behavioural factors that have implications on the resilience of leaders from various sectors. Such an approach offers the researchers enough flexibility to open up the conversations and let participants be the storytellers, allowing for exploring new knowledge. Still, the same interview guidelines comprising core themes are used in each interview to cover the relevant aspects and ensure the comparability of different interviews. To investigate how context, relationships, and support influence young people's resilience in relation to employment, Giroletti and Paterson-Young (2023) utilise semi-structured interviews to engage with young people so as to understand a myriad of contextual and social factors, collecting rich and extensive data thanks to the effective engagement.

The extensive readings helped me to decide that semi-structured interviews were needed for this study because I intended to have a set of standardised questions asked so as to set the conversation on the right track, and to acquire essential information that deepens my understanding of respondents' situations. Additionally, semi-structured

interviews provided the flexibility I needed to tailor my questions or ask follow-up questions according to each participant's response (Forster, Duchek, 2017). An interview guide was used to include the types of questions that were of importance to the research, but fully worded questions were formed only during the interviews, as I played the role that allows for the free flow of conversation and only intervenes when the conversation was too far off the topic (Dunn, 2016; Forster, Duchek, 2017).

*3.4.1.1 Positionality in data collection*

My connections with people who work in the water engineering industry gave me easier access to experienced professionals, and my Chinese identity and professional background helped me to build mutual understanding with the participants. Nevertheless, as I mentioned above, interviewing participants in China who hold senior positions was difficult because the power hierarchy meant that they could easily shut down my questions or give very brief answers without sharing details. However, despite this asymmetry of power, my understanding of the hierarchical culture in work environments meant that I knew the most suitable approach to conduct the interview: firstly by addressing them formally with work titles (e.g. senior engineer, manager), and giving them compliments by acknowledging their status and experience, before starting to ask questions. In doing so, I utilised my "insider" identity to smooth the process and make the participants feel more at ease, so that they could speak to me in a more candid manner. This "insider" identity allowed me to tailor questions to suit the participants' professional status, to make judgements on how to frame a question better, to know the boundaries of what questions should be avoided due to political sensitivity (Yip, 2023; Merriam, et al. 2001). Overall, my identity made it easier for me to build rapport with the respondents, in spite of the power hierarchy, and enabled me to collect some useful information that would be difficult to gather for those who were not in my position (Yip, 2023; Merriam, et al. 2001).

Nevertheless, as aforementioned, my positionality is not static but fluid and contingent on the context (Thomson and Gunter, 2010; Soedirgo, Glas, 2020). When interviewing participants in England, it was more challenging because I was less familiar with the best way to approach participants and gain their trust. In this case, because of my Chinese

identity, professionals in England were likely to regard me as an “outsider”, which might be an obstacle for me to build rapport with them (Chavez, 2015; Merriam, et al. 2001). However, interacting with participants in England was also less hierarchical and less formal, which allowed me to make small talk with participants to smooth the process in spite of my “outsider” positionality. Being an “outsider” also has its advantages: the participants did not see me as aligned with any particular interest groups and were patient and willing to share many details (Merriam, et al. 2001). Moreover, I was able to bring in my knowledge about SCPs in China to facilitate more engaging conversations with participants when needed, which allowed me to ask more pertinent follow-up questions and stimulated the participants to share more information. In that sense, my positionality shifted closer to an “insider” when utilising my professional knowledge, and this shift benefited me in acquiring data. The fluid and contingent positionality (both “outsider” and “insider”) allowed me to notice things in the English context that might be taken for granted by insiders (Yip, 2023; Merriam, et al. 2001). For example, when comparing to the social and political context of China, looking into projects in England enabled me to critically evaluate the strengths and weaknesses of democratic policymaking and how the English context shapes the implementation of GI.

The semi-structured interviews meant that I was more than an interviewer asking prepared questions; I also paid close attention to the details mentioned by the participants so that I could actively tailor my follow-up questions to both resonate with their remarks and connect back to the research focus. Throughout the interviews, I let each participant share what came to their mind without feeding back to them what other participants said. For example, when asking about the challenges facing professionals in the implementation of GI, I did not ask if they had encountered what I believed to be the common challenges, because that would be leading them to consider aspects that they might not have otherwise considered. The goal of the research interview was not to verify how prevalent one challenge was, but to acquire a wide range of challenges to allow for an analysis of the two different social and political environments.

Overall, my professional knowledge and previous work experience in the field made it easier for me to respond to or interact with the information shared by the participants.

In cases where their experiences resonated with mine, I shared my experience so as to build the connection with participants; in cases where the information they shared was out of my expectation or my understanding, I was able to quickly formulate follow-up questions about the reasons behind the discrepancy.

*3.4.1.2 Participant Selection*

When it comes to looking for participants in China, a combination of convenience and snowball sampling is used. My previous work experience helped me to approach a few professionals in the field, and through them, I was introduced to a few more respondents. All five of the participants work for state-owned enterprises (as most infrastructure-related enterprises are state-owned in China). As is shown in Table 3.1, all the participants have been in their current jobs for some time, with work experience ranging from 6 years to more than 30 years.

All five participants' jobs are based in big cities in different regions of China: their work involves conducting GI projects in big urban areas, and such projects are usually part of the national SCPs that are funded by the central government. The interviews of the participants were conducted during a six-month period between December 2021 and May 2022, and the interviews lasted from around 20 minutes to almost 70 minutes. The language used for the interviews was Mandarin Chinese – the common language used in formal settings – and the interview recordings were transcribed before being translated into English. This process required great effort from me as the translator to ensure that I could best capture the delicate differences in choice of words in the two languages and also convey the accurate meanings of what was said.

The following table shows basic information about the five participants, with their names and employers anonymised.

| Participant | Profession | Background Information |
|---|---|---|
| 1 | Urban Planner | Based in a megacity (population over 10 million); more than 20 years of work experience; holding a senior position |
| 2 | Landscape Architect | More than 30 years of experience across China; holding a senior position |

| | | |
|---|---|---|
| 3 | Water Engineer | A decade of work experience; undertaking a dozen of government-funded projects |
| 4 | Urban Planner | Based in a megacity; in the post for 6 years |
| 5 | Landscape Architect | Based in a megacity; around 10 years of work experience; holding a senior position |

Table 3.1 Information about the interview participants from China

In England, participants of the research interview primarily came from purposive sampling – I first identified some institutions and organisations that have delivered GI projects, then sent out interview requests via emails, explaining what my research was about and inviting those who were involved in delivering GI or had good knowledge of GI to participate. Snowball sampling was also used after the first few successful interviews – asking the participants to forward my interview requests to the key stakeholders whom they have worked with in implementing GI projects.

Participants in this research study are mainly based in the north of England, although some have had work experience in different cities across the UK. Some relevant background information is listed in Table 3.2 below. The interviews were conducted from February 2022 to June 2022, with them lasting from 30 minutes to around 60 minutes.

Again, to preserve anonymity as agreed before interviews, the participants, together with the organisations and institutions for which they work, are not named, but the professions of the ten respondents in England are as follows:

| Participant | Profession | Background Information |
|---|---|---|
| A | Urban Planner | Worked in different cities across the UK for more than 12 years |
| B | Community Engagement Lead | Based in a big city in the north of England; working on various GI projects for 5 years |
| C | Project Manager | Involved in GI projects for around 3 years |
| D | City Councillor | Based in a small city (population under 100,000); Involved in around 10 GI projects as a councillor |
| E | Civil Engineer | Involved in dozens of projects in the north; more than 30 years of work experience |
| F | Architect | Based in the north of England; over 20 years of experience |

| | | |
|---|---|---|
| G | Water Engineer | Worked on dozens of projects across the north of England |
| H | Flood Resilience Specialist | Based in the north of England; specialising in designing flood resilience strategies |
| J | Urban Planner | Worked on more than 100 GI projects in different cities across the UK |
| K | Project Manager | Based in a big city in the north of England; around 10 years of work experience |

Table 3.2 Information about the interview participants from England

*3.4.1.3 Discussions of the social construction of participants*

From the participants' responses in the interviews, it is clear that the different social constructions of the two countries can leave an impact on how they think and behave.

For participants in China, as they operate in state-owned enterprises that are under the control and influence of the authoritarian government, they are understandably very cautious about what they can or should say on record. Additionally, the fierce geopolitical rivalry between China and the West adds another layer of uncertainty as well as risk, as talking to researchers like me who are based in the West could be interpreted as a potential risk to national security (Scobell, 2018; Bahi, 2021; Perthes, 2021). Moreover, even though my research about GI projects poses no risk to national security, the ubiquitous government surveillance in China deters people from showing disapproval or being critical of government policies (Qiang, 2019; Huang and Tsai, 2022). Consequently, people whom I approached were hesitant about agreeing to be interviewed online and recorded. As for those who did take part, I observed that there was a high level of caution in terms of what information they could share about the GI projects and what kind of comments they could make about SCPs. This self-censorship resonates with Foucault's arguments about power, which is further discussed in the sections below. According to Foucault, power produces discursive practices and knowledge that compel people to fit into social norms and discipline people to behave and think in a certain way (Khan, MacEachen, 2021; Arribas-Ayllon, Walkerdine, 2017).

In contrast, the society in the UK as a whole is underpinned by the rule of law and free speech, which means the participants are more open and free to share whatever

opinions they may have about GI projects or the authorities (Gherghina and Geissel, 2020; Wilks-Heeg, 2012). It is less likely that participants would fear repercussions when they make critical comments or share negative information. Moreover, involving citizens in policymaking process is relatively common in England, where lay people can engage with the authorities to shape the policies (Huxley, et al. 2016; Davidson and Elstub, 2014). Hence, in the interviews multiple participants mention their experience of engaging the public or how they organise local flood groups to speak up for their communities' interests. These differences derived from differing political and social environments make it intriguing to explore how the participants from two countries operate in the face of predicaments.

### 3.4.2 Collection of documents

Documents about SCPs in China were collected to complement the shortage of information coming from Chinese respondents. I considered two types of documents. The first category consists of official documents from the state and various authorities that are publicly available, while the second category consists of press coverage of GI projects and media interviews with prominent figures in the field.

The first type of documents – official publications from the state and other authorities about SCPs – consists of the policy and guidance for SCPs, design methods, assessment regulations, showing what SCPs mean to the state from a top-down perspective, and how the programmes are beneficial to the authorities in terms of achieving the goals.

Documents were collected through 1) Google keyword searches, e.g. Sponge City Programmes policy (in Chinese); 2) keyword searches on the Chinese government website (www.gov.cn, in Chinese). As SCPs have been in place for around a decade, there is a wide range of government publications and policy guides online. I collected those policy guides coming from the central government, the Ministry of Housing and Urban-Rural Development (MHURD); I also collected various media reports of SCPs from important state-owned media such as People's Daily and China Daily because they promote the values of the ruling party and reflect the direction of travel for policies (Jin, 2023; Wu, 1994). I collected a total of 21 documents for later analysis, with a full list of the documents included in Appendix III.

As Bryman (2008) mentions, the state produces a great deal of textual material that can be of importance for studies like my research. I collected documents that demonstrate not just the policies but also the social, economic, and political factors that shape the discourse of SCPs and flood risk management. Examining these official documents allowed me to demonstrate how SCPs is framed in the official discourse, how these projects help legitimise the communist party's rule and justify their environmental policies. I was aware that the authoritarian nature of the government means that such publications can be biased – promoting so-called advantages but ignoring the potential pitfalls and downplaying the difficulties, and I was therefore cautious when collecting or reading through the documents. In fact, when applying suitable approaches to examining the data, such biases revealed in the documents make the documents intriguing and conducive to my research.

The second type of documents comes from the mass media, so that I could scrutinise the discourse of flood resilience and GI as reported in news articles, magazines, and online forums. Because of my previous knowledge in the field, I had heard of a high-profile professional called Kongjian Yu whose name is frequently associated with SCPs. As one of the key pioneers that have been promoting the concept of "sponge city" in China, his projects and philosophies have been widely covered by both domestic and international media. Considering the weight of Yu in influencing the discourse of flood risk and "sponge city", I decided to include press coverage about Yu as a critical part of the search.

Documents were collected through Google keyword searches, e.g. Sponge City, Kongjian Yu (in both Chinese and English), with the aim to capture as much press coverage as possible in both languages. I gathered documents in both languages in order to bring in new perspectives to contrast the official discourse and the potential biases that come from the Chinese government and state-owned media. In doing so, I could critically examine GI projects as well as the political and social context in which such projects are implemented. Moreover, Kongjian Yu is a well-known figurehead in the field with a global reputation (more analysis in Chapter 4). Examining his interviews with both domestic and international media allowed me to look into the power dynamics embedded in the

implementation and promotion of SCPs, shedding light on the difficulties facing GI in an authoritarian policymaking environment.

There is a wide range of media coverage about SCPs in China due to the scale and scope of the programmes. Despite the central government's tight control over press freedom, certain issues that are less politically sensitive, such as infrastructure projects, are covered by independent and/or social media (Zhang, 2022; Yang and Tang, 2018). For this purpose, I selected documents also from independent media, e.g. Caixin (财新), that critically report on controversies about the programmes and failures of local authorities in handling flood risk. I also focused on media interviews with Kongjian Yu, in which he articulates his philosophies systematically or makes well-known arguments that are widely cited by others. Overall, there are 19 documents collected from independent media. As these documents are written in Chinese, again I carried out careful translation to ensure that I accurately conveyed what was said and took into account the subtlety in word choices and emotions. With these documents, I hope to examine the hotly debated issues about SCPs and the views of professionals revealed in their interviews.

As aforementioned, Kongjian Yu is a figurehead in promoting the "sponge city" concept, which has been recognised by international media. There are plenty of media reports about Yu written in English, I mainly gathered these from world-renowned news outlets, e.g. BBC, CNN, The Guardian, for their influence and their reach to audiences around the globe, and from respected media in the field of architecture, science and technology, such as MIT Technology Review, for their influence within the specific fields and their targeted audience. In total, I collected 30 documents in English from international media. A full list of both Chinese and English documents can be found in the Appendix.

### 3.5 Data Analysis Strategies

The data collected from both documents and interviews amount to a large corpus of unstructured textual material, which, on the one hand, shows the richness of the data but on the other makes it difficult to analyse. Meanwhile, there is a discrepancy between the data collected from England and China. As stated before, the COVID-19 pandemic made a considerable impact on how I could conduct the research and what data could

be collected. For the data from China, documents gathered constitute around 80 per cent of total data, while the interviews with a few professionals account for the remaining 20 per cent. In contrast, the data in England almost completely come from interviews with respondents. To address the difference in the types of data, I therefore chose two separate approaches. Primarily, the explorative nature of the research means that there is no pre-established framework for data analysis, for which situation a grounded theory approach is often deemed suitable in the qualitative research paradigm (Seaton, Schiwer, 2014). Hence, I applied grounded theory to scrutinise the data coming from interviews of professionals in both countries, coding the texts whilst I read through the interview transcripts; whereas for the documents gathered from online sources, I employed Foucauldian discourse analysis for the interrogation of the text.

While I conducted data analysis, I reflected on how my positionality might influence the way I interpreted the data. As aforementioned, my upbringing and professional experience made me more aware of the politics and power dynamics embedded within the state-endorsed projects and how such projects may impact ordinary people's lives. For example, when analysing the data, I was particularly attuned to state propaganda, so I critically questioned the discourse of promoting SCPs in China as the justified alternative to addressing flood risk (further discussions are in Chapter 4). Also, I paid close attention to the potential problems in both countries that may inhibit GI projects from achieving the benefits, because I wanted to find out how well GI projects can protect people from flood risk, especially in comparison to traditional schemes.

Meanwhile, I had also witnessed the impressive economic growth and enormous social change that China has gone through in the last three decades, and understood how the general public has also benefited from the national development. Therefore, I was aware that the authoritarian governance was not just "bad", as there are more nuances to policymaking. Consequently, in data analysis, rather than being simply critical of SCPs, I kept an open mind to considering how professionals' positionalities might have influenced the stance they took, and the difficult roles they played between endorsing the official discourse, placating the public, as well as defending their own interests.

My understanding of the Chinese context also helped me interpret the data coming from England because of the contrast. Taking an outsider perspective, I was able to notice the nuances as a result of the political and social differences, and I was more attuned to how professionals operate in the face of challenges, and how the way they speak or behave is closely related to the social constructions that I examined earlier.

### 3.5.1 Grounded theory

Strauss and Corbin (1998) state that grounded theory "was derived from data, systematically gathered and analyzed through the research process", in which "data collection, analysis, and eventual theory stand in close relationship to one another" (cited in Bryman, 2008 p.541). Grounded theory is not a theory but an approach, a strategy for generating theory out of data (Charmaz, 2006; Bryman, 2008).

Grounded theory is frequently used as an approach to analyse data in social science that examines people's viewpoints and perceptions through interviews (Boon, 2014). Ahangama and Prasanna (2021) explore the dynamics of knowledge transfer among respondents who experience flooding events, applying grounded theory to seek the connection between knowledge transfer practices and the impact such practices have on the resilience of social actors. In their research, grounded theory facilitates open coding and then selective coding, enabling the researchers to break down the transcripts into meaningful sections and conduct constant comparison till new concepts and theories emerge. Brockie and Miller (2017) also utilise grounded theory to look into how social and flood experience facilitate resilience in older people. By repeatedly scrutinising the interview transcripts, they conduct inductive line-by-line coding with a focus on the interviewees' discussions and understandings of resilience, and then review the coding scheme and categories multiple times until a comprehensive and stabilised picture emerges.

In data analysis, grounded theory is often used to facilitate coding to distil qualitative data and to identify themes (McEwen, et al., 2017). Coding in grounded theory is a process of breaking down transcripts into component parts that are of potential significance to the research and giving labels to them (Cope, 2016; Bryman, 2008). Charmaz (2000) explains that "we grounded theorists code our emerging data as we

collect it… Unlike quantitative research that requires data to fit into pre-conceived standardised codes, the researcher's interpretations of data shape his or her emergent codes in grounded theory" (p. 515). Coding often entails constant comparison and revision to indicate emerging concepts and reflect the relations between labels and research aims (Charmaz, 2000; Bryman, 2008; Ahangama, Prasanna, 2021).

In this research study, I drew on grounded theory to analyse the data from interviews: instead of having a pre-determined theoretical framework, I searched for the details and took into account any seemingly relevant information as it emerged. As illustrated in Figure 3.1 below, grounded theory guided the data analysis through three stages of coding (Martland, et al. 2015; Sbaraini, et al. 2011; Cho and Lee, 2014).

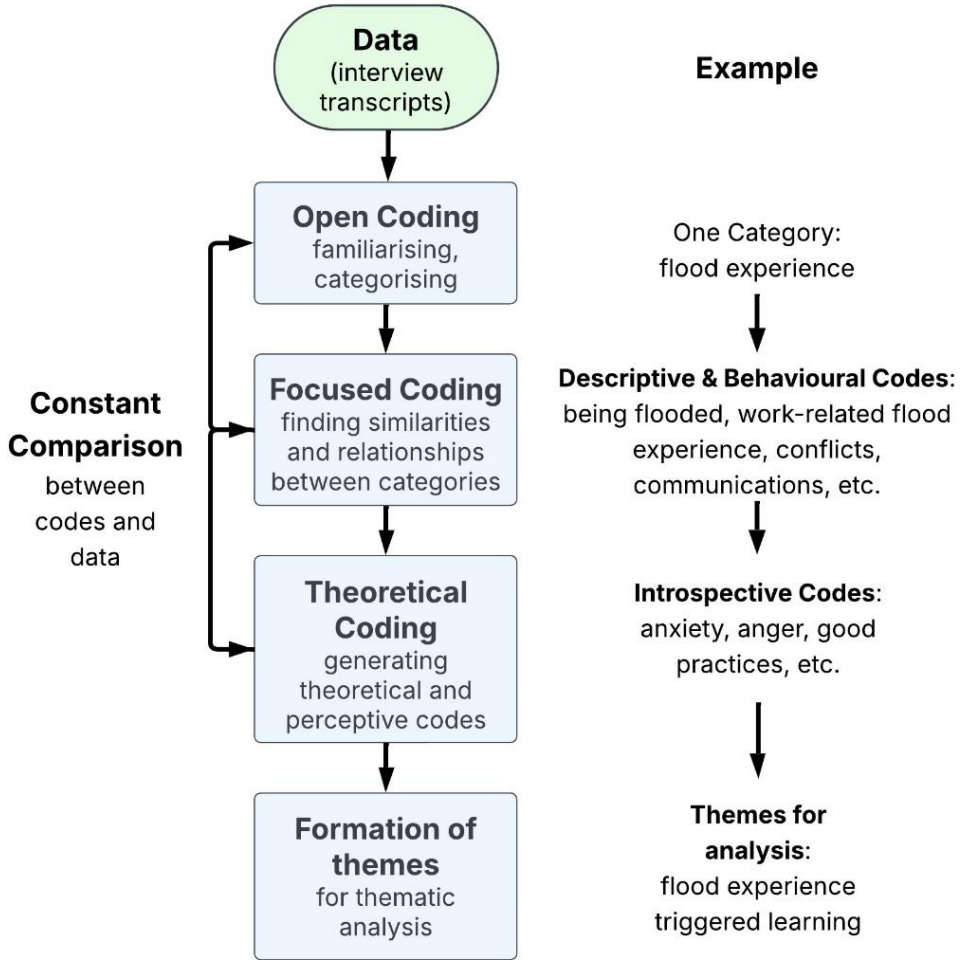


Figure 3.1 The process of conducting data analysis using grounded theory

First, in order to familiarise myself with and extract relevant information from the interview transcripts, I conducted open coding via reading through the entire interview transcripts with an open mind and breaking them down into large segments of data according to emerging categories (Martland, et al. 2015; Sbaraini, et al. 2011). Therefore, I identified many categories, such as participants' remarks about floods, Green Infrastructure and stakeholder interactions. However, the initial coding only broadly categorised participants' answers and a large amount of data was already generated after coding the first few transcripts. For example, regarding the question "can you talk about the work you did in addressing flood risk?", there was a wide range of responses as a result of the participants' differing backgrounds. I noted some participants mentioned their personal experience of flooding events so I gave this category a code "flood experience". Originally, this code did not seem important because it did not appear to be directly linked to my research focus on GI or flood resilience.

Then I entered the focused coding stage, where I further interrogated the different categories of data (Sbaraini, et al. 2011; Martland, et al. 2015). This is when I pursued a selected set of codes and discarded others, requiring me to make decisions about which codes were more prevalent and pertinent to my research focus. For those codes I decided to further examine, they were broken down into more detailed ones. In this process, I utilised the constant comparative method, a core principle of grounded theory, to examine different participants' accounts (Gurd, 2008; Sbaraini, et al. 2011; Cho and Lee, 2014). Through exploring the similarities and differences in the many categories across different transcripts, I noticed some patterns emerge. In the same example, the initial code "flood experience" showed up in multiple participants' transcripts, so I decided that it should be retained to form focused codes. Hence, I further broke down "flood experience" into two focused codes "being flooded" and "work-related flood experience", with the former referring to those who personally suffered from flooding and the latter comprising respondents whose work led them to deal with flooding events.

Through continuous comparison between transcripts, I gradually realised that participants' flood experience was more critical to the research study than I thought, because such experience can lead to tensions amongst stakeholders, and trigger the

respondents' reflections. After identifying the relationships, I created more focused codes such as "conflicts" and "communications".

So far, at the focused coding stage, I created descriptive and behavioural codes that involve when and where certain events (e.g. flooding, GI projects) took place, what the direct impacts were, and what interviewees' responses and actions were. Therefore I discerned the details of the events that were relevant to the research questions.

I then moved to theoretical coding on the basis of the focused coding. Once again I read through the transcripts with constant comparison, before I created introspective codes that are more perceptive and reflective, highlighting how participants believed certain incidents happened and their evaluation of their situations – those scenarios where one's perceptions, interpretations, and emotions were impacting their decision-making or shaping their subsequent actions. In the same example, by constantly comparing to the descriptive codes about flood experience, such as "being flooded", "conflicts", I distilled the emotions related to these codes, therefore I created codes including "anger", "anxiety" and "disappointment" to reflect the intangible impact of floods on the participants. Importantly, through comparing the codes and data, I was able to identify the learning undergone by the participants after experiencing flooding events, and formulated a theme called "flood experience triggered learning" that encompasses all the relevant codes from both focused and theoretical coding stages, enabling me to undertake thematic analysis later.

I employed ATLAS.ti software to facilitate the coding process: creating codes as I read through the text and assigning the codes to component parts. These codes were then thematically linked, grouped and centrally managed in the software. As aforementioned, coding was an iterative process, during which I constantly revisited the codes in the software to alter, merge or delete them according to emerging concepts (Urquhart, 2013; Glaser, Strauss, 2009). The following Table 3.3 briefly summarises some of the codes I created in the focused coding and theoretical coding stages.

| Code Types | Code Groups | Code examples |
|---|---|---|
| Descriptive & Behavioural Codes (Focused coding stage) | **Conditions** (interviewees' accounts of geographical and social context, individual circumstances) | • Flood history<br>• Being flooded<br>• Work-related flood experience<br>• Hydrological environment |
| | **Consequences** (their accounts of what caused their situations) | • Institutional (in)action<br>• Outcome of education and communication |
| | **Interactions among actors** (their accounts of interacting with other social actors) | • Collaborations<br>• Conflicts<br>• Community engagement<br>• Communications |
| | **Actions** (their accounts of responding to flooding) | • Enhancing preparedness<br>• Building grey infrastructure<br>• Resorting to Green Infrastructure<br>• Utilising local knowledge<br>• Raising awareness |
| Introspective Codes (Theoretical coding stage) | **Emotions** (their accounts of flood experience incurred emotions) | • Anger<br>• Anxiety<br>• Disappointment |
| | **Perceptions** (their accounts of resilience, good practices, and what should be done) | • Good practices<br>• Understandings of resilience<br>• Required actions |
| | **Reflections** (their accounts of what went wrong, what are the difficulties facing them, what is needed) | • Local knowledge<br>• Criticism<br>• Difficulties and challenges |
| | **Lessons Learnt** (changes in thinking and/or actions, what is done differently) | • Mistakes made<br>• Systems thinking<br>• (Non) resilient practices |

Table 3.3 A summary of two types of codes employed in the research

*3.5.1.1 Thematic Analysis*

Following the coding process, thematic analysis was used to examine the interview transcripts. The essence of thematic analysis is to draw from the multiple accounts and find common themes that resonate with the research questions.

Thematic analysis is a method for describing, organising, systematising, and analysing themes identified within the data, providing a structured, consistent and rigorous approach for qualitative data analysis (Braun, Clarke, 2006). Alongside grounded theory, thematic analysis is particularly helpful for my research because it helps to examine the perspectives of people in detail, especially the implicit commonalities and differences, producing rich, organised yet complex insights into research questions (Nowell, et al., 2017; Braun & Clarke, 2006; King, 2004).

Themes naturally emerge as a result of coding. Themes in this thesis have to reflect the connections between coded segments of text and the research questions. In this research, I conceptualised three main themes: challenges and difficulties facing Green Infrastructure (GI), the roles of learning agents in facilitating GI, and the learning outcomes identified. Each main theme consisted of multiple subthemes, aiming to bring in the details revealed by respondents in the transcripts.

| Theme: learning outcomes identified in respondents | | | | |
|---|---|---|---|---|
| | Enhanced Preparedness | Improved Adaptation | Transformation | … |
| Interviewee 1 | Related codes: **Good Practices, Local Knowledge** | | | |
| Interviewee 2 | | | Related codes: **System Thinking** | |
| Interviewee 3 | | Related codes: **Mistakes Made** | | |
| … | | | | |

Table 3.4 A presumptive example of thematic analysis

To conduct thematic analysis, first I created a table such as Table 3.4, a matrix showing the subthemes and each interviewee. Once categorised and grouped, I placed the relevant codes under each subtheme, and by clicking on the codes, the software ATLAS.ti was able to show all the text segments that were labelled under the same codes. Table 3.4 is only a presumptive example illustrating how each theme and its subthemes are organised to incorporate the coded components from each participant, which allows me to efficiently revisit the text segments and seek answers to research questions.

### 3.5.2 Foucauldian discourse analysis (FDA)

Foucauldian discourse analysis (FDA) is another method used to look specifically at the data from documents collected about SCPs in China. As aforementioned, the pandemic disrupted my original research plan for doing fieldwork in China and stopped me from meeting potential participants in person. Despite conducting a few interviews online, my access to more respondents was significantly restrained, and those who took part in online interviews were only willing to answer a limited number of questions. To complement the shortage of data from interviews, the primary source of data about SCPs in China comes from documents. Faced with a large corpus of textual materials, I decided to take a Foucauldian discourse analysis approach to examining the data.

Foucauldian discourse analysis is an interpretive approach "to identify the sets of ideas, or discourses, used to make sense of the world within particular social and temporal contexts" (Waitt, 2016, p.288). Foucault applied discourse analysis in his research to explain how some lines of thinking/being/doing are generally considered as the "truth", whereas others are silenced or marginalised (Hajer, Versteeg, 2005; Graham, 2011; Waitt, 2016). The basis of Foucauldian discourse analysis derives from Foucault's unique take on the rules that govern the possibility of true and false statements, which manifests the power/knowledge dynamics (Arribas-Ayllon, Walkerdine, 2017). In his own work, *The Archaeology of Knowledge and the Discourse on Language*, Foucault explains his view on discourse:

> "*I am supposing that in every society the production of discourse is at once controlled, selected, organized and redistributed according to a certain number of procedures,*

*whose role is to avert its powers and its dangers, to cope with chance event, to evade its ponderous, awesome materiality.*" (Foucault, 1972, p.216)

The production and reproduction of discourse constructs knowledge – a process that entails power relations because of what is (not) discussed and what is taken as common sense (Hajer and Versteeg, 2005; Arribas-Ayllon and Walkerdine, 2017). The established knowledge system will then shape people's practices and influence their thoughts, reinforcing beliefs in certain truths and overlooking other interpretations (Khan and MacEachen, 2021; Arribas-Ayllon and Walkerdine, 2017). In other words, discourse simultaneously produces and reproduces knowledge and power through what is possible to think/be/do (Waitt, 2016). Meanwhile, Foucault also argues that power is productive because it produces discursive practices and discursive knowledge that compel individuals to think and behave in a way that conforms to common sense truths – individuals are thus disciplined to fit into the expected social norms but also afforded new ways of acting that may not yet be effectively policed (Khan, MacEachen, 2021; Arribas-Ayllon, Walkerdine, 2017). Therefore, from a Foucauldian perspective, changing social entities and phenomena can be interpreted as shifts in the relative influence of various discourses, and FDA is illuminating in exploring specific policy-making processes as a result of wider discursive struggles (Sharp, Richardson, 2001). In the context of this study, the fast and large-scale implementations of SCPs in China symbolise a new set of ideas taking over in the domain of flood risk management. This shift in policymaking, as well as flood responses, may signal the changing power dynamics among competing discourses, rendering it necessary and intriguing to investigate the textual materials through an FDA lens.

In Foucault's conceptualisation, discourse is not about an instance of language use or a communicative exchange, "but a complex entity that extends into the realms of ideology, strategy, language and practice, and is shaped by the relations between power and knowledge" (Sharp, Richardson, 2001, p.195). Discourse in this sense is about rules, divisions, and knowledge systems (Arribas-Ayllon, Walkerdine, 2017), and thus competing discourses reflect the power struggles that shape the social world and influence individuals' perceptions (Sharp, Richardson, 2001). Hajer (1995) interprets Foucault's understanding of discourse as "a specific ensemble of ideas, concepts, and

categorizations that are produced, reproduced, and transformed in a particular set of practices through which meaning is given to physical and social realities" (cited in Sharp, Richardson, 2001, p.196).

In this research study, applying Foucauldian discourse analysis allows me to examine the complexity and plausibility of 'common sense' or 'truth' that emerged from the materials, so that I can interrogate why certain facts are taken as truth, and how particular knowledge of the world becomes normalised and hegemonic (Akdag, Swanson, 2018; Waitt, 2016). The documents collected are produced in a political environment where censorship is common and government propaganda dominates public discourse. With a Foucauldian perspective, I can problematise the normative discourse and seek the discrepancies between what is said and what is dismissed/silenced, to shed light on the implicit issues that may provide intricate details for addressing my research questions. By uncovering the cultural and social mechanisms that legitimise certain statements about the world, inequalities and injustices can be revealed by investigating how certain truths are sustained by dominant discourse (Khan, MacEachen, 2021; Akdag, Swanson, 2018; Waitt, 2016).

Foucauldian discourse analysis (FDA) can be applied to a wide range of "text", such as social practice, political discourse, expert discourse, and social interaction (Waitt, 2016; Arribas-Ayllon, Walkerdine, 2017). In this study, sources for such "text" comes from policy documents, official reports, public speeches of key figures, media interviews with key figures. FDA is not used to decipher the actual meaning of statements, but rather, to carefully explore what the constitutive or political influences such statements might cause (Foucault, 1972; Graham, 2011; Hajer, Versteeg, 2005). Particularly, among all the possible statements that can be made on a certain subject, why some emerge and are seen as carrying weight, but others are excluded (Foucault, 1972; Hajer, Versteeg, 2005; Waitt, 2016). Similarly, Khan and MacEachen (2021) highlight that it is critical to look at what statements and utterances are in circulation and what are excluded, the inclusion/exclusion process being where the power relationships lie.

There are no set rules or universal procedures for conducting Foucauldian discourse analysis, because Foucault himself is against substituting one 'truth' for another (Sharp,

Richardson, 2001; Hajer, Versteeg, 2005; Graham, 2011). Formalising a specific way of analysing discourse would imply there is a 'right' way and risks dismissing researchers' own approaches to interpreting different contexts (Arribas-Ayllon and Walkerdine, 2017; Sharp and Richardson, 2001). Graham (2011) emphasises that the essence of FDA is recognising that truth is contingent and subject to scrutiny, enabling researchers to question the legitimacy of what is deemed as 'truth'.

*3.5.2.1 Applying FDA in this research study*

As mentioned in the discussions about my positionality, I have a keen interest in exploring the politics behind policymaking and I want to critically examine the official discourse about SCPs and flood risk. Therefore, when collecting the documents from China, I focus on the controversies about SCPs and the conflicts between professionals, because utilising FDA to analyse such documents can reveal the intricate politics and power dynamics embedded in the promotion and implementation of SCPs.

To demonstrate how I conducted FDA in this study, I use the following excerpt from an online publication (in Chinese, here translated) as an example. Drawing inspiration from Rose (2001) and Waitt (2016), I used three primary steps to examine documents through the Foucauldian lens. A detailed analysis of the document can be found in Chapter 4.

> *"Since the pilot schemes of Sponge City started in 2015, the public have been having doubts about the construction of the projects. Some cannot feel the efficacy of the 'sponge' facilities, the reasons are threefold. Firstly, the public have overly high hopes of the benefits that can be delivered by Sponge City Programmes. They hope there is one approach that could solve all water-related problems once and for all, but in reality, the approach does not exist. Besides, when the idea of 'Sponge City' was initially propagated, the expected efficacy was exaggerated in some cases, which undoubtedly contributed to public misapprehension. Moreover, the general public's understanding of Sponge City Programmes is to some degree biased as well, as they think 'on-site runoff control' is what Sponge City is all about."* (She, Xie and Li, 2021)

1) Step One: I critically evaluated the social context of the source materials, including the authorship and the intended audience (Waitt, 2016). In particular, I focused on who

created the materials, when and why they were made, in order to position such materials against the specific political or social events (Rose, 2001; Waitt, 2016).

The excerpt has been taken from an article published online in the aftermath of a devastating flooding event in Henan Province in the summer of 2021. Around 15 million people suffered from the flooding and hundreds of lives were lost in the provincial capital Zhengzhou (BBC, 2021a; People's Daily, 2022). The severity of this flood shocked the nation and led to a rare public outcry about the local government's flood response and especially the efficacy of SCPs, because Zhengzhou was chosen by the central government as a pilot city to deliver large-scale GI projects for becoming a "sponge city" (Guo, et al. 2023; Wang, et al. 2021). Faced with the doubts from the general public and the questioning by independent media, the authors of the article speak up for SCPs, aiming to dispel the doubts and show their confidence in the national programmes.

I conducted a quick search online about their profiles, and it turned out that all three authors hold senior positions in various state institutions and are involved in the policymaking of SCPs. Contrasting their profiles with the devastation caused by the flood, it becomes clear that this article is likely to be politically motivated. With the politics in mind, it is not surprising that the intended audience is the general public who have doubts about SCPs, and they are targeted by the authors many times throughout this article.

Considering this is an article written in response to the public doubts after the floods, it is extraordinary that the experts, instead of acknowledging the devastation and suffering caused by the floods, go straight into shifting the blame onto the public at the very beginning of the article. This made me question: What are their motivations for saying such things about the public? Why do they choose to blame the public in their initial response to public doubts? And how are their responses connected to their social and political positions as experts in the field?

These questions enabled me to look into the intricate power relations between the experts and the government, the experts' professional identities and their roles in policymaking with officials, thus laying the ground for the next step.

2) Step Two: I turned my focus onto power and knowledge revealed in the source materials, especially on how 'truth' is constructed. I examined what is taken for granted as common sense, and I questioned the normative meanings and attitudes expressed in the discourse (Rose, 2001; Waitt, 2016).

In this example, the authors normalise the benefits of SCPs and focus on criticising the public's unrealistic expectations and their biased opinions. Such remarks imply that they firmly believe that it is not SCPs that have problems, it is the public's misunderstandings that cause the doubts. Hence, I questioned: what is the hidden agenda behind the authors' normalised "truth" that SCPs are unfairly judged? How does their positionality shape their claims and assertions? Critically exploring these questions helped me to enter the next phase of analysis.

With these questions in mind, I could therefore critically evaluate this document in an iterative manner, preparing for the next phase.

3) Step Three: I paid close attention to the possible contradictions and ambiguities in the documents, e.g. where the authors appear to show the limits on how they behave and what they talk about (Rose, 2001; Waitt, 2016). Specifically, I identified the "silence" shown in the texts – what is not said and why that might be. In doing so, I revealed the dominant discourse as to who has the right to speak, and whose voices are silenced in the process (Rose, 2001; Waitt, 2016).

In the example, I noticed that the authors mention "*when the idea of 'Sponge City' was initially propagated, the expected efficacy was exaggerated in some cases, which undoubtedly contributed to public misapprehension"*.

Here, the way the authors structure the sentence means that they can intentionally leave out the subject: who propagated the idea of "Sponge City"? who exaggerated the efficacy, and to what extent? If they already know there is public misapprehension, why then have they or the authorities done nothing to dispel the misinformation? The ambiguities and silence here shed light on the hidden power relations between the experts, the government and the general public. Seeking answers to these questions is a critical part of my analysis.

Whilst analysing the documents, I was also mindful of my own positionality, especially how my work experience and my professional knowledge affected my reading of the data, such as examining the experts' identities and their relations with the party officials. For example, rather than being overly critical of the experts in the example, I could see that the experts are also walking a tight rope between convincing the public of the benefits of SCPs and reassuring the party officials that they can dispel the doubts. As I analysed in detail in Chapter 4, the experts are stuck in a difficult position between defending their own reputation as 'scientific' and 'professional', placating the public and demonstrating allegiance to the party leadership.

Following the above steps, I kept asking myself the aforementioned questions while reading through the document. Applying FDA in this research study was also an iterative process: I constantly went back to the three major steps to repeatedly review the documents to enable the data analysis.

### 3.6 Summary

This chapter has introduced the overarching methodologies guiding the direction of travel for the thesis. Fundamentally, this research study is interpretivist and constructionist, which means rather than seeking objective 'facts' or single 'truth', I believe the answers to research questions are multi-faceted and contingent on participants' viewpoints and experiences, and the situations depicted by each participant reflect their own interpretations, and therefore as the investigator I should interpret such situations following the methods set out for analysis. The research study is qualitative by nature, with the data coming from both documents and in-depth interviews. To form a structured and rigorous data analysis framework, I took a grounded theory approach with computer-assisted coding to break down the large corpus of textual material from interviews, before I applied thematic analysis to analyse the coded segments. In addition, Foucauldian discourse analysis was used to examine the documents collected, aiming to bring in a different perspective to complement the shortage of interview data from China.

To summarise the methods in the empirical chapters that now follow:

- **Chapter 4**, addressing the second research question, investigates how Sponge City Programmes are implemented in China, highlighting the difficulties and the related discourse created as a result of policy shift. As mentioned, for the interviews with experts, the grounded theory approach is used to facilitate coding and subsequent thematic analysis. However, as the predominant data sources are the documents collected, a Foucauldian discourse analysis is employed to reveal the power relations among multiple actors and ideological foundations on which SCPs are based.
- **Chapter 5**, also answering the second research question, turns the focus to Green Infrastructure in England – investigating the challenges in the process of implementing SuDS, as revealed by interviewees. Here, grounded theory is again used in conjunction with coding and thematic analysis to dissect the data.
- **Chapter 6** targets the third question – how professionals respond to the difficulties in the process of implementing GI projects. This chapter draws on the interviews with respondents in England, and also brings in media interviews with a Chinese figurehead whose contributions to SCPs are recognised domestically and internationally. As such, coding and thematic analysis are once again used to seek answers to the research question.
- Finally, due to limited information from sources in China, **Chapter 7** mainly looks at the interviews from England to address the fourth research question: what is (not) learnt in the process of delivering GI projects, and how such learning outcomes impact flood resilience. Grounded theory, coding and thematic analysis are employed to examine the interview data.

# Chapter 4 Challenges Facing SCPs in China

## 4.1 Introduction

This chapter aims to address the first sub-question in China's context – what challenges professionals face when implementing Sponge City Programmes (SCPs) in China. As mentioned in Chapter 3, there are two main methods used for data analysis: thematic analysis built on grounded theory – targeting the research interviews with participants – and Foucauldian discourse analysis for examining the documents I collected from online sources.

Specifically, this chapter starts with introducing the political background of SCPs that propels the programmes to become a national policy, highlighting the prominent expert Kongjian Yu's role in promoting the concept of "Sponge City" and facilitating the development of the concept into practice. The focus of the chapter is then shifted to the debates of the efficacy of SCPs – the documents I collected emphasise the core issues in these debates, shedding light on the difficulties that constrain the rollout or even threaten the prospect of SCPs.

## 4.2 The framing of SCPs in the discourse of Ecological Civilisation

Sponge City Programmes (SCPs) represent an important part of the novel practices that the Chinese government is taking to address urban flood risks, which are highlighted in both government policies and press coverage (Xia, et al., 2017; Yin, et al., 2021). But before examining how SCPs are delivered, I first scrutinise the political backdrop against which policies like SCPs are established. In China's political system, the directions for economic development and social reform are mainly set out at the National Congress of the Chinese Communist Party which takes place every five years (Saich, 2015). In November 2012, at the 18th National Congress, the concept of 'Ecological Civilisation' was first conceived as a vital component of socialism with Chinese characteristics. In the speech given by then President Hu Jintao to his cadres, he asserted:

> *"Promoting Ecological Civilisation is a long-term task of vital importance to the people's wellbeing and China's future. Faced with increasing resource constraints,*

*severe environmental pollution and a deteriorating ecosystem, we must raise our ecological awareness of the need to respect, accommodate to and protect nature. We must give high priority to making ecological progress and incorporate it into all aspects and the whole process of advancing economic, political, cultural, and social progress, work hard to build a beautiful country, and achieve lasting and sustainable development of the Chinese nation"* (China Daily, 2012).

Since then, the term Ecological Civilisation has been the bedrock of any national environmental policies, and such policies are made and implemented to embody the concept of Ecological Civilisation in various ways (Chung, Xu, 2021; Gordon, 2018). Similarly, SCPs also bear the political meanings and symbolism that align with the ethos of Ecological Civilisation. In December 2013, one year after the call for Ecological Civilisation, President Xi Jinping gave his opinions on how urbanisation in his era can be improved, amongst which the idea of Sponge City was first highlighted:

*"When upgrading urban drainage systems, priority should be given to storing rainwater, draining rainwater via natural means, and building a 'Sponge City' that allows rainwater to infiltrate into the ground, and to be retained and purified naturally"* (People's Daily, 2013).

This shows how much political weight that SCPs carry, as is further proven in the official document *The Construction Guidelines of Sponge City* (2014). The first few lines of the guide read: "to thoroughly apply the thought of General Secretary Xi Jinping on urbanisation, to conserve water resources, to protect and improve urban eco-environment, and to promote Ecological Civilisation, this guidance is created and compiled" (Ministry of Housing and Urban-Rural Development [MOHURD], 2014, p.1).

The guide goes on by stating that the implementation of SCPs "is an effective measure to restore the hydro-ecological environment, conserve water resources, enhance adaptability to pluvial floods, expand effective investment in public goods, improve the quality of urbanisation, reinforce citizens' sense of gain and happiness, and promote the harmonious development of mankind and nature" (MOHURD, 2014, p.4). SCPs thus become a critical component of Ecological Civilisation by addressing urban water issues in President Xi's era.

Research Participant no.1, an urban planner, explains: “the idea is to turn cities into these big ‘sponges’ – when it rains the rainwater can be absorbed by green roofs, swales, or can infiltrate into the aquifer to supplement the often-depleted groundwater; when there is a drought, the water stored in underground tanks can potentially be reused. By building sponge cities, the urban cycle is made more akin to the natural water cycle.” The participant further adds that the programmes aim to bring the “nature” element into the continuous urbanisation and accentuate the strategy of Ecological Civilisation.

However, as examined in literature review, what SCPs encompass and promote are not entirely new, because they draw on the practices already implemented in other places in the world – similar techniques used to manage pluvial flooding include Low Impact Development (LID) in the US, Sustainable Drainage Systems (SuDS) in England and Europe (Chan, et al. 2018; Nguyen, et al. 2019). Despite the different names used, the commonalities these terms share are the creation of green infrastructure to attenuate runoff, and wider adoption of natural or permeable surfaces for rainwater to infiltrate, and the usage of vegetation, soil and biodegradation to purify water and improve water quality (Lashford, et al. 2019; Esmail, Suleiman, 2020). Another participant (no.2, landscape architect) confirms that SCPs adopt similar techniques as can be found in LID or SuDS, but he defends SCPs by suggesting the supposedly more complex goals encompassed in SCPs, including water resource conservation, the restoration of wetland, and water pollution treatment, most of which are also shared in SuDS in England as I examined in the literature review

As I examined in the literature review chapter, the benefits mentioned by respondent no.2 are also shared in the design of SuDS in England (Susdrain, 2022). Arguably, SCPs are essentially an assemblage of multiple concepts that have been applied in various places. SCPs draw on the common practices in SuDS and LID, and integrate such practices into the context of China: expanding the scales of these projects to city-wide, as a way for the central government to fulfilling its goal of ‘Ecological Civilisation’. The SCPs may appear as a quick fix to the prominent water-related issues and have thus become a demonstration programme for the broad and abstract ‘Ecological Civilisation’, the essence of which can be hard for ordinary citizens to grasp. Moreover, by carrying out SCPs, urban environments are turned more “natural” with Green Infrastructure such as

swales, rain gardens, and urban wetlands, all of which are visible to the urban dwellers. This visual improvement is likely to be welcomed in the urban concrete jungles, but more than the beautifying effect is the political achievements that are created to be seen (Liang, et al., 2020; Goron, 2018). Just as what is outlined in the official construction guide, Sponge City is intended to "reinforce citizens' sense of gain and happiness" (MOHURD, 2014, p.4).

Thereby, the SCPs are implemented for more than managing urban flood risks, as a result of the significant political heft invested in the programmes. Such projects promoted at the national level are a validation of the political legitimacy of the ruling party, and crucially, the leaders in power (Wang, 2018; Dai, 2019; Huang, and Westman, 2021c). As is shown in the first guidance of SCPs, the opening starts with Xi Jinping's thoughts. This almost indicates that those who do well in disseminating the guidance of Xi Jinping and implementing the projects with every effort are qualified cadres and will be valued. So the programmes somehow become a political show where local authorities can swear their allegiance to the party and their paramount leader.

Other than examining the political backdrop in which the SCPs are formulated, it is equally crucial to understand the reasons behind the sudden rise of the "Sponge City" concept, i.e. how it was brought to the attention of the top officials in China and later integrated into the broader Ecological Civilisation. The "Sponge City" concept originates from many years of research and numerous projects conducted by experts in the field, of whom Kongjian Yu is a prominent figure (Chan, et al. 2018; Xia, et al. 2017; Yu, et al. 2015). His name has been associated with the idea of "Sponge City" before SCPs are promoted by the state (Schiffman, 2024; Ghisleni, 2024).

Kongjian Yu is a landscape architect and an urbanist, the founder of the School of Architecture and Landscape Architecture at Peking University – the most prestigious higher education institute in China (Biboum, Rubio and Calzada, 2020). Gaining a PhD from Harvard University in 1995, Yu started working as a landscape architect in the United States before he went back to China and established his own firm Turenscape – one of China's first and the largest landscape architecture firms (Green, 2021; Park People, 2022). From the late 1990s, Yu and his colleague Dihua Li at Peking University

worked collaboratively to study urban water systems, and have since proposed ecological strategies for stormwater management and the concept of a sponge to demonstrate the flood-control capacity of natural drainage systems (Yu, Li, 2003; Yu, Li, Chao, 2001). Much of Yu's pioneering research on ecological infrastructure and "Sponge City" has been integrated into national policies by the Chinese government for tackling urban water issues and ecological restoration (IFLA, 2020). Internationally, his projects in and outside China have won him global recognition and numerous international accolades, including the Sir Geoffrey Jellicoe Award in 2020 – the highest honour from the International Federation of Landscape Architects (IFLA) for recognising his "achievements and contributions that have had a unique and lasting impact on the welfare of society and the environment" (IFLA, 2020). He has long been a fellow of the prestigious American Society of Landscape Architects (ASLA) and is often invited onto the global stage to speak to international audiences, including the United Nations Environment Programmes, COP28. (UNEP, 2022; Green, 2023).

Yu's work often demonstrates his philosophies in addressing urban flooding issues and is deeply intertwined with the making of national environment policies such as SCPs (Yu, 2012). For the following section, I first present a rebuttal from Yu's close colleague Li when criticism of SCPs started to emerge from the press and online forums, after several flooding events happened in pilot cities of SCPs, including a devastating flood in a supposedly "Sponge City" Zhengzhou. Then, I examine the media interviews of Yu, through employing Foucauldian discourse analysis, to showcase how his opinions differ from those of Li and the power dynamics behind their diverging stances.

### 4.3 The rebuttal from Li: how some of the experts see the challenges facing SCPs

Ever since the SCPs become a national policy and are implemented nationwide, there has been heated debates about whether they work as intended to address the flood risk in cities (Du, Wang, 2021). The pilot cities of the SCPs entered an assessment stage after the first five-year funding from the central government ended in 2020 (Yin, et al. 2021; Li, Zhang, 2022). The assessment is critical to deciding which cities would qualify for the second round of funding, and it also provides insights into how well the cities are functioning with respect to addressing flood risks (Chan, et al. 2018; Qi, et al. 2021; Fu,

et al. 2023). However, such assessments are done behind closed doors and the data are not available to the general public.

This section applies Foucauldian discourse analysis to unpack the narratives in a paper that is published online and reported by wider media. In the paper (She, Xie and Li, 2021), the three authors review pilot programmes after the first five years and offer a rebuttal to the concerns raised by the media. The authors of this paper all hold senior positions in institutions which, as they state in the paper, are involved in the central government's policymaking. The corresponding author, Dihua Li, is a long-term colleague of Yu at Peking University, and they have worked side by side for more than a decade to conceptualise the idea of "Sponge City" and advised the governments to take on the initiative (The DIRT, 2020).

The paper is published in the aftermath of the severe flooding event that devasted Zhengzhou in 2021 and shocked the entire nation because of the significant loss of life and damage to property (Wang, et al. 2021; BBC, 2021a). Located in central China, Zhengzhou is a city with over 12 million people, and has been chosen as one of the first pilot cities in the SCPs to invest in Green Infrastructure to tackle urban flooding (Guo, et al. 2023). Yet, the severe rainfall in July 2021 wreaked havoc – around 300 lives were lost in the city alone, and a further 15 million people suffered the damaging flooding in Henan Province, of which Zhengzhou is the capital (People's Daily, 2021; BBC, 2021a; Davidson, 2021). The public backlash culminated after the flood, questioning the point of investing in SCPs that did not seem to save the city from the disaster (Wang, et al. 2021; Du and Wang, 2021).

The experts in the paper emphasise that public distrust can be a major hurdle for SCPs to be perceived as successful. In response to the questioning from the wider media, they diagnose the underlying reasons for the public doubts:

> *"Since the pilot schemes of Sponge City started in 2015, the public have been having doubts about the construction of the projects. Some cannot feel the efficacy of the 'sponge' facilities, the reasons are threefold. Firstly, the public have overly high hopes of the benefits that can be delivered by Sponge City Programmes. They hope there is one approach that could solve all water-related problems once and for all, but in*

*reality, the approach does not exist. Besides, when the idea of 'Sponge City' was initially propagated, the expected efficacy was exaggerated in some cases, which undoubtedly contributed to public misapprehension. Moreover, the general public's understanding of Sponge City Programmes is to some degree biased as well, as they think 'on-site runoff control' is what Sponge City is all about."* (She, Xie and Li, 2021)

Li and the co-authors here claim that the root of public doubt is that the public have unrealistically high hopes. This claim conveniently deflects the blame onto the public. Given the hierarchical structures of the government and the authoritarian decision-making, the public would not be involved or even consulted in any phases of SCPs (Gilley, 2012; Shen and Jiang, 2021 ). What they choose not to say is that, if their claim was valid, why and how the public have unrealistic expectations. Ordinary people can be fallible, but in the political and social context of China, it is more likely the central government and authorities at all levels have hyped up the idea of "Sponge City" via ubiquitous propaganda, e.g. embodying the Ecological Civilisation that is sweeping across China (Goron, 2018; Chen and Zhao, 2022). Furthermore, if the public had high hopes, the experts here appear to not realise that the responsibility to educate the public lies fully in the hands of the institutions and the authorities: to address misinformation requires the people in power to take tangible actions, rather than calling for citizens not to have wishful thinking. After all, ordinary people do not know what level of expectations is realistic if the authorities never involve them in the process of implementing SCPs.

Arguably, the experts are fully aware of the way that policies are made in China – the general public are solely at the receiving end of such policies. It is plausible that the experts make such a claim because they simply wish to reject the continuous questioning amplified by independent and social media, as they may genuinely believe in the programmes that they help to shape along the way. The experts here act as the agents of the official discourse, trying to dissuade the public from being "misled". In doing so, they further strengthen the power and authority given by their unique status in the social hierarchy – their expertise and knowledge in the specific matter have offered them a place at the table with high-ranking officials. Now they are using their prestige to blame the public for not having the 'right' level of expectations about SCPs that are overseen by themselves, and they apparently believe the 'right' type of knowledge is produced

only by them. Li's response here resonates with the literature about experts' entrenchment of views – their expertise in the field can lead to reduced flexibility in adapting to new situations, embracing challenges to their knowledge, or generating creative ideas (Dane, 2010). This cognitive entrenchment means that experts can make worse decisions and judgements (Bedard, Chi, 1992). Li and the other experts appear to be entrenched in their own expertise and thus attempt to define and control the "truth" that they think should be accepted by everyone – not just ordinary citizens who have doubts, but also independent media that question the party's propaganda and even professionals that are not onboard with the SCPs.

Additionally, in the above quote, they downplay the flaws that may be embedded in the party propaganda: *"when the idea of 'Sponge City' was initially propagated, the expected efficacy was exaggerated in some cases, which undoubtedly contributed to public misapprehension*". To structure the sentence in this way is a careful choice – they deliberately leave out the subject "who". This may well be an implicit criticism of the government's handling of the programmes, which signals a careful distancing between the experts and the authorities. However, crucial questions remain unanswered: Who propagated the idea of "Sponge City" initially? Who exaggerated the expected efficacy and to what extent? These are the questions that should be addressed if the experts were genuinely attempting to defend their beliefs in SCPs and not to control the narratives.

However, the experts give no further details and instead highlight the "biased" public understanding – "*the general public's understandings of Sponge City Programmes are to some degree biased as well, as they think 'on-site runoff control' is what Sponge City is all about".* Again, here they foreground the 'fault' of the public: they think if the public do not understand the technical matters, then their doubts must be 'biased'. Their claim resonates with the work of Wynne (1992, 2007), in which Wynne argues that experts can (illegitimately) dismiss the public for lacking knowledge on the basis that the only relevant form of knowledge is technical and scientific, i.e. the knowledge these experts possess. Instead of sticking to their field of expertise and talking in terms of technical matters, Li and the experts opt for emotional self-defensiveness by illegitimising the public forms of knowledge. It might be the case that the experts genuinely have not

understood what caused the public distrust, but it is more likely that the experts here are, again, refusing to concede they may be at fault.

Following the dismissal of public mistrust and media scrutiny of SCPs, the experts eventually arrive at a critical problem that constrains the delivery of SCPs on the ground – a lack of skilled workers and quality control – an issue that has also been highlighted by Chinese participants of this research interview.

> *"Another reason for public doubts is that there may well be quality problems in these projects … such projects are largely construction-oriented, often the project design plays a minor role and is only for the price accounting. Such a situation remains in the delivery of Sponge City Programmes. Only caring about the construction phase, rushing through the project schedule, and neglecting project designs are common problems. The quality of the projects primarily depends on the experience and attitudes of workers on site, so the lack of a standardised construction process and lack of rigour, together with low-skilled workers and tight schedules, lead to poor project quality that has long been criticised."* (She, Xie and Li, 2021)

Such insights into the current problems of construction bear a certain level of political risk – they risk embarrassing the authorities for oversight, but these problems may be too well-known to ignore. The interview participants in this research study also acknowledge that the quality issues mentioned in the quote are common, largely due to the lack of skilled labour across the country as well as the lack of supervision. But this revelation in the quote is also part of the ongoing political education for these experts – they are treading a fine line between acknowledging the flaws of the institutions without offending the authorities and defending their beliefs in SCPs by illegitimising public doubts before admitting there are reasonable grounds for public concerns.

It now makes sense that this crucial insight into the problems of SCPs can only come after the telling off of the public, so that they set the rebuttal in a conciliatory tone when they slightly deflate their dismissal of the public and their hyped self-defensiveness -- they have no choice but acknowledge key problems do exist that threaten the performance of SCPs. However, faced with the political pressure associated with the programmes, it is understandable that the experts downplay the authorities'

accountability in promoting political agendas and their failures in supervising project delivery. By intentionally foregrounding the 'misperceptions' and 'biases' held by ordinary people, the experts signal that SCPs should not be doubted despite some faults in the process.

This constant reproduction of their 'expert' identities indicates their possibly genuine (and mistaken) belief in their superiority of technical knowledge and reasoning over the public's questioning and experiences. Meanwhile, their claims are also a reflection of their precarious situation where they are sandwiched in between handling the public discontent and managing the amicable relations with the authorities and the party in power.

Rather than calling out the central government to modify its way of doing propaganda, it seems much easier to turn the public into the default scapegoat for 'misunderstanding' the party's plans for progressing Ecological Civilisation in the form of SCPs. It is debatable whether the experts genuinely believe that the public is where the primary problem lies; however, the rebuttal certainly implies the predicament that these experts are in: the quality issues existing in the construction phase are plainly mentioned by them without challenging why the issues persist. What can be done to step up the quality control? How do the blunders in construction impact the projects' performance? And how has the poor quality undermined the public perceptions of what SCPs can do? The silence from the experts on these missing questions sheds light on the underlying challenges arising from the political structure as a whole.

A much bigger problem that arises from this is that if such quality problems persist across pilot projects across the chosen cities, how can the experts believe the benefits of SCPs can be achieved? how can they be optimistic about the future of SCPs with the "normalised" issues in the construction phase?

**4.4 Yu's defence: his idea of "Sponge City" VS the national SCPs**

As a pioneer of the idea of "Sponge City", Yu had been persistently promoting it both in media and amongst the policymakers before SCPs was designated in 2014 as a national policy for tackling flood risk. One would expect Yu to have a similar stance to that of Li

and the other experts in the above – defending the political project despite the inherent issues. However, Yu's interviews with the media showcase his disapproval of the direction of travel for the SCPs, and his frustration with the problems that he thinks damage the future of the programmes.

> *"After the pilot schemes started by the central government, the word 'Sponge City' entered the public sphere and has been continuously brought up in official documents and conferences. It gradually becomes an important means to boosting economic growth, and consequently, a large number of state-owned enterprises start to come in… Although the current Sponge City Programmes, to some degree, have alleviated pluvial flooding in pilot cities, the lack of understanding of its essence leads to some deviations in the implementation process – those profit-seeking developers and investors turn it from a green approach into a grey one – doubling down on investments in grey [infrastructure], and that has misled the public to believe that the cost of building 'Sponge City' is high while the benefits are unnoticeable."* (Architecture Practice, 2021)

It is likely that the central government and the party have claimed the title of "Sponge City" but dispensed with the substance of his idea of "Sponge City" – repression and co-optation of experts are common in autocracies (Bakir, 2023). It is understandable that Yu feels aggrieved and sees the need to denounce the current SCPs. But his achievements and international reputation give him the confidence to speak up about what he thinks is the truth about SCPs.

As Yu points out, the institutional set-up in China means the political project has been skewed into a profit-making scheme for the vested interests whilst ignoring the scientific and technical aspects of his "Sponge City" idea. Chastising the current state of SCPs reflects Yu's attempt to assert control over the term "Sponge City", which he thinks has been tarnished by the issues and failures embedded in SCPs. In doing so, Yu distances himself from the widespread "Sponge City" practices and also establishes an image of himself that is outspoken and determined to stand up to vested interests.

He goes on to say: *"once the concept becomes a political movement, a means to capitalisation, then the programmes are turned into a 'vessel' to contain all sorts of*

*vested interests, so naturally the projects delivered are not going to realise the expected efficacy."* (Architecture Practice, 2021)

Yu's criticism here is a marked contrast with the paper above. This is further evidence of the immense, unshiftable weight of political imperative in the Chinese system – the text indicates that the very originator of the concept has possibly been sidelined by the system. This contrast can be connected to the diverging positions of the two parties: Li and the experts are still involved in the political project of SCPs, their prestige is primarily national and they are firmly embedded in the national political system; whereas Yu is now an international celebrity – he has a deep connection to the US, and his firm takes on projects all over the world, so he is not beholden in the same way as Li to purely domestic politics. Yu has the capacity to defend his international reputation and that of his 'Sponge City' idea against the failings in the problematic implementation in China.

Yu believes that the current SCPs are not working and will not work as intended, and he is disappointed at the political discourse of the SCPs that is pushed by vested interests, because of the unnecessary political meanings that move the programmes away from the original course. By disputing the official discourse, he attempts to challenge the institutions that are exploiting the programmes to legitimise the party's leadership and competency; meanwhile, he also separates his "Sponge City" from the national project – creating his own discourse of what "Sponge City" should be.

> *"The concept of 'Sponge City', in fact, has not been fully understood. When it is applied to building infrastructure, it gets mixed up with other practices. Building deep tunnels, expanding the size of drainage pipes, adding water pumps, etc. are all seen as 'Sponge City' practices, but they are opposite to the essence of 'Sponge City' that is nature-based, and those hard engineering measures have actually undermined the roll-out of Sponge City Programmes across China".* (Architecture Practice, 2021)

Sharing what he thinks is the 'truth' about the ongoing SCPs, Yu intends to reaffirm his authority on this matter, given the clear rift between him and the official discourse. The rift signals the heated debate at the very heart of policymaking about SCPs – if Yu disassociates himself with the political project, it may be that his concerns and advocacy are being systematically neglected, hence further suggesting the opposite entrenchment

of positionings from the experts. Li chooses to play along with the entirely top-down, expert-led, engineering orthodoxy, whilst Yu does not.

Other than the institutional neglect, the rift may also be because individual projects implemented in the pilot cities are out of the control of any experts or party officials sitting at the top of the power hierarchy. As the central government only plays the role of the funder, the planning, bidding, and construction of any specific projects are predominantly the responsibility of local governments (Griffiths, et al., 2020; Zevenbergen, Fu and Pathirana, 2018). Given the political heft of the SCPs, local governments are likely to take advantage of the opportunities to impress their superiors – generating space for cronyism, nepotism, and corruption, all of which are common in infrastructure building in the Chinese system (Bai, Hsieh and Song, 2020; Zhang, Gill, 2018; Leung, Heung and Wong, 2008). This echoes what Yu mentions: how the investments are being used to boost economic growth for local governments and how the programmes are more like a "vessel" for vested interests. Under this "political correctness" of Ecological Civilisation, SCPs are done by local governments more for showing their allegiance to the party leadership than for realising the intended benefits. The likely lack of quality supervision and skilled labour means that projects implemented across the country do not necessarily meet the standards for "Sponge City", so Yu is understandably upset about the reality. But neither he nor the other experts have the capacity to oversee the many projects carried out under the banner of SCPs. The text above implies he may have tried to bring in a different approach to address the issues, but he is likely to have been overruled by the top policymakers.

### 4.5 The point of tension: will SCPs make a difference to urban flooding?

The flood in Zhengzhou, a pilot "Sponge City", has stoked a new wave of heated debates both domestically and internationally and posed difficult questions to the governing political elites (Myers, Bradsher and Buckley, 2021; Wang, et al. 2021). Among the professionals in the field, how well the SCPs are performing in dealing with flood risk is also a hotly contested topic. Li and the experts in their paper demonstrate vastly different views to those of Yu. I first analyse Li and the experts' remarks before I dive into

the response from Yu, and then I conclude with the viewpoints from the research participants who contribute to this debate from their experience on the front line.

4.5.1 Li and the experts: defending SCPs' future

> *"It's not long since Sponge City Programmes started, the doubts the public have are necessary and inevitable for pushing for progress in the continuing roll-out of Sponge City… The construction of Sponge City must centre on improving citizens' well-being in all aspects, it is only after citizens genuinely feel urban water problems are solved, and see the improvement of living environments that they can be more supportive of the work so that Sponge City can be promoted from pilot projects to a larger scale."* (She, Xie and Li, 2021)

After the dismissal of the public concerns I have examined above, Li and the experts here appear to make a concession – maybe a sign of learning from hearing the feedback from the public. However, "necessary and inevitable" also indicate their normalisation of the issues arising in the process – rather than coming up with serious solutions, they choose to reiterate and reconfirm the importance of SCPs. It is clear that they believe SCPs should continue and will eventually solve water-related problems in cities and dissipate any mistrust in the end.

They seem to admit that the public's concerns need to be taken seriously, but again, by the experts and those who push for SCPs, not by actually involving the public. Here is the evidence of the blind spot in these experts' thinking: they do not seem to realise the public could actually be engaged in the process. Or rather, in the context of China's policymaking, they believe the public can only be placed at the receiving end of policies. What is clear from their remarks is that the public should just believe in the arrangements set out by the experts and the authorities and wait patiently to appreciate the benefits to be realised.

The quote not only implies their condescending attitude towards how citizens should feel, but also indicates the carefully maintained relations between the experts and the party propaganda. The experts may or may not want to involve the public to address the doubts and the inherent problems, but they certainly cannot appear to invalidate the

political meaning of SCPs as the (communist party's) designated approach to water-related issues. Understandably, in this paper, they imply that the targeted audience – the ordinary people and the media – tend to be fallible and easily misled by disinformation, but the experts themselves, together with the government behind them, are the carers of the people and are making hard decisions for the greater good.

Regarding the questioning of SCPs' performance during the disastrous flood in Zhengzhou, their response is:

> *"Sponge City Programmes are only one element of flood risk management, the aim of SCPs is to make sure the pilot cities retain runoff under light rain and prevent surface flooding under heavy rain, so heavy rainfall* [25 – 49 mm in 24h] *is the maximum capacity for these projects to address. At times when torrential rainfall* [over 50mm in 24h] *causes natural disasters, rather than relying on SCPs, it is the disaster response strategy that is needed to minimise the loss of people's lives and assets. For the disaster in Zhengzhou, it is because the continuous rainfall exceeded the combined capacity of SCPs and urban drainage systems, what was required was the emergency plan that protects citizens' safety and reduces economic loss."* (She, Xie and Li, 2021)

Here, they once again defend the national scheme by defining what SCPs are designed for. In the case of Zhengzhou, they argue that the disaster is not a verdict invalidating the effectiveness of SCPs, because a downpour like that is never the remit of SCPs. So rather than conceding the design standards are inadequate in the face of climate change or the propaganda is misleading, they divert the attention to the local government's failures.

However, as extreme weather conditions become increasingly frequent as a result of climate change, this level of rainstorm is likely to happen more often. If, as they claim, SCPs are intended for dealing with light rainfall, then they need to justify the promotion and investment in SCPs for doing a job that conventional grey infrastructure is capable of. If SCPs cannot help to mitigate the increasing flood risk, then why are they promoted as the novel alternative to grey infrastructure in the government propaganda? Unanswered questions like these mean that the public and the media are naturally in doubt. The effective way to address the concerns is for the experts (if not the

government) to directly confront the pressing issues rather than gloss over the problems by taking away the public's attention.

### 4.5.2 Yu's frustration

Yu, however, holds a drastically different view with regard to the floods that happened in "Sponge City" Zhengzhou. In an interview with the American Society of Landscape Architects, Yu says, "*First of all, Zhengzhou is not a true 'Sponge City'. There has still been way too much development and grey infrastructure*." He adds that the term 'Sponge City' has been used "as a political slogan" to acquire funding from the central government (Green, 2021).

Yu claims that with the story of Zhengzhou, "the *media is seeking conflict and targeting something that isn't a 'Sponge City'. 'Sponge Cities' can solve the problem…If a 'Sponge City' is working as it should, there would be no flooding. People forget about these projects when they don't have disasters… We need more sponges, not less*." (Green, 2021)

Yu's stance has not changed – he opposes the current programmes and does not believe they are working as intended. By reconfirming his position on this matter, he rejects any possible discrediting of his "Sponge City" idea. In his view, Zhengzhou unavoidably would suffer from floods, and the SCPs cannot protect the city from future flooding, because the ongoing SCPs are not the "Sponge City" he champions, so the disaster in the city cannot illegitimise his idea. In doing so, Yu retains his prestige in influencing the discourse of "Sponge City", and thus steers the discourse towards a positive direction for himself.

The rift between Yu and the other experts is apparent. Li, representing the stance of the authorities, rejects any doubts while insisting it takes time to prove their work once the programmes are scaled up. Yu attacks the ongoing programmes for heading in the wrong direction whilst reinforcing his idea of "Sponge City" as the "right" approach to addressing flood risk.

### 4.5.3 From the front line: the views of the participants

After exploring the two contrasting views held by the pre-eminent experts Yu and Li, both of whom conceptualised and championed the idea of "Sponge City" and worked with central government officials, it is intriguing to look at the viewpoints of professionals who work on the ground delivering such projects.

One interviewee (no.4) disputes the statements made by Li and the experts. Speaking from his experience of working as an engineer overseeing the delivery of such projects:

> *"What I understand is, the overriding goal of the government to implement Sponge City Programmes is to address pluvial flooding that considerably impacts citizens' lives as well as industrial production. If they can achieve other goals, purifying or restoring water systems, that would be the icing on the cake; even if they cannot, that is acceptable too……The most straightforward approach to address urban pluvial floods is to completely rebuild drainage systems in every city across China, but that is unaffordable and unfeasible. So the question now becomes how we can address pluvial flooding without re-building the entire drainage systems or massively increasing investments. This is where Sponge City comes in. The point of Sponge City Programmes is the attenuation of rainwater to alleviate the short-period pressure on the pipe-drainage systems."* (Participant no.4, urban planner)

This shows the dissonance between experts at the top shaping policies and those on the ground implementing the policies. Experts on the front line tend to see through the veneer of the appealing official discourse and understand what hides underneath the grand narrative is plain and mundane work and a focus on cost.

> *"The Sponge City Programmes learn from the practices applied in North America and West Europe, but these places already have well-developed drainage systems, they do not seem to put the cart before the horse. Also, there is a big difference in climate types. The temperate oceanic climate in West Europe means the intensity of rainfall is not comparable to that of monsoon seasons in China."* (Participant no.4, urban planner)

Such comments deal a blow to the government's discourse about SCPs, indicating the respondent's distrust in the future of the projects, as he sees the apparent flaws in the basis of the programmes – failing to consider the local climate. Contrasting to similar practices in the West that work as a bonus on top of the existing drainage systems, he believes the discourse of promoting SCPs has wrongly prioritised Green Infrastructure as the primary approach to address increasing flood risk. Hence, there seems to be the eminent risk that SCPs, combined with the existing drainage systems that are inadequately developed, could potentially exacerbate the flooding in Chinese cities, not just because SCPs alone are not enough for tackling the increasingly extreme rainfall, but they also distract the attention and investment away from upgrading the conventional drainage systems.

Another respondent (no.5) voices his concerns about the lack of detailed quantitative analysis for projects and stresses the significance of quantitative modelling in deciding the technicalities and realising the intended benefits.

> *"As far as I am concerned, too many projects went ahead without collecting detailed data for the project sites and without rigorous quantitative modelling; it is as if you go to buy shoes without knowing the right size. This is why I am upset. If there is no quantitative modelling, how can we know the depth of a flood caused by a certain storm at a specific location, how can we know the speed of the runoff, how can we know how big the rain gardens should be to accommodate the excessive floodwater, how can we know the size of the swales needed?"* (Participant no.5, landscape architect)

> *"The awkward reality facing the SCPs, probably, is that they are effective in addressing light rainfall but struggle to cope with heavy rainfall. But light rainfall is harmless after all and does not make us need the SCPs."* (Participant no.5, landscape architect)

This is another blow to the political project of SCPs that some experts like Li are relentlessly defending. In the officials' documents, there are grand visions about the multiple benefits of SCPs. Here, contrasting those glorified plans is the worrying reality of lacking rigorous research and oversight. These issues could potentially incapacitate projects, rendering them useless in tackling floods, and yet these problems are tacitly

allowed to persist – the authorities never officially acknowledge the problems, and experts like Li choose to downplay the problems and shift the blame.

It appears that the inherent issues of SCPs, which may be conveniently glossed over by experts like Li, really unsettle the professionals working on the front line, and these concerns are inevitably circulated online. It is now understandable why public doubts and mistrust are widespread, so much so that experts such as Li feel the need to step forward and dissipate the concerns.

### 4.6 Discussions: through the lens of FDA

#### 4.6.1 The power dynamics embedded in the rebuttal from Li

The refutation from Li and the experts reflects their strong belief in the SCPs that they are likely to have vested interest in, so they go to some great length to deflect the blame, despite knowing the significant flaws in the process of delivering SCPs. As the refutation comes from the experts not the government, one way of interpreting this is that the experts are doing the bidding for the authorities, because of the authoritarian nature of governance in China, there is no incentive for the authorities to directly respond to the criticism from media when they can shut down online platforms or silence the media easily (Xu, Albert, 2014; Kuang, 2018). However, there is a need for authorities to assuage the public concerns because according to the central government propaganda, SCPs are to "reinforce citizens' sense of gain and happiness" (MOHURD, 2014, p.4). The other way of interpreting this is that the experts are walking a tightrope between maintaining the collaborative relations with the state machinery and persuading the public to believe in SCPs. This could be because Li and the experts genuinely believe in the intended benefits of SCPs and want to communicate that clearly to the public. When the experts have the option of simply ignoring the criticism from the press, they choose to offer a detailed and carefully argued rebuttal, suggesting that this rebuttal may not be a monolithic response from the establishment, but they seek to defend their reputation as competent and scientific experts.

The rebuttal also indicates that the SCPs mean much more than infrastructure building, as the political heft embedded within the programmes turns them into a political project

that needs to quash any doubts. There are two dimensions to the highly political nature of SCPs: one is the central government's integration of SCPs into the grand plan of Ecological Civilisation, which means high investment of political capital and thus high stakes; the other is the experts who are eager to defend themselves and their reputation as being competent and scientific. The former profoundly shapes the latter but also creates tensions for the latter – because the political project may not be scientifically viable, but for the experts who have already been onboard, it now becomes nearly impossible to publicly acknowledge the potential failure without antagonising the government. Even when such experts have faith in the political project, they now have to step up and defend the political project – or essentially defend themselves from being seen as incompetent or making the wrong judgement, but this political reasoning is likely to be viewed as the antithesis of their reputation.

### 4.6.2 The power dynamics behind the varied stances on SCPs

There is a clear rift between Yu and the experts like Li, about their stances on the current SCPs due to their diverging positionalities. Yu, as examined in this chapter, is internationally recognised, and his firm takes projects from all over the world, giving him the incentive to speak to a wider audience on the global stage and appease the public as well as the media to market his ideas. As the current SCPs encounter numerous blunders, Yu feels obliged to distance himself from the national political project which he originally championed but has since drifted away from his vision. It is thus understandable that Yu feels frustrated or even aggrieved when seeing the current SCPs do not exemplify his visions, due to all the uncontrollable factors impacting individual projects on the ground. Hence, his denunciation of the current SCPs suggests that he positions himself as the pioneer of the "Sponge City" concept and thus has a responsibility to clarify where he stands in relation to the criticism of SCPs, so as to protect his reputation, his career, as well as reaffirm his idea of "Sponge City" is scientifically sound. In doing so, he also establishes an image of himself that dares to stand against the vested interests and speak up for the "truth", aiming to retain his prestige over setting the "right" discourse.

The other experts, including Li, do not have an international audience to speak to. Instead, their concerns are, firstly, the potential damage to their reputation after backing the SCPs, which are later turned into a political project, and secondly, their relations with the central government in the context of China's authoritarian political structure. These are the likely motivations behind their clearly argued rebuttal that is published online and disseminated by media, with the aim to convince the public and professionals who have doubts to believe in the benefits of SCPs that represent the grand Ecological Civilisation.

Professionals on the ground who deliver projects are far away from the political centre and have little incentive to toe the line of the central government. Participants who work on the front line are likely to care about the projects' impact and want to see them succeed, so they are not so bothered by the political propaganda behind SCPs and choose to be frank about the challenges that they are faced with.

### 4.7 Chapter conclusions

In the review of literature I have identified a number of challenges that risk derailing the implementation of SCPs in China: SCPs heavily depends on the state to promote and fund, whilst facing the uncertain future when the state funding withdraws; guidelines for SCPs are usually borrowed from the West and lack consideration of local conditions, which undermine the delivery of intended benefits. This chapter examines the professionals' viewpoints in depth, in particular some high-profile experts such as Yu and Li who are involved in the government's policymaking process. Through the analysis of this chapter, I find out how these key actors see the challenges on the basis of their positionalities and expertise, and I reveal the intricate power dynamics related to their varied stances.

Yu points out the high political stakes vested in SCPs have turned the programmes into means of scoring political points and making profits for vested interests; even Li and the experts who come to SCPs' defence acknowledge that the projects delivered on the ground are often plagued by quality issues rooted in the lack of effective oversight and skilled labour. On top of such flaws, the participants mention more problems, such as a lack of consideration of local context and a lack of quantitative analysis using specific

local data, all of which are likely to undermine the overall quality of SCPs and cause failures in benefit realisation.

Furthermore, Li's rebuttal of the public doubt and media criticism in turn sheds light on the importance of engaging the public to address misconceptions and distrust. Media scrutiny and public distrust, even in the political context of China, seem to be a challenge that may damage the government's competency in the public's eyes. Engaging the public can be an opportunity for the authorities as well as the experts to learn about the value of engagement.

Such problems, as reflected by the professionals, are commonplace, but there are few tangible actions from the central government to combat these problems – a conundrum that may be caused by a number of reasons:

a) Considering the political heft injected into the formation of SCPs, I think SCPs are primarily a slogan and a political distraction tactic to present the government as being in charge and trustworthy. The implementations of SCPs is to showcase the ruling party's competency, thus maintaining their legitimacy in power (Holbig and Gilley, 2010; Zhu, 2011). For the central government, SCPs are an important means to give substance to Ecological Civilisation, which explains why they may be triggered by the seemingly public mistrust and media scrutiny. This is where the agents such as Li come in, they deflect the blame and downplay the exposed institutional weaknesses, so they and the authorities that they side with retain the power for not just defining what is true or false regarding the efficacy of SCP, but deciding how flood risk should be managed without citizens' input.

b) In reality, as respondents reveal, there are limited options and limited resources, including financial, necessary expertise and organisational skills, to address urban flooding problems. Therefore, implementing SCPs is likely to be a trade-off for the government – rhetorically, they are committed to addressing flood risk, but in practice, they are unable to afford a complete upgrade of the existing grey infrastructure to keep up with the rapid expansion of Chinese cities.

c) For the authorities, there is a systematic and self-reinforcing incentive to dismiss and control public criticism and negative feedback, rather than engage with the public and learn from differed opinions. Because of the authoritarian nature of the political system and the top-down set-up for executing orders, the public are always at the receiving end of any policies, without meaningful mechanisms to influence the decision-making process (Ahlers and Schubert, 2022; Zhang and Gill, 2019). Meanwhile, demonstrating allegiance to the ruling party and executing the plans from the central government are what keeps local officials in power, so implementing SCPs for local government is more about impressing the superiors and scoring political points for themselves (Fewsmith and Gao, 2014; Qiaoan and Teets, 2020). What citizens actually need or want bears little importance to the local governments; hence there is in fact no meaningful political pressure to rectify the problems (Fewsmith and Gao, 2014).

Overall, to address the research question (what are the challenges facing professionals in the implementation of GI projects?), it is now clear that challenges primarily come from three dimensions.

The first dimension of challenges is quality-related problems. The design standards are borrowed from the West and therefore lack consideration of local conditions, such as climate types and precipitation, making it ill-suited for varying geographical locations in China. In addition, in the construction phase of GI projects, there is a scarcity of supervision and a lack of quantitative analysis using specific local data.

Another dimension of challenges involves the lack of necessary expertise across the country to adapt the design standards to local conditions, to supervise projects under construction, and to monitor and maintain projects post-delivery. Additionally, there is also a paucity of skilled labour that can execute projects to meet the design standards.

The third dimension of challenges comes from SCPs being promoted and implemented as a political project to enshrine Ecological Civilisation. The political nature of the programmes means that local officials are motivated to score political points and demonstrate their competency to Beijing, rather than care about whether and how GI projects address flood risk. Since the physical presence and visual image of these

projects are enough to validate the local officials' alignment with Ecological Civilisation, little attention is paid to the design standards, quality control or the training of labour. Against this political background, undertaking a GI project for local government is a way of acquiring central government funding to invest in the local economy; and the completion of a project is a demonstration of their allegiance to the party leadership. There is little incentive for local authorities to rectify the said problems, because they are not elected by local residents and are only responsible to the central government.

To link the findings in this chapter back to the overall research aim, the reflections of the experts including Yu and Li about the flaws in the process, and the problems highlighted by the participants, are a demonstration of the learning process of these actors, which I will examine in detail in chapter 6. Despite the clear evidence that learning is taking place in the implementation of SCPs, the political structure can constrain and limit the level of learning, making it difficult for actors to share or discuss publicly.

# Chapter 5 Challenges facing SuDS in England

## 5.1 Introduction

Chapter 4 illuminates the political and social contexts for SCPs to burgeon and upscale in China, highlighting the top-down decision-making and a range of challenges that could derail SCPs as a result of the authoritarian push for SCPs. In contrast, the situation in England is vastly different as the result of its political and social structure. The following section explores the common difficulties facing the rollout of Green Infrastructure (GI) in England, as explained by participants. Following Chapter 4, this chapter also addresses the second research question in the context of England, i.e. what are the obstacles hindering the implementation of GI. The chapter employs grounded theory with thematic analysis to examine the interviews with respondents. Through categorising and coding the data, I identified the common challenges and grouped them into four categories: the lack of legislative backing and related issues, limited resources, tensions amongst stakeholders, and the lack of integration and connectivity of SuDS projects.

Because of the participants' different expertise, the answers about challenges vary from person to person. Hence, this chapter only presents the common challenges that are mentioned by at least two participants. Throughout the thesis, the cross-participant comparison is only used to identify similarities, not to verify the prevalence of any particular theme, because each participant was only asked to share their own perspectives without being told to comment on what other participants said. The way the interviews are conducted aligns with the research focus: this research study is conceptualised to gather what each participant thinks is relevant to their own experience, not to find out which respondents agree/disagree with any particular subject. In doing so, both Chapter 4 and this chapter are designed to explore how the professionals operate in the two different social and political environments to confront challenges, laying the ground for Chapter 6 in which I examine the professionals' situated practical wisdom in overcoming difficulties.

### 5.2 Non-statutory status of SuDS and related problems

The literature reveals that a predominant factor that constrains the uptake of SuDS is the absence of legislative support for GI (Potter, Vilcan, 2020; Lashford, et al. 2019). At the time of writing, SuDS has no statutory status, which means SuDS schemes rely on local champions to promote and implement. This legal hurdle manifests in many other difficulties that constrain the upscale and expansion of SuDS schemes across England, as is analysed in the following sections. In the research interviews with participants from England, four respondents (A, F, G and H) explicitly acknowledge that the lack of legislative backing is a major bottleneck that disempowers key actors from taking up SuDS schemes.

> *"It is the legislation basically, there's not enough"*. (Participant G, water engineer)

> *"The SuDS design is only a government guidance, which is very, very weak"* (Participant A, urban planner)

Participant H shows frustration about the developers' unwillingness to sacrifice their profitability for installing SuDS features in new housing schemes, and signals the significance of legal requirements to change the status quo.

> *"We are trying to negotiate with developers, but it just becomes, you know, at the early-stage chances are that our discussions and conversations will be positive, but as you get near to putting a spade in the ground or the developer wants to start squeezing more profit out of his land, the nice-to-have start to drop away."* (Participant H, flood resilience lead)

Without a statutory status, SuDS are only "nice-to-have" and are dependent on developers' willingness rather than a necessary element, emphasising the profit-driven reality of land development. As the respondent explains, as SuDS schemes take up a certain percentage of the land for housing, developers are more tempted to squeeze more housing into their plan at the cost of scaling back or completely scrapping SuDS projects, as a result of no legal obligations for implementing SuDS.

*"SuDS does work when they're developed, but the problem is it's very easy for the developer not to build them… it's quite often that they'll be submitted as part of the planning framework to have them built in, but then they'll get pulled back because the developer will go 'actually, no, we're going to build more houses on that land and therefore we're going to give up that SuDS and just put all the water into the sewer instead'"* (Participant H, flood resilience lead)

In November 2023, the then Conservative government brought change to Flood and Water Management Act 2010, mandating SuDS in all new developments in England and Wales starting from April 2024 (CIWEM, 2023), so the wider landscape started to change. Nonetheless, the years leading up to this change of legislation have left a considerable impact on the scale and perceptions of SuDS. Before the change, the adoption and implementation of SuDS mostly relied on local actors, and guidelines and manuals for SuDS design and construction came from not-for-profit organisations such as Construction Industry Research and Information Association (CIRIA), with miniscule roles played by the government or local councils (Lashford, et al. 2019). The situation in England gives rise to the bottom-up approach to implementing SuDS and leads to the piecemeal and fragmentation of SuDS schemes – most SuDS projects are small-scale that only impact the local area (Li, et al. 2020; Melville-Shreeve, et al. 2018; Lashford, et al. 2019). A statutory approach for implementing SuDS, however, will significantly shift the dynamics: local actors who once battled with barriers now are empowered, and land developers who used to care only about profits now have to consider legislative compliance.

### 5.2.1 Minimal retrofitting examples of SuDS

Before the change of the legislation, the promotion of SuDS heavily depended on not-for-profit organisations such as CIRIA, with land developers being the major actors delivering SuDS. This leads to the current state that SuDS installations are highly concentrated in new builds (Oladunjoye, Proverbs and Xiao, 2022; Maqbool and Wood, 2022). However, as only around 1% of the housing stock in the UK can be considered new, retrofitting SuDS increasingly seems more necessary for the society as a whole to transition to GI (Committee on Climate Change, 2012; Lashford, et al. 2019; Oladunjoye,

Proverbs and Collins, 2017). In the research interviews, Participant C, D and F mention the challenges in retrofitting SuDS and remain pessimistic about the limited impact of SuDS on addressing flood risk.

> *"A lot of these [SuDS] projects are not retrofit… I don't think you can retrofit it onto houses"* (Participant C, project manager)

> *"But [the SuDS project] has not actually contributed to what would happen if [the city] was to flood… we did not put them into housing"* (Participant D, city councillor)

> *"Our vision was that you could get a grant to put SuDS into an existing house, because if you've got three thousand houses already existing in a flood plain, and you're building 10, so you're only having to comply with that requirement for new builds, how can SuDS make a difference? So it would be a good idea to be doing a small amount over a wider level of properties than doing little bits of fiddling with small stuff."* (Participant F, architect)

At a time when installing SuDS in new builds is difficult, it is more challenging for local actors to retrofit SuDS into built-up areas. There are a myriad of factors that stall the retrofitting, including high initial costs, the need for space in built-up areas, and how to maintain them (Lamond, et al. 2015). Arguably, these factors are caused by and intertwined with the lack of legislative backing and regulation. Local actors have little to no incentive to retrofit SuDS when faced with many unresolved questions, including who should lead the retrofitting, where the retrofitting should take place, and who should bear the cost.

However, the change of legislation is a positive signal. The statutory status of SuDS is likely to ensure a broader and quicker adoption of SuDS in new builds, but it can also potentially widen the gap between SuDS installed in new builds and those retrofitted in built-up areas as the resources and focus are shifted onto compliance with the law.

### 5.2.2 Unresolved ownership and the cost of maintenance

The literature shows that the unclear ownership and the related long-term costs of maintenance often hinder the installation of SuDS (Melville-Shreeve, et al. 2018; Everett,

et al. 2016). Similar issues surrounding the ownership and maintenance are also highlighted by Participant E, G, H, J and K. As a result of the inadequate regulation, the responsibilities of the many stakeholders involved are not clearly defined – landowners, local councils, and water companies can all be liable for maintaining SuDS depending on the individual situation (Everett, et al. 2016; Melville-Shreeve, et al. 2018). It is the ambiguity that leaves actors hesitant to deliver SuDS, and in the end such ambiguity constrains SuDS projects from delivering the desired benefits.

> *"There's always a bit of a grey area whose responsibility is to maintain…"* (Participant E, civil engineer)

> *"So it's really quite tricky for us to adopt them [SuDS], we'd have to be funded for it. And in the current economic model, that's not how it works."* (Participant G, water engineer)

> *"One of the biggest barriers though is the maintenance, who maintains SuDS. Because they are not our assets, they don't come to us. As for the developer, once they've built and sold the last home, they'll leave site. So it sort of falls to local authority and the highways, drainage board and all those sorts of things. And even when it falls to them, they are not funded necessarily to keep on top of maintenance. And then when the outfalls block up on the SuDS, well, you just get a pool of stagnant water, which the residents complain about, and it also doesn't deliver the solution you're trying to do, which is to alleviate surface water flooding."* (Participant H, flood resilience lead)

> *"The challenges that we've had in this project and we are still having is that many [stakeholders] can be quite risk averse. So anything that is not standard, anything that is not what we've used before, they will basically not take the responsibility to adopt and maintain. So we are still battling with some of this understandable but not particularly helpful attitude."* (Participant K, project manager)

The respondents' remarks foreground the importance and necessity of legislation and regulation. Uncertain ownership of liabilities can prevent local actors from producing an acceptable drainage plan that satisfies key stakeholders, thus impeding the implementation of SuDS schemes (Lashford, et al. 2019). Even if SuDS projects are

installed in new builds, what comes after their delivery is where tensions arise. Without clearly demarcating the responsibilities of the multiple stakeholders, conflicts can easily develop over who takes care of the SuDS projects in the long run and who bears the cost (Cotterill, Bracken, 2020; Melville-Shreeve, et al. 2018). In addition, the aforementioned low level of retrofitting SuDS is a direct consequence deriving from the complexities around the ownership for long-term responsibilities and maintenance of SuDS (Everett, et al. 2016; Melville-Shreeve, et al. 2018).

The literature shows that regular maintenance of SuDS schemes, such as trimming vegetation and de-clogging, is key to sustaining their functions and ensuring they perform as intended (Scholz, 2004; Lashford, et al. 2019). Since the legislation now demands land developers to equip new builds with SuDS, ownership and maintenance are now critical factors that must be addressed promptly – without regular maintenance, the impact of SuDS deteriorates and flood risk increases (Lashford, et al. 2019).

### 5.2.3 The shortage of funding and investment

In comparison to SCPs in China that are mostly funded by the central government at present, SuDS projects in the UK predominantly rely on local actors to fund and deliver, as a result of non-statutory status and a lack of guidance from the government (Potter, Vilcan, 2020; Lashford, et al. 2019). Several participants (C, D, G, H, J and K) admit that securing funding is challenging and it is thus a big hurdle preventing the upscale and widespread installation of GI.

> *"We'd love to do nature-based solutions… but they are all going to be balanced against cost and deliverability. So it's a bit of a Venn diagram, and we are in the position of trying to just work out where we are in the diagram against all the other competing needs of cost."* (Participant H, flood resilience lead)

> *"There isn't that much funding available for SuDS"* (Participant G, water engineer)

> *"We've got very limited pot of money to deliver flood resilience… So we have to be very clear in terms of the prioritisation and optimisation of programmes to deliver flood resilience"* (Participant C, project manager)

Respondent D mentions that the austerity measures that were in place for more than a decade have severely impacted the funding for project supervision and monitoring, making it difficult to ensure the building standards are maintained and SuDS is performing as expected.

> *"The huge problem, I think, is that you can have all the rules and regulations you like about SuDS, if you don't have the building inspectors to actually ensure that these measures are being implemented, it's futile. So it's that gap between rhetoric and the cheesiest business of ensuring that we have trained inspectors available to go and look at projects when they're being built… but in the last twelve, thirteen years the amount of money that's gone into local government has been cut back very, very harshly, and with the [Conservative] government's bonfire of red tape and so on, what has been affected by that are things like environmental inspectors and building inspectors. The problem was horribly highlighted by the Grenfell Tower fire. It's very clear that there was a lack of trained professional judgment in it, but it happened very regularly with things like building developments going ahead without adequate checks on their flood precautions."* (Participant D, city councillor)

This reflects the inherent institutional obstacles in England, which are unlikely to change in the short-term. In contrast to China's top-down governance, the British economy and society are fundamentally shaped by neoliberalism that ideologically prefers market mechanisms to organise the economy, over state planning (Berry, 2022). Since 2010, consecutive Conservative governments have promoted minimum state intervention and market relations into all aspects of economic activity, and introduced stringent austerity as the primary means to balance the books (Pearson, 2019). Public expenditure has been considerably cut back, and public infrastructure assets are financialised to "transfer responsibility for financing, ownership and operational management to private investors" (McArthur, 2024, p.47), so the investment and building of infrastructure heavily rely on private financing with an increasingly shrinking role of the state (Olesen, 2020). As Pearson (2019) puts it: "the resulting withdrawal of the state from responsibility for the economic security of its citizens clearly has an impact on social security and public services; and it also has the effect of transferring risk from the collective to the individual." (p.28)

After the Brexit referendum, British politics has increasingly been taken over by neoliberal-nationalist thinking that champions deregulation with slogans like “bonfire of red tape”, and the then Conservative government was more concerned about generating political currency and appealing to its electorates, than creating material improvement (McArthur, 2024; Valluvan, 2022; Gallo, 2022). Despite the change of government, Labour still faces the strained public purse and crumbling public services and infrastructure, so they are understandably cautious about public borrowing and spending (Borrett, Foster, 2024; Kelso, 2024). It is, therefore, unlikely for the current government to prioritise regulation and financing for SuDS in the short term.

### 5.3 Resource constraints

Another issue that stands out from the interviews is the limited resources. This echoes what is examined in Chapter 4. In the delivery of SCPs in China, there are substantial quality problems that even the experts defending the programmes cannot ignore. As is laid bare by the Chinese respondents, there is a shortage of skilled labour on the frontline to execute specific jobs to the designed standard; and on top of that, there is neither enough knowledge, nor enough human resources in the field, to oversee the construction and ensure the quality of projects. In England, without the state funding and government promotion of GI as seen in China, employing and potentially upscaling GI are particularly challenging, as respondents (A, E, G, J and K) reveal. Similar to the issues in China, in England there is also a lack of knowledge and skills in the design and construction phases, and a lack of human resources to guarantee that projects meet the standards for SuDS.

> *“We could definitely do with green roofs and more interventions in the city and but there’s not enough people, I think, that’s limiting it.”* (Participant A, urban planner)

> *“To do a catchment-scale SuDS is really difficult because… you would need a lot of people working on it, not just the Environment Agency but university specialists and researchers”* (Participant G, water engineer)

> *“There isn't the resource, as in people, to monitor everything we do. So we just use the evidence we've got to assume SuDS will work.”* (Participant J, urban planner)

Exacerbated by the aforementioned austerity, insufficient financing and investment in human resources hinder the production and sharing of knowledge as well as limit the prospect of skills training in the field (Feagan, et al. 2019; Huck, Monstadt, 2019; Choudhury, et al. 2021). Without the political backing or legislative support, SuDS projects primarily depend on local actors to promote and implement. Against this backdrop, one participant recalls the experience of wanting to implement SuDS but struggling to find a contractor with the knowledge and skills to deliver what was required.

> *"Where we had the most problems was during the construction phase… because it's quite a specific job, building swales and rain gardens and things like that, it's not something companies necessarily have experience of. The construction company was in theory a specialist in these areas. However, we found that not to be the case. You know, the people that are on the ground, the builders and construction workers, they don't necessarily understand the importance of building exactly to the specifications, they had to follow very technical drawings… So for them to understand how important it was to follow the exact technical specs, like the gradient of a swale, that was the battle we had... SuDS is quite a niche thing that I'm not sure there is really the experience out there, or someone that's done it. At the end of the day, even if there is experience in the company, it's the lads you get who go down and do the work, isn't it?"* (Participant K, project manager)

### 5.4 The lack of connectivity between SuDS and the wider catchment

The literature shows that SuDS schemes in England are usually delivered as standalone projects: they tend to have minimal integration with the wider area, and are often not considered as part of catchment-wide flood planning (Wingfield, et al. 2021). However, if SuDS schemes are designed and delivered as a package of measures in catchment-wide flood planning, or multiple SuDS devices can be combined to create a "management train", the cumulative effect on managing runoff and reducing flood risk can be profound (Maqbool, Wood, 2022; Lashford, et al. 2014; Lashford, et al. 2022)

Interviews with the participants (E, H, G and J) show that SuDS projects are often locally based and small-scale, lacking consideration of the wider catchment area. The lack of hydrological connectivity between SuDS schemes and the surrounding areas means that

the impact of SuDS is limited to the local level and unlikely to make a difference to address flooding at the city scale (Lashford, et al. 2022).

> *"In many ways [a GI project] doesn't address the concerns I have around flooding because it's not integrated into the area around it… It's just a standalone project and it's not integrated into how houses are built*." (Participant E, civil engineer)

> *"It's critical to understand how you make the links between all the different initiatives and legal requirements to make sure you're focusing on the geography of a wider catchment and not just the project site, like if a council is leading on [a project], they may only consider their council boundaries but not the county boundary or the river boundary"* (Participant J, urban planner)

I believe the issue highlighted here is a result of the fragmented and small-scale nature of SuDS in England. As previously mentioned, SuDS schemes currently concentrate in new builds, and after the change of legislation, they are likely to be more concentrated in new developments whilst retrofitting SuDS into the built-up area is not under way. Hence, the fragmentation of new builds means that the interconnection between SuDS devices is unlikely to be achieved in the short-term without political or economic incentive.

In addition, the barrier to SuDS integration suggests the importance of systems thinking – flood risk is an issue in a complex system that requires systemic and holistic approaches (Kuecker, Hall, 2011; Rehman, et al. 2019). As Participant F (flood resilience specialist) elaborates: *"chances are that the flood risk itself is passed, you know, cascade downstream. So it might even be a different planning authority's area where the flood risk actually increases"*. Systems thinking necessitates and resonates with evolutionary resilience, as examined in the literature review, cities are socio-technical-ecological systems with a wide variety of interconnected and interdependent factors influencing one another (Marcus and Colding, 2014; Mehmood, 2016; Abdulkareem and Elkadi, 2018). To consider SuDS projects as part of wider catchment-wide flood planning allows for a holistic view of flood risk and is likely to generate the impact needed for enhancing flood resilience (Pisano, 2012; Ramyar, Ackerman, Johnston, 2021).

Nevertheless, I notice positive signals from the interviews. Some of the respondents (A, F, G, H and J) start to realise the importance of systems thinking and working with multiple stakeholders.

> *"We are taking things like that [systems thinking] into account so that we're making the right informed decision about resilience."* (Participant A, urban planner)

> *"What I think is quite clear now is that flood resilience can't be delivered in isolation, you know. If we're truly to deliver resilience it has to be done in an integrated way and that's where the partnership approach comes in. So yeah absolutely, that collaboration and communication with all the different partners is pivotal to this success."* (Participant G, water engineer)

**5.5 The contentious relations among actors**

5.5.1 Clashes between professionals

In the interviews, as I specifically asked every participant if there is any conflict between them and other stakeholders in the implementation of GI, most of them (except Participant A and D) acknowledge that there often is some level of tension among stakeholders. Even within the same institution there can be conflicts, according to Participant F, G, H and J, different departments can clash over the efficacy of SuDS due to their diverging expertise and interests.

> *"There are two departments in [the institution where the participant works]: a flood risk department and an environment department, and we don't always agree. It's not like one person. In our corporate strategy, it says we should be thinking about nature-based solutions, but to develop a project you do need to get approval from multiple different people that all have different tolerances and acceptance of evidence, and I think that's why it's difficult, we all work from a different perspective… The environment department would be more prone to adopt nature-based solutions, but the issue is that a lot of our methods of looking at cost benefit analysis of flood schemes isn't weighted as much. When you're designing like a multi-million-pound flood scheme, you have to look at percentages or probabilities of how successful it will*

*be, and the cost benefit of it. You have to say what's your confidence that this is going to work. At the moment it is a low confident for nature-based solutions."* (Participant J, urban planner)

What Participant J reveals here echoes the views of Participant F, G and H: the novel practice of GI is often judged by the metrics designed for the old schemes, and inevitably the result tends not to be in GI's favour.

To make matters worse, as demonstrated earlier, SuDS performance are further undermined by the aforementioned shortage of funding and resources: the lack of monitoring and maintenance damage the realisation of the intended benefits (Participant E, G, H and K). Consequently, as Participant A, G, J and K reveal, the wider stakeholders who value quantitative data and mathematical evidence more tend to doubt the performance and efficacy of SuDS, and there is no effective solution in sight to break this impasse in the short-term.

*"Not everyone is fine with the fact that you can't really measure it in quantitative data… some people are very used to mathematical figures"* (Participant J, urban planner)

*"The cost benefit analysis looks different and is dependent on the organization or the company that you work for"* (Participant G, water engineer)

*"The drivers [for a GI project] might be quite different for different organizations."* (Participant A, urban planner)

Participant F who has an engineering background wants to see more hard engineering work taking place.

*"I indicated to the Environment Agency that there needs to be more actions in terms of the management for sustainability. We need to go beyond sustainability. It's not just about adaptation, it's not just about climate change, it's about what we do to our rivers normally. And we've been doing very little to our rivers normally. We have, I suppose, been letting the nature interests to take too much hold, you know, the CaBA*

*[Catchment-based Approach] input into river systems and catchment management is probably too strong in shaping the flood risk assessment."* (Participant F, architect)

A Catchment-based Approach (CaBA) focuses on habitat restoration, sustainable land usage and management within a catchment, with partners including the Environment Agency (EA), The Rivers Trust, Wildlife Trusts and RSPB involved (Collins, et al., 2020; Catchment Based Approach, 2022). The respondent believes the EA favours the nature interests under the influence of the many organisations named, implying a power struggle between the multiple stakeholders. From this participant's point of view, engineer groups' advocacy is overlooked, and their perceived waning influence is likely to continue causing tensions. The clashes further manifest in this participant's criticism of the EA's approach to addressing flood risk.

*"Since the Environment Agency took over from the National Rivers Authority in 1995, it has stopped maintaining rivers, and there is a real swing towards naturality -- making rivers become more natural in terms of the ecosystems, wildlife species, invertebrates. The problem with that is if you're looking at the animal kingdom, it then becomes a competition between animals and humans, and there has to be a level of balance somewhere as to where that maintenance is implemented and in what way, so that everybody benefits but one doesn't benefit more than the other. That's the problem we've got at the moment: there's a pendulum swinging, and at the moment, the human population is on the wrong side of the pendulum"* (Participant F, architect)

Mimicking a "typical" response from the EA, respondent F contrasts the "irrationality" of the institution to what they think is a "rational" approach.

*"We're heading to adaptation, which is 'sorry guys, it's tough, climate change. You know, whenever you flood it's going to be climate change. We'll do what we can, but there you go, the rivers are natural and we like our rivers to be natural and having lots of life in them'… But there are great difficulties in going down that route, because we say that a river can never be natural except when it gathers the water from the mass of the fells, until it goes under its first bridge. Once it goes under a bridge or into a pipe, your river has been engineered. And we as humans are then responsible for it from that point on. We cannot leave it to fallow. We cannot leave it to silt up in the*

*wrong places. We recognize that we need to look after as much of wildlife as we can, but we still need to put a foot in the water sometimes"* (Participant F, architect)

The conflicts revealed here are akin to the discord found between Li and Yu in China. Arguably, such tensions not only come from the participants' differing knowledge and expertise, but are also rooted in stakeholders' varying responsibilities and interests. However, unlike in China where SCPs are enforced top-down and professionals on the ground have little influence on the implementation of projects, there is no strong legislative or political backing for SuDS in England, and most SuDS projects have to rely on the support of local actors (Potter and Vilcan, 2020; Li, et al. 2020; Ashley, et al. 2015). The conflicts between the professionals here can potentially derail the implementation of projects (Galuppo, et al. 2014; Zimmermann, Albers and Kenter, 2021).

5.5.2 Barriers to engaging with the public

As explained in the methodology chapter (Chapter 3), I did not recruit participants from the general public, instead all the respondents in England are professionals with knowledge of SuDS. Even so, there is plenty of textual materials that reflect the difficulties faced by the respondents (B, C, D, H and J) when they interact with the public.

*"It's really hard getting people to engage in a concept [flood resilience] when they have no experience of that concept before, and it's obviously not going to work if we just say to them 'we're going to put in some sustainable drainage systems, how do you feel about that'."* (Participant B, community engagement lead)

*"At the moment it's difficult engaging with people on a sustained basis… they don't really want to commit to joining a group or something like that"* (Participant C, project manager)

*"I think the main problem that we have is indifference, that most people don't think about flooding from one week to the next. It only becomes an issue when it happens. So when we try and talk about preparedness, people either completely ignore it or there's unity that's somebody else's job to do it… So they don't think flood risk is*

*relevant to them until it happens. And also they tend to feel that it should be somebody else's responsibility."* (Participant D, city councillor)

*"If you're restoring a river, the anglers might not like it because it changes their fishing rights or you might have to move a footpath, so I think it's not so much the flood side of it, it's more the other things, how it affects people."* (Participant J, urban planner)

A stark contrast to the experts in China examined in Chapter 4, these professionals (B, C, D, H and J) show a clear willingness to engage with the public and help them to become more resilient to flooding. However, involving the public is challenging and such barriers are likely to be inevitable because of the relatively democratic decision-making process in England, in which a wide range of stakeholders are involved (Papadopoulos, Warin, 2007; McAvoy, 1998). The many stakeholders, including the public, tend to have differing interests as a result of their backgrounds, knowledge, and expertise, and therefore it is difficult to reach a consensus (Newig, et al. 2018; Reed, 2008; Zimmermann, Albers and Kenter, 2021).

Despite the difficulties, such engagement with communities helps to raise communities' awareness of flood risk and therefore enhance preparedness, which in the end benefits flood resilience (Garvey, Paavola, 2022; Azad, Haque, Choudhury, 2022). To implement novel practices like SuDS in England, it is necessary to bring the public on board – effective engagement and communication are key to winning over the support and building the momentum for the uptake and upscale of SuDS (Azad, Haque, Choudhury, 2022).

### 5.5.3 Tensions caused by participants' different positionalities

As I find out, three participants (D, E and F) have experienced flooding events: they or their communities suffered from flooding in the past. This experience seems to have led to changes of positionality in two of them (E, a civil engineer; and F, an architect), as they choose to speak as a member of their communities to criticise the institutions' preference for GI over traditional schemes; whilst Participant D does not voice any criticism in the interview about the authorities or GI projects, likely due to their profession as a city councillor. I will further discuss in Chapter 7 how flood experience

shapes Participant D, E and F's perceptions of flood risk and influences the actions they take, but here I focus on the tensions caused by their changed positionality.

The two participants (E and F), relying on their professional knowledge and skills, mobilise their respective communities to form local flood action groups after they suffered flooding (Detailed analysis in Chapter 7). In the interaction with authorities as members of their local flood groups, their positionalities shift as they have to battle with institutions for the interest of their own communities. Their recollections shed light on the tensions, and more importantly, the reasons causing such tensions.

A pronounced rift emerges when E and F reflect on the approaches the EA takes to managing flood risk in local communities.

> *"There is a feeling amongst people who were flooded that the EA is more interested in preserving the environment and the other wildlife habitats -- letting things fall in the river, for instance, but it is the responsibility of the EA to move the tree trunks from the bed of the river. And we've reported them now for two or three flood forums in a year and the tree trunks are still there, restricting the flow. Whether the EA intend to move it or they're consciously not moving them, we don't know, but that's not moved"* (Participant E, civil engineer)

> *"We wanted the Environment Agency to identify short term actions to improve prospects in time for next winter, so that was two scales of things, isn't it? Sort that problem now, then we can look at the longer issue. That didn't happen really, because there's so much prevarication, so much difficulty in getting funding to spend money on something that might not necessarily be used in the later event. It tended to be nothing done. A lot would have been done: putting diggers in rivers and on the banks straightaway would give the public a lot of confidence, and it would also make people allay fears and we'd have less people having PTSD."* (Participant F, architect)

What the respondents have in common is that they both have personally experienced flooding events – they suffered and/or witnessed the devastating impact of flooding on their communities. This direct exposure to floods can fundamentally influence their perceptions of flood risk and their attitudes towards practices for boosting flood

resilience (Kuang, Liao, 2020). Literature indicates that the policies and approaches for resisting floods, e.g. floodwalls, are still preferred in communities that are flooded, as a result of people's flood experiences and perceptions of flood threat (Morrison et al., 2019).

The participants' remarks show that they are eager to see actions that favour the communities' needs – certainty and reassurance that are usually offered by the engineering oriented traditional schemes. Flooding events can lead to strong emotions in flooded communities, and such emotions, as revealed by the respondents, make it more difficult for local actors to champion or carry out SuDS projects (Terpstra, 2011; Ogunbode et al. 2019).

The professionals' prior knowledge of traditional schemes may further dissuade them from seeing GI as a viable alternative to traditional schemes, echoing the cognitive lock-in mechanisms (Klitkou, et al. 2015; Buzási and Csizovszky, 2023; Simoens, Leipold and Fuenfschilling, 2022). The traditional grey infrastructure, for them, stands for the known and delivers the protection they need; whereas GI stands for uncertain benefits realisation and higher risk.

## 5.6 Chapter conclusions

This chapter has examined the interviews with respondents in England to identify and analyse the challenges facing the professionals in the delivery of SuDS. There are a series of obstacles that are deeply rooted in the political and social environments of England, and therefore many of the challenges differ from those in China as analysed in Chapter 4.

### 5.6.1 The lack of legislative backing and the interconnected issues

One crucial factor, the lack of legislative backing, leads to a number of interconnected and interdependent challenges. Without the statutory status, SuDS implementation is at the whim of local actors and often sidelined by developers seeking higher profitability. This also means that retrofitting SuDS into existing urban fabrics is unlikely, restricting the scope and scale of SuDS. Moreover, non-statutory status brings about the issues of

project ownership and maintenance cost, which further discourage actors from taking up SuDS when their responsibilities are not clearly defined. On top of the said challenges, SuDS projects are usually plagued by unstable funding opportunities, which results in a lack of monitoring or maintenance and further complicates benefit realisation.

Another interconnected problem is the resource constraints, manifesting in the lack of skills in the field, including skilled labour and qualified professionals for quality supervision and inspection. According to the participants, policies in England like the austerity have damaged investment in human resources, and undermined an environment that could otherwise foster learning and knowledge circulation (O'Donnell, Lamond, Thorne, 2018; van Herk, et al. 2012).

Furthermore, the neoliberalism behind much of the policymaking in England manifests in the deregulation and the diminishing role of the state, suggesting that barriers related to legislation and funding are unlikely to go away in the short term (Duncan, 2022; Mell, 2020; O'Brien and Pike, 2019).

### 5.6.2 SuDS integration and connectivity

I found that there is a lack of connectivity between different SuDS devices, and SuDS projects are poorly integrated with the wider catchment area. Such issues emphasise the importance of systems thinking that sees flood risk in a certain location as interconnected with other elements in the complex urban system, which in turn necessitates evolutionary flood resilience as the holistic approach to addressing flood risk.

The issues identified here stimulates me to explore what professionals may learn in relation to the lack of systems thinking, and if any learning outcomes shape their responses or actions – this investigation is detailed in Chapter 7.

### 5.6.3 The conflicts between actors

As the participants point out, to design and deliver SuDS projects in England requires collaborative work with many stakeholders across different institutions. The multi-stakeholder environment creates discord among professionals, which is similar to that

found between Chinese experts who also clash on many fronts. Such tensions can be a result of different expertise, priorities, and positionalities.

Engaging with the public comes with various challenges due to their varying backgrounds and interests, creating hurdles for building up trust between institutions and communities, and making it harder to increase community buy-in for the novel practices of GI (Jang and Doyon, 2024; Schilling and Logan, 2008; Thorne, et al. 2018). Also I noticed how the changed positionalities of some participants bring about tensions between them and the authorities. Speaking for their communities' interests, those who have suffered flooding tend to be critical of the institutional approach to tackling flood risk, indicating how flood experience can shape their perceptions and priorities. Such changes in positionalities render it necessary for investigation into how their positionalities influence their learning process, which is detailed in chapter 7.

Moreover, this chapter reveals conflicts between professionals regarding the implementation of SuDS. One particular challenge for SuDS is that they are currently at a disadvantage when judged by the metrics designed for the traditional schemes. This discrepancy in performance discourages those who value quantifiable data from taking on SuDS. Hence, the tensions between those who actively promote SuDS and other stakeholders seem inevitable. Worse still, such tensions are exacerbated by the lack of monitoring and long-term maintenance, both of which further prevent SuDS from achieving the intended benefits and undermine the argument for the transition to GI.

Arguably, such tensions can also be associated with the lock-in mechanisms in transitions literature. Implementing GI, as argued in previous chapters, is a socio-technical transition that involves changes on many fronts and faces opposition from vested interests (Van Buuren, Ellen and Warner, 2016; Goldstein, et al. 2023; Wilson, 2014). It is now clear that there is an uneven playing field for SuDS projects because the existing rules and standards favour the traditional schemes; also the incumbents can question the performance of SuDS on the basis of evidence produced by grey infrastructure, all of which are similar to the challenges studied by scholars on the institutional lock-in mechanism (Seto, et al. 2016; Klitkou, et al. 2015).

On the other hand, the hurdles in engaging with the public, and the criticism from the participants who speak for the interests of their communities, resonate with the cognitive and social lock-in mechanisms (Geels, 2019). When communities' practices and lifestyles are organised based on the protection provided by flood defence infrastructure, their routines and mindsets are then hard to change, so they tend to ignore or resist new developments outside their scope (Goldstein, et al. 2023; Eitan, Hekkert, 2023; Klitkou, et al. 2015; Laurien, et al. 2020).

All in all, through examining the various challenges facing the professionals, I address the first sub-question. Together with Chapter 4, this chapter sets out the foundation for the following chapters: an investigation into how the professionals respond to the challenges and overcome the barriers to delivering GI projects. With the multi-stakeholder environment being a particular challenge for participants in England, it is intriguing to further explore if professionals learn from the interactions with other stakeholders, and what learning outcomes emerge from the changing power dynamics.

# Chapter 6 Actors' Situated Strategic Wisdom

## 6.1 Introduction

This chapter is developed around the theme of actors' roles in the socio-technical transition in the form of implementing GI. Throughout this chapter, I focus on examining how the professionals respond to the predicaments facing them and how they learn to overcome the barriers to facilitate the delivery of GI projects, aiming to address the second sub-question. In the review of the literature, I examined many of the transition studies, and identified a number of limitations, including insufficient attention on how the actors play a role in shaping a transition or how the power dynamics between actors influence the transitional trajectory (O'Neil and Gibbs, 2014; Beers and Van Mierlo, 2017). Hence, to better studying actors' activities in the transition to GI, I look into the concept of 'phronesis', or situated strategic-ethical wisdom, which reflects the importance of "situated institutional and individual capacities to learn and continually adapt to doing governance better" (Tyfield, Yuille, 2022, p. 2). I apply a phronetic view to examine the transitions by focusing on the wisdoms and skilled judgements of actors that 'cultivate the activity, direction and momentum of the progressive institutional change" (Ibid. p. 9). Crucially, phronesis is situated within local specificity, formed and shaped by actors' lived experiences and learning processes rooted in their predicaments (Kodama, 2021; Tyfield, 2020).

This chapter covers actors' operations in both China and England. Specifically, for China's context I investigate the prominent figurehead Yu because of his heavy involvement in promoting GI and introducing a different set of discourse on flood risk management that has been dominated by traditional grey infrastructure. As aforementioned, Yu accomplished a series of renowned projects featuring GI, and contributed to the creation of the national policy of SCPs. There is a rich corpus of text available online documenting Yu's philosophies and speeches, including a wide range of media interviews with Yu domestically and internationally. Through Foucauldian discourse analysis, I am able to scrutinise the discourse that he creates for advocating "sponge city" and expose the strategies that he employs to sway the officials and influence the policymaking process. I conduct a detailed analysis of Yu's story to demonstrate how technocrats like Yu can

operate strategically to challenge the incumbent interests and utilise the state machinery of China to help advance their agendas.

In contrast to their Chinese counterparts, professionals in England operate in vastly different social and political contexts. As examined in previous chapters, multiple interconnected challenges originate from the lack of regulation and legislative backing. On top of that, fundings are usually short-term oriented, and multiple stakeholders tend to have conflicts and tensions that may impede the rollout of SuDS. With such challenges facing the professionals, in this chapter I explore how the interview participants respond to these challenges, and reveal their calculated and strategic moves.

### 6.2 The pioneer of Sponge City Programmes in China

Chapter 4 shows that Kongjian Yu is arguably the most prominent figure in promoting the idea of 'Sponge City' with a great deal of press coverage of his success. The following is a dissection of his active role in mobilising officials to fund his projects, (re)producing his public image via media, influencing policymakers to change their mindset, and creating opportunities for the niche innovation of Green Infrastructure to thrive and spread. Yu's activities in this socio-technical transition signal that strategic operators like him have a significant role in shaping and changing the trajectories of a transition – SCPs are incorporated into a national policy and become a pivotal piece of the Ecological Civilisation discourse.

Table 6.1 below is a brief timeline summarising Yu's work in the years leading up to the adoption of SCPs by the central government in 2016. Before that, Yu accomplished individual 'sponge' projects in various cities and therefore built up the momentum to network and influence policymakers at different levels.

| Year | Actions |
|---|---|
| **2000** | The concept of 'sponge' first emerged in one of Yu's iconic projects – a park in Beijing's technology zone that used green infrastructure such as rainwater retention facilities and urban wetlands, demonstrating the functions of collecting and purifying rainwater. (Yu and Zhang, 2001) |

| | |
|---|---|
| **2002-2004** | Yu worked on the ecological restoration project of River Yongning in the coastal city Taizhou in Southeastern China. To implement this project, he persuaded city officials to knock down the concrete riverbank and floodwalls, and replaced them with 'adaptive' green infrastructure as well as a riverside park. (Yu and Li, 2003) |
| **2003** | Working with colleague Dihua Li (as mentioned in Chapter 4) at Peking University, Yu formalised the concept of 'sponge' in their published book named The Way to Urban Landscape: Communicating with Mayors (Yu and Li, 2003b) in which they also argued ecological and social benefits of urban wetlands, and advocated for building green infrastructure to be considered as a critical government strategy. |
| **2004** | Yu proposed ten key strategies for constructing 'ecological infrastructure' in both urban and rural areas, and this proposal was accepted by the Ministry of Housing and Urban-Rural Development of China. (Yu and Li, 2004) |
| **2005-2007** | Yu and his firm accomplished a number of 'sponge' projects in metropolises like Tianjin, Shenyang and the capital Beijing. These projects embody his values in landscape architecture and urban design. (Yu, Li and Han, 2005; Yu, 2010; Liu, Yu and Zhan, 2008) |
| **2006** | Yu's advice to the central government on the "ecological security patterns at the national scale" was valued by the State Council, and he was later commissioned to lead the national planning of the ecological security patterns. (Yu, 2006) |
| **2006** | Yu delivered a keynote speech at the 2006 ASLA (American Society of Landscape Architects) Annual Meeting and 43rd IFLA (International Federation of Landscape Architects) World Congress in Minneapolis, USA. The speech titled "Position Landscape Architecture: The Art of Survival" (Yu, 2006) is about finding solutions for the challenges caused by the deteriorating eco-environment. |
| **2009** | At the Ecological Urbanism Conference at Harvard University, Yu gave a speech titled 'The Big-Foot Revolution'. In the speech, he compared the grey infrastructure-focused flood practices in China to the notorious foot-binding tradition of limiting women's mobility, as he argued they were similar in that they were both 'unnatural' and promoted distorted values (Yu, 2013). |
| **2010** | Yu and his firm completed another high-profile project – a riverside park built on a brownfield of a former industrial site in the centre of Shanghai (Yu, 2011). This park is part of a larger area hosting the World Expo 2010. New |

| | |
|---|---|
| | technologies were used to create green infrastructure that purifies the polluted river water (Yu, 2011). The park won the ASLA Award of Excellence (ASLA, 2010). |
| **2011** | Working as an adviser for the Ministry of Housing and Urban-Rural Development, Yu suggested to the ministers the adoption of two new technologies – 'sponge' infrastructure for addressing pluvial flooding and urban wetlands for purifying water. (Yu, 2011; Yu, Zhang and Li, 2008) |
| **2011** | 1. A devastating flood happened in central Beijing that paralysed the city and led to 79 casualties. Yu wrote an open letter to the political leaders of Beijing to call for a change of course in urban flood risk management – shifting to what he promotes as 'sponge' practices. (Yu, 2011)<br><br>2. Yu presented his ideas of building 'sponge' cities in front of political leaders of the Southern city of Guangzhou. Guangzhou's first 'sponge' project – a wetland park that stretches more than 3 kilometres – started in 2013 in the central business district. (Turenscape, 2022) |
| **2013-2015** | The Sponge City Programmes were set out as a national strategy by President Xi in 2013; the subsequent construction guidelines were published by the Ministry of Housing and Urban-Rural Development in 2014; the State Council published further policy guidance in 2015 for promoting Sponge City programmes (Chan, et al. 2018) |
| **2015-2016** | The first batch of pilot cities (16 in total) for Sponge City Programmes was announced in 2015, while the second batch of pilot cities was chosen in 2016. (Li, et al. 2017; Nguyen, et al. 2019) |

Table 6.1 The timeline of Yu's work leading up to SCPs

### 6.2.1 The strategy of invoking a historic imaginary

The above timeline is Yu's frequent appearance in media, e.g. newspapers, TV news, and documentaries, for having in-depth interviews with journalists or giving talks to a wider audience. I believe this move is a key part of Yu's carefully calculated strategy to influence the discourse of flood resilience, and to establish a positive image of himself as an authority in the debate of flood resilience policy and infrastructure. First and foremost, in many interviews Yu tends to bring in his childhood memory as a starting point to

articulating the underpinnings of his philosophy – 'living with floods', which he claims to originate from ancient Chinese practices.

> *"For me (in my childhood), flood is a time of excitement because the fish come to the field, the fish come to the pond…We need to make friends with flooding."* (Yu interviewed by Gies, 2021)

> *"In my village growing up… 2000-year-old Chinese traditions say that if you cultivate four hectares of land, you set aside one hectare of land for water… Each family had their own pond to collect water from the roof and from the fields around the farm. Each household had enough pond capacity to regulate water on site. The ponds protected our family but also protected others in the community from dealing with our runoff."* (Yu interviewed by Park People, 2022)

Here, Yu constructs a discourse that suits his advocacy by reinventing a historic imaginary that has been cast aside for the past few decades in the wake of industrialisation and urbanisation (Mayer, 2018; Anagnost, 1997). His childhood experiences and observations are brought up to make his advocacy seemingly justified.

> *"I grew up in a riverside village… My relationship with water started when I was a child. There were seven ponds in the village for adapting to the seasonal change of rainfall: excessive water was retained during the monsoon season for later usage in the dry season. The cultivation and usage of lands in the village conformed to water, and therefore, the village was never flooded. We never feared floods, because there was an abundance of marshes, wetlands and ponds on two sides of the river that absorbed and retained floodwater – blurring the boundary between land and water, just as a sponge that boosts resilience".* (Yu interviewed by Architect Practice, 2021)

Here, the idea of 'living with floods' is being constantly reinforced and therefore normalised, signalling that the traditional way is unquestionable and unproblematic. In reality, however, there have been casualties and asset losses in every flooding event in the past (Luo, et al. 2015). What really happened in the past does not matter for his argument, because this is a purposely constructed discourse that forms a bigger strategy of his to connect to and communicate with policymakers. Through the repeatedly

revived historic imagination distilled from his supposed lived experience, Yu rejuvenates a seemingly lost memory of his generation – the generation that witness China's transition from an underdeveloped agricultural society to a rapidly industrialising and urbanising nation, also the generation that includes those who currently hold pivotal positions in governments (Zhang, 2017; Jia, Kudamatsu, and Seim, 2015). In doing so, an emotional connection is built with his primary audience who resonates with his visions.

After explaining the ancient practice of 'living with floods' and connecting the audience to the historical imaginary, Yu then brings in the brutal reality of modern society – everything that was cherished and valued by ancestors has now been destroyed and replaced with something vastly different: industrial, grey, anti-nature. This contrast in Yu's storytelling prompts the audience to reflect on the current practices and elicit an imagination of an alternative urban environment with the ancient practice in place.

> *"For the past 30 years [in China], we have destroyed the [old] system. We now build cities based on the early European urbanisation model, levelling the ground, laying down pipes and using pumps to work against gravity, filling in all of the ponds, channelising the rivers with concrete…"* (Yu interviewed by Daroy, 2018)

> *"In the modern era, we've forgotten this ancient wisdom. We've replaced it with the idea that we can control water with dams, floodwalls, and sophisticated drainpipes. The result is soil erosion, an interruption between surface water and groundwater, excess runoff, and severe floods."* (Yu interviewed by Park People, 2022)

> *"More than ever, facing global climate change and destructive industrial technologies, we have to rethink the way we build our cities, the way we treat water and nature, and even the way we define civilisation."* (Yu interviewed by Campbell, 2022)

The ancient wisdom is sanctified to a degree where it justifies Yu's call for a rethink of current policies and a revival of practices from the imagined old times when floods were not feared but accepted as the course of nature. Yu carefully constructs his case so far to lay the foundation for his proposal of 'Sponge City' that now appears to be a valid idea.

> *"The concept of 'sponge' in 'Sponge City' can trace its origin to the five-thousand-year accumulation of China's agricultural civilisation, which forms a whole system of techniques of flood management that adapt to the unique climate patterns… But the infrastructure our cities adopt now is the techniques invented in the industrialised European countries, destroying the old nature-based drainage systems… The primary cause of pluvial flood is the over-dependence on the industrial techniques that are grey infrastructure."* (Yu interviewed by Architect Practice, 2021)

> *"Sponge Cities are inspired by the ancient wisdom of farming and water management that use simple tools to transform the global surface at a vast scale in a sustainable way."* (Yu interviewed by Campbell, 2022)

Yu acts strategically on many levels. To start with, by contrasting China's native wisdom derived from agriculture civilisation to the industrialised practices of the West, Yu rebukes what he sees as ill-fitted Western technologies in China's urban fabrics, and hence elucidates the significance of old and native practices as the right way to tackle the current urban flooding issues. Moreover, this contrast is likely to elicit a sense of national pride from the audience, especially government officials, allowing them to focus on China's strength inherited from ancestors – in an era when the heightened geopolitical rivalry between China and the West are fuelling nationalist sentiments on both sides (Scobell, 2018; Bahi, 2021; Perthes, 2021). This nationalist undertone can easily play into the national mobilisation of 'the great rejuvenation of the Chinese nation'—a slogan under Xi Jinping's rule that is ubiquitous via state propaganda, so that Yu's criticism of the existing practices and his promotion of the ancient wisdom are both legitimised (Kallio, 2015; Carrai, 2021). This alignment between Yu's advocacy and the overarching narrative of the state is especially appealing to policymakers who are seeking solutions to urban flooding whilst fulfilling the Ecological Civilisation requests.

### 6.2.2 The strategy of (re)producing and reinforcing his image

Another calculated move for Yu is taking to the media to create an image of him that is conducive to his cause, showcasing him as a pioneer leading the debate of flood infrastructure in the public realm. In the years leading up to SCPs becoming a national policy, Yu has been fervently active in winning publicity, throwing himself into the

limelight and promoting the projects completed by his landscape firm, Turenscape. During this period, Yu's focus is mainly on the domestic audience. He is frequently interviewed or featured in documentaries about urban flooding issues by various state-owned media outlets (People's Daily, 2024; China Central Television, 2017). Consequently, the discourse of 'sponge city', and his philosophy are constantly reproduced and propagated in public spheres targeting domestic audiences. Meanwhile, he gains a spotlight on the global stage for winning heavyweight awards for projects at home (shown in Table 6.2). These internationally recognised projects serve as a validation for his ideas in the eyes of politicians at home and aid him in winning the battle of setting the discourse at home.

| Project Profile | Location & Year | Awards won |
|---|---|---|
| *Shipyard Park, Zhongshan*<br><br>Built on the site of an abandoned shipyard from the 1950s. The old docks and machinery were preserved and integrated into the park. (Turenscape, 2009) | Located in Zhongshan, on Pearl River Delta, South China.<br><br>Finished in 2002. | 2002 ASLA (American Society of Landscape Architects) Honor Award (ASLA, 2002) |
| *Qiaoyuan Wetland Park, Tianjin*<br><br>Built on what was a rubbish tip, the 22-hectare park is part of an urban regeneration project, featuring 21 excavated ponds to allow wetland plants to grow. (Turenscape, 2009) | Located in Tianjin, a major port city in North China.<br><br>Finished in 2008. | World Architecture Festival 2009 – Best Landscape Award (World Buildings Directory, 2009)<br><br>2010 ASLA Honor Award (ASLA, 2010) |
| *Houtan Park, Shanghai*<br><br>"Built on a brownfield of a former industrial site, Houtan Park is a regenerative living landscape on Shanghai's Huangpu riverfront" (ASLA, 2010) | Shanghai, East China.<br><br>Finished in 2010. | 2010 ASLA Award of Excellence (ASLA, 2010) |

| | | |
|---|---|---|
| *Qunli Stormwater Park, Harbin*<br><br>Situated at the heart of a newly built urban district, the 30-hectare Stormwater Park, acting as a 'green sponge', is an urban wetland. (Turenscape, 2011) | Located in Harbin, Northeast China.<br><br>Finished in 2011. | 2012 ASLA Award of Excellence (ASLA, 2012a)<br><br>2012 International Architecture Award (The Chicago Athenaeum, 2012) |
| *Yanweizhou Park, Jinhua*<br><br>A wetland park located in the middle of a confluence of two rivers. (BBC, 2024; Turenscape, 2014) | Located in Jinhua, East China.<br><br>Finished in 2014. | World Architecture Festival 2015 – Landscape of the Year (World Architects, 2015) |

Table 6.2 Some of Yu's iconic projects that won international accolades.

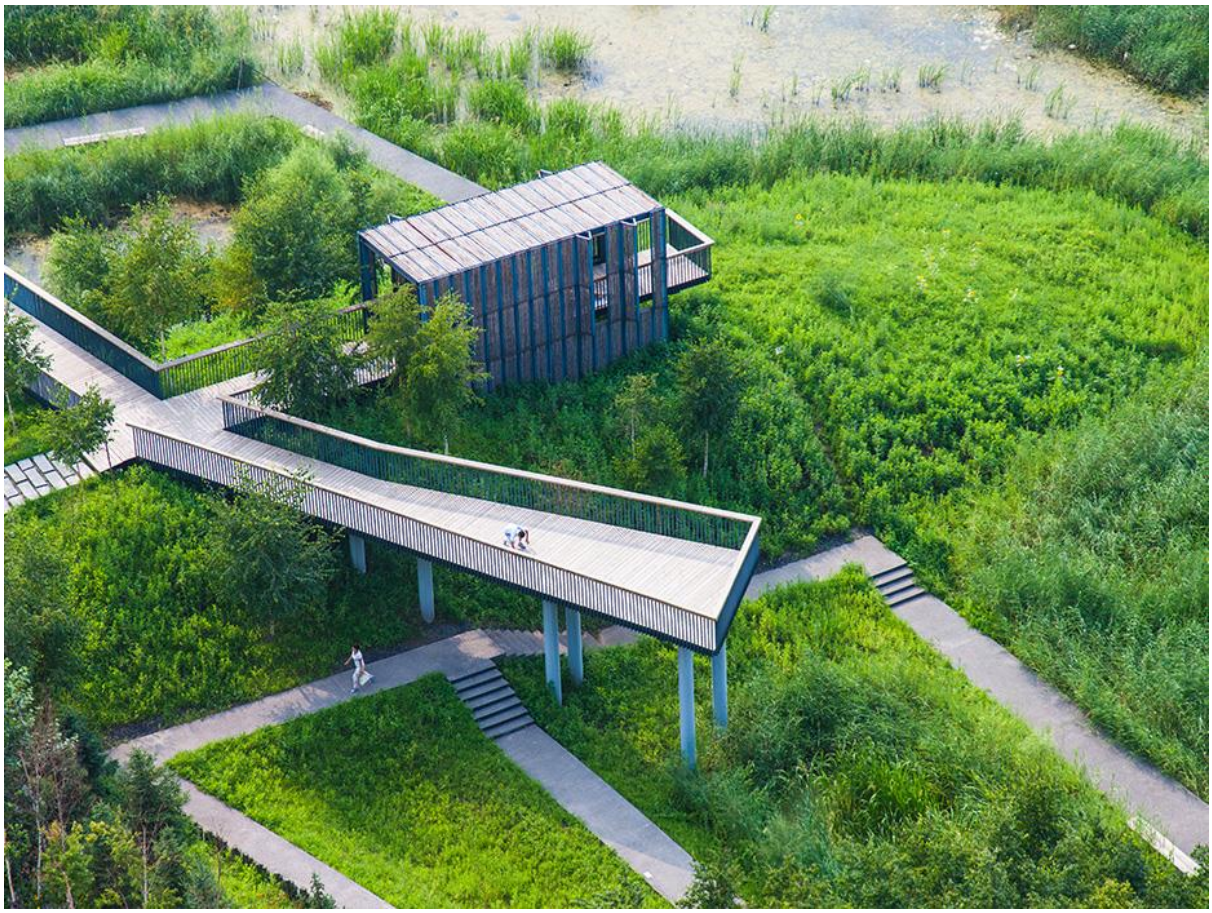

Figure 6.1 Qunli Stormwater Park, Harbin (Credit: Turenscape)

Figure 6.2 Yanweizhou Park, Jinhua (Credit:Turenscape)

Figure 6.3 Fish Tail Park, Nanchang (Credit: Turenscape)

Drawing on his study and work experience in the US, Yu asserts himself as commanding the state-of-the-art knowledge acquired in the West to form the 'Sponge City' philosophy, on the basis of his understanding of ancient practices – "the peasant wisdom" (Gies, 2021). This becomes a unique selling point of him to both media and policymakers. Admiration of Yu, such as "Western systematic thinking is grafted together with traditional Chinese wisdom" (Daroy, 2018), is often seen on English language media targeting Western audiences.

> *"However, to revive the wisdom of agricultural civilisation is not to simply go back to the old path. Rather, it is built on the foundation of industrial civilisation and the systemic understanding of water, while integrating a range of advanced practices such as Low Impact Development in the US and Sustainable Drainage System in England… The Sponge City concept is formed as a combination of traditional agricultural civilisation and the modern science of water, so the concept boasts both a link with old local knowledge and a representation of advancement." (Yu interviewed by Architecture Practice, 2021)*

After SCPs are initiated nationwide as a key policy, Yu is widely seen as winning the national endorsement of his thoughts and projects, resulting in another round of promotion among world media, such as BBC, The Guardian, The Sydney Morning Herald, World Economic Forum, and CNN (Delaney, 2018; Backhouse, 2018; Myers, 2019; Wong, 2021; Paddison, 2023). The constant (re)production of his discourse through both domestic and international press enables him to become the figurehead representing a socio-technical transition that embodies a new set of ideas and practices for dealing with urban water issues. His name is therefore associated with the landmark Sponge City Programmes. Associated Press dedicates an entire news article to Yu and his advocacy of 'Sponge City' (Fujiyama, 2022); Euronews credits Yu as "the mastermind behind" the concept of 'Sponge City' (Campbell, 2022); The Guardian reports that "Yu is leading the way as China re-engineers old cities and designs new ones to accept rather than fight natural water flows" (Gies, 2022). Consequently, the momentum enables him to open the door to wider international communities for promoting his thoughts and his business overseas, he has since been invited as a speaker in various global forums and high-profile conferences, including the United Nations Environment Programme (Turenscape, 2021).

The way that Yu constructs his image and markets his ideas reveals multi-layered power dynamics that interconnect different groups of his audience, including professionals, politicians and the public. Within the multi-layered power dynamics, his image and his career are two core elements that are mutually reinforcing. First and foremost, his US-educated background introduces him to professional circles, and gives him a competitive advantage in China where talents like him are rare; with the positive media coverage, he garners the attention of professionals and academics in the West, who then award him many times for his talents and boldness in transforming China's urban landscape. Daroy (2018) summarises that Yu "won a staggering number of awards, including 12 ASLA Awards; five Human Habitat Awards; four World Best Landscape Awards; three Excellence on the Waterfront Awards and an Urban Land Use Institute (ULI) Global Award of Excellence". Moreover, the fact that he won some world-renowned awards, in turn, encourages the media to follow his stories closely, so his image is being constantly reproduced and perpetuated via the broad media coverage on the world stage. Meanwhile, Yu never hides his identity as a businessman searching for public attention and potential contracts for his architecture firm Turenscape (ASLA, 2012b; Brook, 2024). The media works in his favour by bringing him customers from China and abroad. This, in turn, maximises his opportunity to take on various projects with ambitions to win more awards. With the widespread positive media reports and the international recognition, he thus strengthens his professional as well as political status in the highly competitive power hierarchy of China.

### 6.2.3 The strategy of lobbying and networking

The reputation and fame gained on the international stage with the help of the media are reflected in his growing influence on domestic policymaking. As is shown in Table 6.1, Yu has talked to officials many times or presented his ideas in government meetings and has been commissioned with government tasks.

In one interview, Yu points out the reality that urban design in Chinese cities is the job of mayors rather than urban designers, an example of the top-down, authoritarian way of decision-making. He further explains:

*"The first book I wrote after I returned to China (after studying and working in the US) was called 'the road to urban landscape – communicating to city mayors' … Since urban designers and architects in China cannot conduct their work independently, then mayors must be educated, enabling them to know what good urban design is. If designers and architects in China want to make their views count, they have to target officials at the top. Because we have very limited power, we have to sway influential people and educate the influential to materialise our ideas and visions. This is what I have been doing over the years. For example, I had been promoting the Sponge City concept that would boost urban water resilience before it became a national strategy… This is how urban designers can step in and have a say on the practical issues facing China today. You have to realise the powerlessness of urban designers, so we need to implement good ideas through state machinery, this is my core experience over the years." (Yu interviewed by DESIGN, 2019)*

Writing an in-depth report on Yu and his projects, journalist Erica Gies from MIT Technology Review is invited to meet Yu in various settings. Recording her experience of visiting Yu's private club where Yu socialises and networks with people, she writes:

*"He bought and renovated a building in one of Beijing's few remaining historic hutong neighborhoods, turning it into a private club for fellow Harvard grads, Beijing politicians, and other power brokers. This move is in keeping with his modus operandi, according to Niall Kirkwood, a professor of landscape architecture and technology at Harvard's Graduate School of Design who has known Yu for many years. Kirkwood says Yu is a political animal, and that this—along with his vision and ambition—accounts for his success… I got a chance to observe Yu in his natural habitat that evening. He escorted me and Geng into the club… Finance ministers were also visiting the club that evening, so Yu rotated between our tables." (Gies, 2021)*

When visiting Yu's home, Gies notices that "in the hallway are photos of his family back on the farm, Yu and his Harvard mentor, Yu with two Chinese presidents." (Gies, 2021). This frequent and close contact with some of the most senior policymakers in the country is vital for Yu to make his voice heard most effectively. As noted earlier, Yu acknowledges that by influencing 'the influential' people, ideas of his are discussed and

understood. This shows how agents can have an augmented impact on policies even in an authoritarian setting where the power rests in a few at the top: utilising their 'guanxi' networks to mobilise resources to their advantage (Bian, 2018; Huang, Westman and Broto, 2021a).

### 6.2.4 The strategy of utilising the institution to break the lock-in

In socio-technical transitions, lock-ins are "the inertia built into certain infrastructures, technologies, institutions, and behavioural norms" (Ürge-Vorsatz, et al., 2018, p. 174) that create and perpetuate path dependencies. Lock-ins pose a systematic challenge to social actors seeking new development pathways, as they have to fight against the constraints that could stifle the alternatives. Although the lock-ins are present in the making of flood resilience policies and projects, well-suited strategies can break the impasse and push for changes. As Van Buuren et al. (2016, p. 41) conclude, "specific mechanisms of path dependency, for example, the existing power asymmetries between competing coalitions and the intricate complexity of flood policies, prevent institutional change, but cannot prevent ideas about resilience slowly gaining more impact." Yu works wisely and strategically to spread his ideas on the basis of both his knowledge and his understanding of the system and power hierarchy in China.

> *"…in China, you have to make the policymakers understand (your ideas). Chinese landscape architects have little power in shaping discourse, but if you could make use of the decision-making systems and the administrative institutions to promote your ideas, then you would have a voice and thus the power of setting discourse".* (Yu interviewed by GUDE Design, 2016)

Yu is also aware of the forces that may stand in his way to a transition. He makes it clear that "*to create a new type of landscape requires new aesthetics and standards, and thus demands subversion of the existing values and aesthetics*." (Yu interviewed by Architectural Knowledge, 2015). A lock-in manifested in the rollout of SCPs: the resistance of the incumbents, including politicians and technocrats, whose interests are deeply rooted in the existing policies for flood risk management. Professionals in the fields of engineering, architecture and urban planning see the ideas of Yu as challenging their authorities and competing against their core interests (Hong, 2017). In the event of

Yu being made a candidate for the prestigious Chinese Academy of Engineering, an open letter signed by dozens of heavy-weight professionals is published online to oppose this decision, denouncing Yu's advocacy and questioning his motives (Hong, 2017). The open letter argues that Yu chooses to "desecrate and debase China's traditional culture heritages" for promoting his own ideas influenced by American values, and accuses him of being "money-grabbing" by taking advantage of "the mentality of local politicians who blindly worship everything American and dictate the decision-making process" (Hong, 2017).

The power struggle signals the incumbent interests are entrenched in the old way of addressing flood risks in cities: once the transition happens, the professionals who do not have the same kind of knowledge as what Yu has gained in Harvard will be less competitive in the job market; enterprises for design and construction that do not have the know-how to deliver "sponge" projects will find it difficult to survive. Confronted with the fight of setting the flood risk discourse, Yu takes advantage of the authoritative governance model so that policies can be made in his favour: "*one must rely on the administrative power of China to rectify the wrongs because the outdated knowledge and faulty practices were introduced and normalised through the very administrative power, the changes can only happen in the same way*". (Yu interviewed by GUDE Design, 2016).

Other than mobilising the authoritarian power relations, Yu acknowledges the significance of social actors in shaping the discourse and shifting the power struggle in his favour. He carefully walks a tightrope between influencing the highly centralised administrations and mobilising the general public without antagonising the former. To achieve that, he often aligns his beliefs with the grand strategy of Ecological Civilisation endorsed by Beijing, validating his move of acting as an agent on behalf of the government to communicate to the people.

> "*We need to disseminate the new ideas that would make our clients, the society, and particularly policymakers change their values… this is the way to creating new aesthetics. When there is a collision between the old and the new values, we urban planners alone cannot address it, the whole society must come together to advocate*

*Ecological Civilisation. That's why I cannot stress enough that urban designers are more than artisans drawing blueprints, more than professional technicians, they have to get in contact with social actors and change social values. So you often see me in mass media promoting ideas and concepts, rather than merely publishing papers*." (Yu interviewed by GUDE Design, 2016)

### 6.3 Professionals in England and their reflections

In China's context, Yu's success in pushing for a socio-technical transition is enabled and perpetuated by the 'guanxi' network as well as the centralised policymaking at the top. In contrast, the process of implementing flood resilience projects in England is more fragmented, carefully negotiated and opportunistically funded.

As I examined in Chapter 4 and 5, the interviews with participants in England illuminate that some challenges, such as the shortage of skills and the lack of maintenance, are common in China as well. However, the context of England also gives rise to difficulties that are not seen in China's case, including the lack of legislative backing, the unstable funding opportunities, and the barriers in the multi-stakeholder environment. In the face of such predicaments, they work strategically to create better conditions for delivering their projects despite the difficulties in the process.

#### 6.3.1 Overcoming the mutually reinforcing vicious circle

As elaborated in chapter 4 about SCPs in China, the policy and guidance installed by the political centre in a top-down manner leave actors on the ground little room to inject their visions when it comes to carrying out a project. Those who are eager to make a change, such as Yu, utilise and expand their networks to influence and persuade the top policymakers.

In England, there is a lack of vision and long-term goals from the authorities about GI, as I examined in Chapter 5. Without strong regulations, a myriad of questions, e.g. if and how GI can be employed, what the intended benefits are, or how GI fits into long-term plans for flood resilience, are not addressed (Melville-Shreeve, et al. 2018; Knapik, Brandimarte and Usher, 2024). The absence of guiding policies from the top impacts the

funding available for GI projects (Ellis and Lundy, 2016; Lashford, et al. 2019). In the research interviews, Participant C, G, J and K mention that funding is unlikely to be long-term oriented, so the scopes, scales and potentials of projects are constrained. Faced with this conundrum, the respondents have to work around many institutional hurdles to implement the projects.

> *"Because we only really get funding for one year. Unless it's a scientific study, it's quite difficult to get long-term monitoring… I haven't monitored something so scientifically that I've been able to say this has made a definite impact on this community at risk of flooding, because the money hasn't been available for that… There isn't the resource, as in people, to monitor everything we do. So we just use the evidence we've got to assume it will work. I guess that's where we're at the moment. We can't afford to monitor absolutely everything. Also I found that the match funders that fund things that aren't the government, they prefer to see outcomes. So they prefer to see the habitats created rather than pay for staff to monitor."* (Participant J, urban planner)

Participant K, a project manager, echoes the issue – it is difficult enough to acquire funding for the construction phase, but the post-delivery maintenance requires long-term funding that is even more challenging to secure:

> *"What is more complex than the capital money that goes into creating a 'sponge' park, is the maintenance and management of a park long term because the moment you create something of really high quality, it costs a lot more to be managed in future… it's a lot more to maintain, especially if you want to maintain that high standard. So that's where the complexities really come in and that's where we still haven't really completely resolved some of those."* (Participant K, project manager)

*Similarly, Participant C said "…funding and the cost [of maintenance and monitoring] are a major obstacle… the last thing you want to see happen is [the project site] being overgrown and full of rubbish"* (Participant C, project manager).

There is a vicious circle that consists of three elements: visions, funding, and monitoring & maintenance. The three interconnected and interdependent components seem to mutually reinforce one another. To start with, visions are missing from the policymakers.

The absence of long-term goals from the top means that projects at a local scale lack a policy underpinning, leaving greater leeway for those who work on the ground to adapt to the predicament they are in (O'Donnell, et al. 2020; Potter and Vilcan, 2020; Ellis and Lundy, 2016). Such difficulty prompts professionals to make skilled judgements based on their experiences and command their practical wisdom to grasp opportunities available. Additionally, as mentioned by Participant G and J, the absence of visions creates a level of uncertainty about the progression of Green Infrastructure, so the funding schemes tend to be short-term oriented with the aim to see tangible outcomes in the shortest time possible, instead of investing in a long-term fashion to allow for scientific assessment and monitoring. Furthermore, as mentioned by Participant F, G, H and J, due to the scarcity of funding, projects are designed to be small-scale and the process of monitoring is often omitted instead of being part of the project delivery (). Without the follow-up monitoring, new projects are less likely to be shaped by the supposedly important lessons learnt in previous projects, and the constant lack of monitoring data fuels suspicion and distrust among professionals and policymakers (Participant F, G, H and J). *"It's very difficult to say for sure 'this is what's happened' [about the performance of a project], because we haven't monitored it… there's always suspicion when that is not clear…"* (Participant H, flood resilience specialist).

Such realities make it even harder for potential projects to get sustained funding, let alone long-term investment, hindering knowledge accumulation and sharing among policymakers. Hence, a mutually reinforced vicious circle is formed: the benefits of GI are hard to sell to policymakers or unconvinced professionals, further impeding the formation of a long-term vision to encourage the uptake of Green Infrastructure.

Nonetheless, in the face of such difficulties, participant G utilises their practical wisdom to adjust their strategies for delivering GI. The respondent seeks to build partnerships with private financing and remains optimistic about continuing to deliver GI projects in future.

> *"What's developing is these codes. So there's different codes like carbon codes and water codes and soil codes. And because of climate change and the need for either offsetting carbon or marketing your company in a more socially responsible way,*

*there is now more interest and the codes are developing, like the woodland code, the peatland code. There's lots of different codes that queued us to private companies in terms of their green business models. So there is a lot more investors that are now willing to invest in it because ultimately it's good for their business." (Participant G, water engineer)*

Another example is respondent J. Understanding that project maintenance remains a big hurdle for GI projects because fundings tend to fall short and are likely to be short-term, respondent J actively link different legal frameworks together to ensure the projects are more likely to be maintained in the long-term.

*"For my projects I try and make them more natural so there's less maintenance and if it does require maintenance, I will try and link it with Natural England Land Management schemes so that the landowners are maintaining them."* (Participant J, urban planner)

### 6.3.2 Opportunistic decision-making

Faced with the challenges in securing funding for GI, Participant A, B, H, J and K mention how they have to be opportunistic and flexible to adapt their projects to windows of opportunity that are available. Although the primary purpose of GI projects is to address flood risk, there are cases when such projects are delivered in areas that are not prone to floods:

*"The area itself is not a high-risk area in terms of flooding"* (Participant B, community engagement lead).

*"The site is not really known to have flooded, at least not in a very, very long time"* (Participant K, project manager)

These projects are delivered mainly because opportunities align, e.g. enough funding, a suitable site. "*You can have an area that is prone to flooding, but it's not necessarily the right location for something of the scale*" (Participant A, urban planner). Participants are still happy to learn from such projects – "*we can still get the learning from swales and the rain gardens, even if it's not an area that floods, because SuDS is about how it*

*manages the volumes of water.*" (Participant B, community engagement lead). Similarly, Participant H mentions some projects are designed and delivered in a small scale without considering integration with the wider catchment planning.

> *"Nature-based solutions could be opportunity based on what landowners are willing to do…it could be based on whether funder is going to fund or not… Sometimes because of the way funding works and time, people don't have the time to design a project based on physical geography and hydrology. So it's a bit more opportunistic, like opportunity-oriented, which means you haven't got the full catchment picture in project."* (Participant H, flood resilience lead)

> Participant A says that GI projects are usually delivered to accompany new land development rather than being purposely envisaged and designed to manage flood risk. *"The council has to provide land for housing… so when developers are designing new development, that's when you need to try and make things better, the way to make it better is ensuring that you've got the green and blue infrastructure in there"* (Participant A, urban planner).

As aforementioned, the vicious circle – the absence of guiding policies and long-term visions, in conjunction with the shortage of fundings – creates uncertainties as to if and how a project can be implemented, which explains why at present GI projects are often opportunity-based rather than being part of a long-term or catchment-wide plan for addressing flood risk. Participant K reflects that they only take on SuDS projects when it is convenient and have little idea about GI beforehand.

> *"The council always had the vision that the old park was going to be improved as part of the regeneration. So almost at the right time really, we were approached by the EU to see if we wanted to take part as a demonstration project for flood resilience… So we put in a bid for that to base the project at this regeneration site and we were successful… The idea of 'sponge park' wasn't something the Council thought of, it was because we took part in the European Commission project… There's not really a very clear reason for choosing this site, it was just the right timing because we had this space that needed to be redeveloped and the funding came along for this project. So we combined the two."* (Participant K, project manager)

Remarkably, the participant here indicates that actors in the city council decide to utilise the rare funding opportunity to transform what would otherwise be a normal park. By connecting to the EU programme, the actors thus acquire a chance to learn novel practices with fellow European cities through participation and communication, so that new knowledge is created, shared, and gained. In doing so, the council also secures a large sum of financial investment to facilitate their urban regeneration programme, enabling them to politically showcase their progress and advertise the council's competency alongside the intended benefits of the GI project.

### 6.3.3 Working in a multi-stakeholder environment

In chapter 5, I showcased that attempting to deliver SuDS projects in a multi-stakeholder environment is challenging because of the potential conflicts and tensions. Even within the same institution, actors from different departments can have diverging opinions originating from their expertise and priorities, as mentioned by Participant F, G, H and J. To push through GI projects amid such tensions is a test of the professionals' skills and judgements.

> *"There's lots of different stakeholders but trying to create a vision for an area is also key and that is difficult to do because a lot of people specialise in certain topics and not necessarily all thinking in an integrated way, so we try to integrate it so that it ticks lots of boxes and it can be funded in lots of different ways, that's really key."* (Participant H, flood resilience lead)

> *"A lot of people are still thinking that with traditional flood scheme there's very mathematical evidence. I feel that there is still quite a lot of people that are uncomfortable with the lack of evidence as nature-based solutions being a bit more theoretical… because you can't quantify it in the same way as you do a floodwall. So for us to get a project through, we have to get quite a lot of approval and the bigger the project is, the more approvals we need… so our projects probably aren't as big and strategic as they could be because of the amount of time and resource it takes."* (Participant G, water engineer)

Here again, the novelty of GI and the shortage of quantitative evidence apparently bring about tensions, especially when funding opportunity is involved. Respondents (F, G, H and J) showcase their ability to navigate the complex power relations, and to manage different expectations on results and tolerances of uncertainty: *"A lot of the time I have to take the cost-benefit away from a subjective discussion around things and move it to an objective discussion on the drivers, and value metrics, because otherwise you will clash heads up and everybody has the point they want to go out from it and lose the key focus."* (Participant F, architect). Understanding the nuances embedded in such challenges and thinking of responses to tackle the various issues in the multi-stakeholder environment are a clear demonstration of the professionals' situated wisdom – quick learning and adjusting their strategies accordingly (Rogers, 2014; Tyfield, 2015; Kodama, 2021).

Through the interviews, I find that some respondents (B, C, and K) actively engage with the public, cultivating the public' interest in the novel practices, boosting GI's popularity and fostering opportunities for future projects; whilst Participant J understands the importance of maintaining long-term commitment to landowners: through building mutual trust and understanding, they garner stronger support and increase landowners' willingness for embracing future projects.

> *"So the language we use to engage people is critical, it has to be something more practical and fun for people… we use a lot of visuals to engage, and we ask what their interests are, which is the first part of our conversation. And then we can build on it from there and start bringing in conversation about flood resilience. Once we have that initial relationship with people, it's definitely the building of the relationship that's really important… We organise creative activities with people, have a bit of a chat and just try to make it sound a lot less scary, I think that's key to engaging better."* (Participant B, community engagement lead)

> *"It takes a lot of time to build relationships with landowners and you can't just go in say 'I want to do this' and then disappear and not have some kind of long-term commitment with them… What I try to do is work with charities that have a presence in the local area. So I'll try and work and ensure that there is a longer term because*

*landowners need to trust that you're not just going to go in and mess up the land and then walk away. So I try to work with local charities that will be there no matter what, because our organisation is not as locally placed as the local charities."* (Participant J, urban planner)

Participant J adds that, in some cases active engagement may not be enough for bringing some stakeholders onboard with GI projects, because they want to gain tangible benefits – financial incentives are an important factor that can deepen the collaboration. Therefore, the respondent relies on their professionalism to ascertain the possible conflicts and deliver the projects in a way that suits stakeholders' demands, which necessitates both skills and wisdom.

*"Other than understanding how to deliver the project, we have to ensure that landowners get something out of it. So the future of nature-based solutions is probably going to be influenced by funding and where future funding comes to the landowners. So I think we need to be really understanding where that funding, especially if it's private finance, is coming from so that we can influence those decisions."* (Participant J, urban planner)

In contrast to the multi-stakeholder environment in England, when Yu promotes his vision of "Sponge City", he understands that political leaders have the sole power to decide the fate of his projects, and therefore he sets on a drastically different trajectory – persuading government officials at the top and educating mayors at local levels. Hence, his actions can be made sense of; whether it is giving controversial public talks or receiving media interviews at home and abroad, he acts with a bigger strategy in mind – reinforcing his image and gaining attention from the officials, so that he is better placed to network and influence the policymakers. Whilst in England, situations are more challenging for professionals as they have to strike a balance in the often-contentious multi-stakeholder environment. They also act with a full picture in mind: whose interests should be prioritised, whose advocacies should be heard but cannot be acted on, how to manage the varying expectations from different stakeholders, and how to tailor GI plannings to promote specific benefits to suit certain audience (Warner, 2006; De Brucker, Macharis and Verbeke, 2013; Mostert, 2007). All of these actions require

professionals to be strategically minded and proactively learn from ever-changing situations.

### 6.4 Discussions

In this chapter I employed Foucauldian discourse analysis (FDA) to scrutinise various speeches given by Yu and many interviews he did with journalists, showcasing how Yu is challenging the dominating discourse about flood risk. To reinforce his discourse of "sponge city", he also marginalises and dismisses other interpretations, creating a single "truth" about his advocacies (Akdag, Swanson, 2018; Waitt, 2016). Through his strategies of marketing his ideas via mass media, his discourse is constantly (re)produced, and he is empowered to compel the audience to think in a way that advances his cause. In the literature review chapter, I mentioned that the transition to GI is also a transition of power dynamics: the power/knowledge relations and technologies are transformed alongside subjectivities, identities and agencies (Tyfield, 2014, 2018). Resonating with that point, the discourse of his in this chapter represents the dynamics of power/knowledge, through which he influences officials to see adopting GI as the right way forward, and therefore consolidates his power in defining the discourse and his dominance over what to think/do in the context of flood risk management (Khan, MacEachen, 2021; Arribas-Ayllon, Walkerdine, 2017).

Regarding the transitions studies, many of the papers I examined, particularly those that employs the MLP, see that there is stability in socio-technical regimes as the configurations, the set of rules between different social actors are relatively stable, and innovations happen incrementally (Geels, 2002; Geels, Schot, 2007). However, this chapter has shown that in China's context there is little stability in regimes or the wider landscapes, because a substantial change of policies can happen in the span of a few years – the central government supports and promotes the SCPs with state fundings for dozens of cities across the country. Also, no three levels of variables can be clearly demarcated and identified, because actors like Yu not only promote niche innovations, but actively work with both the state machinery and the local governments.

As such, a research gap is that much of the transitions literature is conceived and developed in the context of Western societies, which Huang, Westman and Broto (2021a)

argue are drastically different to that of China. Instead, they believe that 'guanxi' (a structured order of relations) is the fundamental constituent of Chinese society, and propose a correlative perspective to interpret transitions as being shaped by pre-existing guanxi networks (Huang, Westman and Broto, 2021b). They stress that the importance of guanxi in Chinese society "means that 'who you are' (in terms of relations) might matter more than 'what you are' (substance)" (Huang, Westman, Broto, 2021b, p. 911).

In this chapter, the examples of Yu acting strategically to achieve his goal resonate with the correlative perspective – guanxi networks are mobilised strategically by actors like Yu to channel resources, e.g. knowledge, capital, legitimacy, to facilitate the transition (Huang, Westman, Broto, 2021b). Such examples indicate that employing a correlative approach provides a crucial perspective for studying transitions in the highly centralised and authoritarian policymaking environment of China. By focusing on the power dynamics within the relations between actors in this chapter, I thus highlight the agency of actors and showcase the important part that such agency plays in enabling a transition. In doing so, I contribute to closing the research gap by offering insights from key actors in the socio-technical transition to GI in the context of China.

Not just Yu but the professionals in England as well have demonstrated a high level of agency in the face of challenges. I believe the agency of actors is closely related to the learning of the actors, i.e. their ability to learn from the predicaments. Phronesis, the situated strategic wisdom that derives from learning, indicates the dynamic and ever-changing environment in which actors are operating. Such dynamics also resonate with the evolutionary resilience thinking that I have examined in the literature review chapter. For evolutionary resilience, there is no equilibrium, or an end point, for urban systems to be at. The concept of resilience itself is a state of constant change that requires continuous adaptation and evolvement, highlighting the significance of learning and echoing with phronesis.

Phronesis, hence, is the core that ties the two different contexts together. One is about a crusading figurehead that challenges the incumbent interests and strategically utilises the guanxi network and the state machinery for advancing his agenda; the other is a collection of actors who work strategically to avail or create opportunities for trialling GI

projects. To act tactically, judge the circumstances and find appropriate solutions to each problem indicate the actors' situated wisdom derived from their ability to learn. Phronesis, as Tyfield and Yuille (2022) conclude, is "the self-conscious practice and orientation to cultivation of ever-greater skilfulness in both strategic and ethical regards, and hence, in turn, to learning about such learning" (p. 5).

### 6.5 Chapter conclusions

This chapter is developed around the professionals' operation to overcome barriers in the two countries, clearly demonstrating their high levels of agency. Hence, the sub-research question on how the actors rise above the challenges and deliver GI projects is answered: the professionals showcase remarkable strategic wisdoms situated in their experiences, or in other words, they quickly learn from the predicaments and adjust their ways of operation.

In China's context, before the formation of SCPs, the discourse of flood risk management was dominated by the then incumbent interests who believed in hard engineering projects. Yu enters the arena with the aim to subvert the status-quo and promote his belief in GI. Faced with the rigid power hierarchy in which only government officials can determine policymaking and any policies are enforced top-down, Yu learns the importance of relying on the state machinery to push for changes. Backed by numerous accolades he won as well as the global recognition of his projects within the field, Yu strategically creates an impressive image in front of domestic and international media, links his projects with traditional Chinese wisdoms, utilises provocative language in his speeches – all to draw the attention of the authorities and allow him to stand out from peers. Yu also learns to create, expand, and maintain 'guanxi' networks, enabling his meticulously constructed discourse of "sponge city" to be convincing and well-received by officials.

In England, due to the lack of guidance and legislative and political support from the top, SuDS is therefore in competition with traditional schemes. Professionals on the ground face a wide range of challenges, many of which are related to the unclear statutory status of SuDS, such as the ownership of projects and the cost of maintenance. Respondents in England showcase that they act strategically and opportunistically to promote GI. For

example, some actors combine a one-off funding scheme with the existing urban regeneration programmes to deliver a GI project; others utilise their expertise to connect GI with laws on land management to ensure projects are maintained in the long term. In the face of a multi-stakeholder environment where there are conflicts and tensions, they learn to consider the different priorities and responsibilities, to communicate, negotiate and compromise – a clear demonstration of their situated practical wisdom. This wisdom, or phronesis, is what connects the actors in the two countries. Albeit working in vastly different settings, through continuous learning, they all have the strategic wisdom formed in their predicaments and cultivated by their lived experiences.

Therefore, regarding the sub-question of how the professionals overcome the challenges, it now becomes clear that many actors demonstrate extraordinary ability to learn from their predicaments. Such learning allows them to develop situated practical wisdom for navigating various difficult situations and devising strategies accordingly.

# Chapter 7

# Learning in the Implementation of Green Infrastructure

## 7.1 Introduction

This chapter centres on the 'learning' element of the research, and addresses the last sub-question: what is (not) learnt in the process of delivering GI projects, and how the learning outcomes impact flood resilience.

I employ grounded theory and thematic analysis to analyse the interview transcripts, generating insights into the details of professionals' learning experiences. First, I provide an account of learning that I observed in China's context, before looking into the various ways of learning in England. Drawing from the rich literature on learning, I identify three main types of learning from the participants: learning from flood experience, learning by doing/through trial and error, and learning in the multi-stakeholder environment. The various forms of learning generate a range of learning outcomes, some of which are particularly pertinent to the scope of this research study. I therefore further investigate the outcomes in relation to the attributes of flood resilience that I detailed in Chapter 2, namely preparedness, adaptability and transformability.

In doing so, I complete the last piece of the puzzle for this study: after I found out the challenges facing professionals in delivering GI projects in different social contexts, I then explored their remarkable situated strategic wisdom that helps them to overcome numerous challenges. Such wisdom is already a testimony of the professionals' ability to learn from the predicaments, but in this chapter, I offer further details about their various learning experiences and connect such learning back to attributes that enhance flood resilience, aiming to emphasise the significance of learning in evolutionary resilience.

## 7.2 Learning observed in China's context

From the conceptualisation of this research study, I experienced difficulty accessing necessary data in China's context, and interviewing participants in China through video

calls was particularly challenging as respondents were unwilling to touch on sensitive subjects related to policymaking and politics. With the asymmetry of data availability across both two countries, I do not intend to conduct a comparative study juxtaposing the data from China and England, but instead I wish to present the available data from China with my analysis of how the 'learning' element manifests in the changed policies and mentality revealed in the limited conversations with respondents.

In China's context, after extensively reading through policy documents and official publications I find little trace of the concept of resilience in the years leading up to and immediately after Sponge City Programmes were integrated into national policy. The term 'flood resilience' only started to emerge in official documents from around 2020 (Xinhua News, 2020), long after the concept of 'Sponge City' gained prominence in 2013 (Chan, et al. 2018). The lack of Chinese academic research about 'resilience' and the little political attention it gains are also reflected in the fact that the term does not have a universally accepted translation in the Chinese language, with words such as "弹性[Tan Xing]" (literal translation: elasticity) or "韧性[Reng Xing]" (literal translation: persistence, tenacity) being commonly used to refer to resilience. However, during the study, I discovered how the concept has made its way into flood response and flood risk management in general.

Grey infrastructure, such as floodwalls, dams, and embankments, acts as the flood defence facilities and provides resistance to flood threat, which has long been the focus of local authorities in battles against floods. However, the interviews with the respondents from China reveal a different picture. A trend is emerging in cities' responses to flood risk: non-engineering methods are increasingly favoured as opposed to the conventional 'hard engineering' approaches that prioritise continuous construction and reinforcement of grey infrastructure. According to Participant no.3 who is a water engineer, non-engineering methods involve a wide range of aspects, including catchment-level coordination and collaboration across multiple government departments and different jurisdictions that oversee water infrastructure in one catchment area. In this case, as the respondent elaborates, a dam upstream can take pre-emptive actions before a flood strikes so that the peak discharge can be flattened downstream. Such non-engineering measures offer flexibility and boost the capacity of

an urban system in response to uncertainty (Wang, et al. 2022b; Mugume, et al. 2017; DiFrancesco and Tullos, 2014). In doing so, local authorities are taking one step closer to confronting the fact that flood threats are becoming increasingly uncertain and unpredictable, and that they cannot keep expanding flood defence facilities indefinitely.

This trend of utilising non-engineering methods for addressing flood risk is supported by other respondents. Participant no.5, a landscape architect whose work involves flood forecasting acknowledges that there is a consensus in the industry about the uncertainty that climate change has on flood risk, and that new flood models are being created to take into consideration extreme floods caused by climate change.

> *"A flood does not happen immediately, it starts with the accumulation of rainfall and the gradual increase of river discharge, so we are now improving the hydrological forecast modelling. For example, we used to be able to do a real-time forecast for only the next 12 hours, now we can confidently extend that forecast period to cover 4 more hours."* (Participant no.5, landscape architect)

Furthermore, Participant no.3 emphasises that a contingency plan has been introduced by the government of the city in which they work. Such a plan is, as they argue, another important component of the non-engineering measures. The authorities in their city set up a flood agency – a centralised governance body that oversees evacuation and rescue in a flooding event as well as organises drills during normal times. With the help of the advanced flood forecast models, the flood agency is then able to make contingency plans, which include designing the routes to safety, forecasting the depth of floodwater at a given location, how far back people should be evacuated from the flood-prone area, and how long it would like for the floodwater to recede.

> *"The contingency plan comprises two parts: one is evacuation, the other is how to coordinate and organise rescue and recover among different departments and institutions; all these are included in the plan. But the plan still prioritises evacuation, because human lives matter the most in the face of a disaster, so evacuation takes the priority"* (Participant no.3, water engineer)

The change in the way to respond to floods signals shifts in mindset and actions: from attempting to prevent floods from happening to accepting the possibility of being flooded; and from resorting to continuous construction and reinforcement of 'hard' infrastructure to adopting non-engineering methods that embody flexibility and adaptability. Such shifts, as I demonstrate later in this chapter, symbolise cognitive and behavioural changes that contribute to preparedness and adaptability, both of which are crucial components of evolutionary resilience.

### 7.3 The non-learning situations in China

Superficially, contingency plans seem invaluable if a flood were to happen. However, the authoritarian political structure and the strictly top-down decision-making often constrain the possibility of communication between the authorities and other stakeholders, and can hamper the chance for learning across the different parties (Wu, 2020; He and Warren, 2011; Lo, 2015).

A respondent explains that even in the making of a contingency plan, the government dictates the process and the top-down decision-making stifles learning from other stakeholders, be it the professionals or the public.

> *"Government involvement is the most important [in the making of the flood contingency plan]. Although the drawing up and compiling of the draft plan are mostly the responsibilities of experts, they are chosen by the government. In the end, the government will have the final say and decide to approve of it or not. And to be honest, it is very unlikely to have public involvement in such process in China."* (Participant no.3, water engineer)

As aforementioned, the city of Zhengzhou, a pilot "sponge city", experienced a devastating flood in July 2021 as a result of extreme rainfall. 624.1mm of precipitation in a single day on 20th July, close to the total rainfall (640mm) that the city receives in a year on average (Zhao, et al. 2023; People's Daily, 2022a). In the week of the extreme rainfall, nearly 15 million people in Zhengzhou and the surrounding areas suffered the flooding and more than 380 lives were lost, including 14 people drowned in the

underground train that was not supposed to operate during a torrential cloudburst (Davidson, 2022; Wang, et al. 2021; People's Daily, 2022b).

A national inquiry, led by the central government, finds out that, although the meteorological office had already given four red warnings for the extreme rainfall a few days ahead of the deadly disaster on 20th July, the authorities in Zhengzhou did not trigger the contingency plan or take any actions until 4.30 pm of 20th, when rainfall was at its heaviest and floodwater were already threatening the city (Wang, et al. 2021; People's Daily, 2022a, 2022b). The inquiry also identifies that 90% of the deaths in the city happened between 1 and 3 pm on that day, hours before the authorities acted according to the contingency plan (People's Daily, 2022a).

This disaster shocked the general public across the country and led to a massive outcry (Qu, Wang and Zhang, 2023; Davidson, 2022). The inquiry reveals that the city government dismissed the red warnings from the meteorologists, as the political leaders, based on their own knowledge, judged that rainfall in the city would not be as intense as the weather forecast. With the complacent attitude, the authorities believed the city could function as normal and did not carry out any coordination work across the departments, making no preparation for the extreme weather event (People's Daily, 2022a, 2022b). The inquiry also points out several issues regarding the delivery of GI projects: central government funding for SCPs were diverted to be spent on unrelated infrastructure projects, the lack of project supervision led to the undermined quality of GI projects (Wang, et al. 2021; People's Daily, 2022a).

Despite all the seemingly rigorous plans and regulations in place, this centralised and powerful top-down governance model can potentially nullify the built-up preparedness when critical decision-making is in the hands of a few officials (He and Warren, 2011; Duckett and Munro, 2022). Since the legitimacy of political leaders of Zhengzhou is not given by the citizens but is designated by the central government, the local authorities are less obliged to act in the best interest of the locals (Dickson, Shen and Yan; 2017; Whiting, 2017; Duckett and Munro, 2022). Rather than listening to people working on the ground, they tend to look to Beijing for guidance and orders (Duckett and Munro, 2022; Dickson, Shen and Yan; 2017).

## 7.4 The various forms of learning in the English context

There is a rich set of data coming from the interviews with participants in England, as the participants demonstrate multiple ways of learning from the situations they are in, and I thus categorise the different forms of learning into three groups: learning from flood experience, learning by doing, and learning in multi-stakeholder environment.

Although the participants are recruited on the basis of their professional knowledge or work experience about GI, multiple participants shared their personal experience of flooding events: some have personally suffered from floods, others have dealt with flooding at work. It was through these conversations that I realised how the flooding events can serve as a catalyst for them to reflect on the events and learn from such experience, and how the flood experience can influence their positionalities. Other than flood experience, factors such as the participants' professional knowledge of GI and traditional schemes, their geographical location (prone to flood risk or not) also shape their positionalities (Ceaser, 2015). Hence, in the following sections, I differentiate the participants' positionalities based on their flood experience, and I am also mindful of the influence of their expertise and professional knowledge.

Overall, an individual's positionality is reflected in their situated knowledge, including biases, interests, and blind spots (Simandan, 2019; Pronin et al., 2004). The situatedness of knowledge is key to understanding how individuals interpret certain situations differently and thus go through different learning trajectories (Haraway, 1988). Hence, in the remainder of the chapter when I analyse the interview data, I take into consideration participants' positionalities differentiated by their flood experience and the power dynamics associated with their situations.

### 7.4.1 Flood-experience triggered learning

As there are five participants who reflect on the impacts of flooding events, this section is structured to include those who have suffered or witnessed flooding events in their communities (Participant D, E, and F), and those who have not personally suffered from floods but dealt with flooding events at work (Participant G and H).

Learning from flood experience refers to how the three participants (D, E and F) think or act differently as a result of the flood impact. As literature shows, flood experience serves as a trigger and/or catalyst for learning among the participants (Morrison, et al. 2019; McEwen, et al. 2018). Even in those non-damaging flooding events, individuals still draw lessons from the flood experience and change their responses to adapt to flood risk (Kuang, Liao, 2020). Therefore, I identify the three respondents' accounts in relation to learning from their past experience of floods, aiming to illuminate how such experience influences their views and informs their actions, which in turn generates meaningful learning outcomes.

The accounts of Participant D, E and F validate that major flooding events do trigger learning or serve as a catalyst for learning among affected communities, and such a learning process can generate effective learning outcomes that contribute to building up resilience. Two respondents (D and E) mention that the year 2015 as an inflection point when the destructive Storm Desmond struck the north of England and wreaked havoc.

> *"But all the actions [establishing local flood groups and subsequent meetings] we've taken were triggered from the two 2015 storms, especially Storm Desmond on December the 5th. And just unfortunately, it was started again completely in 2016. So as a result of that, the [flood action] group was formed from nothing."* (Participant E, civil engineer)

> "*In December 2015, this area was very badly affected by Storm Desmond, as well as flooding, there was also a complete loss of power up to the urban area… My particular village, we were affected by the flooding from the river, some of the buildings which aren't normally affected by high water were flooded. And afterwards, I started thinking that really, we didn't know what to do, we didn't have any plan if anything like that ever happened again."* (Participant D, city councillor)

Because of the disruptive and traumatising nature of the floods, the three participants thus look for a sense of security and safety and start to reflect on what went wrong in the past. As I mentioned in Chapter 5, Participant E and F choose to speak as members of their communities to explicitly criticise the institutions – the changed positionalities are likely a result of their personal flood experience. Participant D, on the other hand,

does not voice any criticism about GI or the authorities in the interview, likely a result of them being a councillor. Participant E and F specifically point out they are angered by what they believe to be inaction from institutions, and are worried about the authorities' shift to GI as the alternative to traditional schemes.

> *"After the flood the EA was still talking about 'was it worth repairing this barrage', and yet there're people being flooded and the model they use didn't take into account of trauma… so many people can't sleep every time it rains"* (Participant E, civil engineer).

> *"What the EA did in the past… there's an awful lot of error around for a long, long period… people feel that it was kind of a man-made disaster…"* (Participant F, architect)

The emotions and feelings derived from their own flood experience impact their views of flood risk for them and their communities. I believe the participants' professional identities and their flood experiences deeply shape the actions they take in terms of forming local flood groups and influence their perceptions of flood risk facing their communities.

First of all, their professional backgrounds mean that they have better insights into the flaws embedded in the implementation of GI, such as the lack of maintenance and monitoring (mentioned by D and F), and a long timeline for SuDS to deliver the designed benefits (mentioned by E, quoted below).

> *"If you build a big concrete tank for storm water detention, then once that tank is completed, you can use it to 100% of its capability, whereas if you're looking to deliver a swale, some kind of wetland, then actually the fact it's a natural solution will mean that it takes time to grow, it's got to bed in, and until that's happened you're not going to realize the maximum peak benefits from that"* (Participant E, civil engineer)

The participants' understandings of the weaknesses of GI mean that they may already have suspicions about the effectiveness of the novel practices even before a flood hits. Meanwhile, Participant E (civil engineer) and F (architect) come from an engineering background, as they elaborate in the interviews, they resonate more with the traditional schemes that value mathematical evidence and quantitative data – an aspect that GI is

lacking *("They [GI projects] can't be measured in the same way"* – Participant F). Hence, in the face of a flood, their professional knowledge of grey infrastructure can lead them to compare the advantages of grey to the weaknesses of GI: traditional schemes represent the certainty that their communities need most after the floods, whereas GI cannot deliver the same type of benefits.

This echoes the cognitive lock-in mechanism: their previous knowledge restricts them to see rationales of novel approaches beyond their scopes and they feel more comfortable with the continuation of what is known and tested (Klitkou, et al. 2015; Buzási and Csizovszky, 2023; Simoens, Leipold and Fuenfschilling, 2022).

On top of the influence of their professional knowledge, their lived experience of traumatising flooding events in their communities further strengthens their belief that some visible actions are needed to boost confidence and reassurance.

> *"putting diggers in rivers and on the banks straightaway would give the public a lot of confidence, and it would also make people allay fears and we'd have less people having PTSD"* (Participant F, architect)

Reeling from the floods, the three participants (D, E and F) begin looking at approaches to coping with similar events in the future. The first step that they take is to form local flood action groups that brace communities for the potential flood risk. Participant E and F say that they only start to take local actions because they are dismayed by the authorities – *"no one is looking after us"* (Participant E), and they want to make their concerns heard – *"There is a real swing towards naturality…human population is on the wrong side…"* (Participant F).

The participants are anxious about future flooding and thus become engaged in planning for alleviation, evacuation, and rescue, so that their communities are better protected against the uncertainties. The learning process manifests in the participants' reflections on their sufferings and the various actions taken post-flooding. *"We've met with… other flood groups in the area to talk about how we should do the training, how we prepare the plans, what sorts of training we might need and so on…"* (Participant D). These respondents' accounts show that flood experience deeply shapes their decision-making

– after setting local flood action group to formulate a united voice arguing for local interests, they are then empowered to speak up about their concerns regarding the authorities' handling of flood risk, and sometimes challenge institutional decisions that they are not content with.

For Participant G and H who have not personally suffered from floods, they still demonstrate learning from dealing with flooding events at work. They are concerned about the risk of extreme weather events induced by climate change, and are therefore spurred to rethink long-term flood strategy. Their flood experience at work stimulates them to think ahead and consider the uncertainty and volatility in future.

> *"Climate change specifically in the Northwest was, the key manifestation that people talk about with climate change was about drought, not flood. So people worry about it not raining as opposed to the other way round. And I think it took Storm Desmond and stormy weather in 2015, 2016 as the eye openers really…* so off the back of 2015, our flood strategy was developed in the aftermath of Storm Desmond." (Participant H, flood resilience specialist)

It becomes clear that flooding events can leave a huge impact on professionals. Although they have learnt different lessons (as will be explored later in this chapter), this learning enables them to see the inadequacy or flaws in their old way of operating and seek solutions to improve their responses to future flood risk.

### 7.4.2 Learning by doing

Learning by doing here refers to the scenarios where participants do not possess enough knowledge or skills before they embark on new initiatives, be it a GI project or a flood action group, and yet they utilise such initiatives as an opportunity, through trial and error, to generate, accumulate and circulate knowledge.

Learning by doing is well studied by researchers in many different fields, including economics (Young, 1993), and education (Moye, et al., 2014; Bot, et al. 2005). Von Hippel and Tyre (1995, p.5) assert that learning by doing is "a form of problem-solving that involves application of a production process (or product, service or technique) in its

intended use environment", and they believe the learning process is made up of trial and error, but agents' insight may guide the learning to the direction of solutions. Reese (2011) argues that learning by trial and error can be effective because it is learning by self-shaping, so that the learning outcomes based on agents' actions lead them to not only knowing, but also knowing how and why. Roussou (2004) contests that learning by doing is constructivist, meaning that agents actively construct their own knowledge by testing ideas and drawing conclusions from their actions and experience in an activity, and then apply the gained knowledge to a new situation. Despite the differing research focus of the many studies, the commonality about learning by doing is that agents do not possess enough knowledge prior to the learning process, and come out with more knowledge gained as a result of reflecting on their hands-on practice.

For Participant D, E and F who have suffered flooding, learning by doing primarily manifests in taking rapid actions through their local flood groups. Learning by doing in this process is fundamentally shaped as well as boosted by the participants' professional knowledge and skills, which also resonates with the respondents' situated strategic wisdom that I have examined in Chapter 6.

Such learning taking place in the formation and operation of local flood action groups is a response to the lack of "*effective actions*" from the authorities (Participant D). Such a response also reflects their communities' shortage of trust in institutions and the intensified worries about flood risk. *"We didn't know what to do, we didn't have any plan if anything like that [flood] ever happened again"* (Participant D, city councillor). Moreover, although Participant D does not make any criticism of GI projects, the other two participants (E and F) are clearly disappointed with the institutions' shift to GI: they organise flood groups to speak up against institutions' preference for GI and wish to see reinforcement of grey infrastructure.

> *"The Rivers Trust are hell bent, at least around here and probably nationally, on favouring nature and taking out weirs… But to us, we should be looking after our weirs better, taking out the gravels from behind them to allow water storage when we need it, so a flood has to go through a system: lots of weirs, and lots of storage capability before the big rush comes. But at the moment there's no mitigation to flooding at all.*

*So there's lots of engineering works that we could do without really causing immense harm to nature."* (Participant F, architect)

After experiencing flooding events in their communities, E and F conclude that their sufferings are a direct result of the institutions' pursuit of GI, because they believe only the traditional measures can offer them the level of protection needed. In other words, the flooding events prompt them to learn that the benefits of grey infrastructure outweigh those of GI, and such learning is closely related to their professional knowledge about traditional schemes, as I mentioned earlier. The uncertain performance of GI as a result of the lack of monitoring and maintenance, and the longer timeline for GI to achieve the peak performance, in the eyes of the respondents E and F (both of whom have an engineering background) are the opposite of what their communities need when reeling from the "*trauma*" (Participant E).

The three participants (D, E and F) rely on their flood action groups to champion the locals' interests in front of policymakers. The three of them make it clear that the formation of these groups are spontaneous and reactive, and the operation of such groups, including balancing power struggle within the group (F), liaising with similar groups from other communities (D, E and F), agreeing on the right approach forward (D, F), communicating and negotiating with authorities (D, E and F), is a challenge that they have not anticipated. *"We found it very difficult to get more people involved in our flood action group… they don't think it's relevant to them until it happens"* (Participant D)

However, their professional knowledge and their strategic wisdom derived from their professionalism enable them to rapidly learn from their interactions with authorities and change their strategies accordingly to advance their cause.

*"The group was formed from nothing… People were very angry so we decided to form an action group, not knowing what action we could take… But then we thought what can we do when we had died down, you know, what constructively can we do? We could try and make things happen by nudging the people that had the money and the budgets and the responsibilities… So we first concentrate on seizing resilience grants."* (Participant E, civil engineer)

> *"In the beginning no one knew what to do, but our flood group made its first meetings quite clear that… we wanted to establish what the cause of flooding was, and to assist to eliminate that cause… So we are looking at history, and looking at all sorts of other aspects and also talking to the flood risk agencies."* (Participant F, architect)

Without the professional knowledge, lay people would struggle to rapidly set out a long-term strategy and clear goals for a flood group, nor could they prioritise acquiring resilience grants that requires an understanding of the system. The respondents' professionalism is closely intertwined with their learning by doing: all the three participants (D, E and F) are the first person in their respective communities to come up with the idea of forming a local flood action group, and two of them (E and F) mention they both are the chairs in their respective groups. (*"they turned to me to be the chairman. But I'm an engineer, so I sort of do things in logical steps. So perhaps that was the reason they trusted me."* – Participant E, civil engineer).

In comparison to lay people, their professions also provide opportunities for them to have direct contact with the government that would otherwise be unlikely for ordinary people. For example, Participant D says: *"A few weeks ago I sat in on a meeting done by the All-Party Parliamentary group on flooding… so we tried to keep feeding information to our MPs about the problems that need to be addressed at the government level".*

The participants' professional knowledge and skills enable them to learn in the operation of the flood action groups: reflecting on the predicaments facing their communities (D, E and F), engaging and mobilising their communities to take a stance against the authorities (E and F), utilising the inherent flaws of GI to make a strong case for bringing back traditional schemes (E and F). Overall, the specific knowledge and skills in relation to their professions empower them to learn at work, and to make strategic judgements on the spot, which echo professionals' situated practical wisdom that I examined in Chapter 6.

I use the following two examples of E and F's operations in their flood action group to underline how their professional knowledge and, indeed, their situated strategic wisdom, guide them to learn from the predicaments and to overcome the challenges.

Participant E said they are dismayed by the authorities' preference over GI, and as the chair of the group, this respondent learnt to mobilise the group and their community to demand the Environment Agency to build a floodwall where there is a high risk of river flooding (*"Because I'm an engineer, it's very common sense that there needs to have a floodwall"*). After being rejected a few times, the participant decides to rely on their engineering knowledge and skills to build the floodwall on their own: they learn to battle against the bureaucracy of the institutions (*"The biggest stumbling block, in the end looking back, was the EA. It was almost they're trying to stop us doing it"*); they learn to conduct the mathematical calculation and design of the wall, and then they mobilise their communities to raise as much as £100,000 to fund the project without the help of the authorities. In the process of delivering the floodwall, the participant learns to address any challenge that arises: *"we just kept batting away every time [the institutions] bowled to us, we hit it back. Eventually we got [the floodwall]. But most groups aren't capable of doing that, a lot of people would give up"*.

Participant F, in the aftermath of Storm Desmond, learns that they need to join forces with more flood action groups from other affected communities to forge a strong voice that authorities cannot overlook. They learn to overcome a number of difficulties, including the General Data Protection Regulation (GDPR) that stalls them from looking for other groups. (*"A colleague from the flood group and myself decided to go on one of the local news programmes to share our contact details, and other flood action groups saw that, and contacted us"*). They then manage to go beyond the county boundary and unite multiple groups within the same catchment area, aiming to speak up collectively to the authorities and thus amplifying their influence.

> *"[the combined group] means that the whole of the community of the county arguing at county level and at national level rather than a little flood group arguing about their own little problem which could easily be dismissed."* (Participant F, architect)

The participant learns from the predicaments as they go along, and their professionalism empowers them to formulate strategies to confront the Environment Agency and gain attention from the government directly.

*"We targeted the Environment Agency policy with our vote of no confidence paper… that was sent to everybody that we could think of: it was sent to all the media agencies, all the local MPs, Defra [Department for Environment, Food and Rural Affairs], and it was sent to the Secretary of State. And we've had a dialogue since with [a government minister] who was the Under-Secretary of State whose responsibility is flood management."* (Participant F, architect)

For a lay person to lead a local group to achieve what the participant has done would be daunting, but the participant's strategic wisdom deriving from their professional knowledge and experience enables their group to go to greater lengths to argue for their local interest. Their relentless attempts are rewarded with being invited to the national roundtable discussions as representatives of the region. Such a success boosts the confidence of locals and makes them believe that they can take the "trial and error" (Participant F) attitude to learn from predicaments and make meaningful changes to their communities.

So far, I have demonstrated how participants learn in the process of organising flood action groups, and how their professionalism is critical to them making decisions and judgements. Moreover, learning by doing also takes place in many other participants' day-to-day work: as Participant B, C, J and K indicate, they often learn on the job. Participant K recalls the experience of taking on a GI project for the first time. They do not have relevant knowledge or cannot find people with the required skills to work with. However, they utilise the first project as an opportunity for learning, and thus embrace the trial-and-error process.

*"[implementing this project] is a rare occasion where some elements of the project can fail because it's a learning project and a research project, so we were allowed to try things knowing they might not work exactly right. And then that's part of the learning: we know that this way it doesn't work and it needs to be a different way."* (Participant K, project manager)

Participant B reflects on the important engagement with the communities for a new GI project, in which they learn the suitable ways to interact with lay people and share the knowledge about GI.

*"Definitely through the engagement process, you definitely could see the need to build on that gap in understanding sustainable urban drainage, because it's such a complicated sounding thing, and it did come up as the lowest priority for people. People would simply ask "what's that?", "why would it be useful?"… The consultation definitely highlighted the need for us to be doing more education and making sure that people could… understand all the different functions of [the project]."* (Participant B, community engagement lead)

### 7.4.3 Learning in the multi-stakeholder environment

Literature shows the prevalence and importance of learning during the interactions of actors (Zuniga-Teran, et al. 2020; Campbell, Svendsen, and Roman 2016; Colding and Barthel, 2013). Learning that takes place in the interactions between a range of stakeholders enables those involved to overcome differences in their views and interests, and generate a shared understanding of the common issues facing them (Raymond, et al. 2017; Stam, Van Ewijk, Chan, 2023). In this research study, I identify learning that happens between professionals within the same institution and inter-organisationally, and also learning taking place between professionals and communities through engagement.

#### *7.4.3.1 Communication and knowledge sharing among professionals*

Many scholars denote that learning happens during frequent communication between professionals. For GI projects, the division of work, e.g. project initiation, design, and implementation, means that multiple stakeholders have to communicate and collaborate, thus creating opportunities for the sharing of information about the projects from various perspectives (Frantzeskaki, 2019; Kiss, et al. 2022). The flow of information, sometimes coupled with necessary collaboration, can be a nourishing environment for innovation and contribute to the transferability of learning outcomes (Ugolini et al., 2018; Frantzeskaki, et al. 2019).

In particular, the inter-organisational networks found to be crucial arenas for learning between actors possessing different types and degrees of knowledge, because the expertise of one individual or the knowledge in one profession is deemed insufficient for

tackling complex transitions in socio-technical systems (Singer-Brodowski, 2023; Kabisch, et al. 2016; Raymond, et al. 2017). Through the communication and collaboration across organisations, professionals are able to "update their planning, governance, knowledge production practice over time to continuously address arising risks and uncertainties" (Kabisch, et al. 2016, p.10). All of the participants in the interviews reveal that there are, albeit to different degrees, communication and collaboration between institutions, such as local councils, the Environment Agency, utility companies, charities, and NGOs.

> *"So we work with quite a lot of the NGOs as well… we do a lot of work with The Rivers Trust in our area…"* (Participant C, project manager)

> *"We found groups on each catchment, called catchment partnership groups, and they facilitate conversations with different partners…"* (Participant J, urban planner)

This form of learning usually takes place in the interactions between actors from a wide range of backgrounds, the actors learn through formal meetings and informal talks, sharing of information, and providing assistance to one another. (Ugolini, et al. 2018; Frantzeskaki, et al. 2019) Through effective communication and collaboration, such learning is crucial to bring many key stakeholders onboard with the GI agenda (Frantzeskaki, 2019).

> *"In the north of [the city where the participant works], there is a big regeneration project: a new park, and a whole new development of quite a lot of apartments and housing. So we've been speaking to colleagues there and they've taken on board some of the lessons and ideas from our [GI] project to implement theirs, because our project has been really successful from the nature-based solutions point of view. So they are now taking into account the concept of taking rainstorm water through the roads and into rain gardens that's already been designed into new areas, so it's definitely making an impact. And we're doing our best… to influence our planners and our strategic colleagues to make sure that we continue to replicate what we've learned"* (Participant K, project manager)

> *"So we try to work with the local authorities and the planning authorities in particular, and the Environment Agency. So we basically meet and talk about SuDS, and*

*encourage the use of these things more properly. And we do a lot of engagement with planning authorities on the benefits of SuDS and how to site them. And we provide expertise on where they should be best placed and those sorts of things. And we do try to encourage the application of SuDS…"* (Participant H, flood resilience specialist)

However, as I mentioned in Chapter 5 about the challenges facing professionals in England, tensions and conflicts are common difficulties (eight of the ten participants acknowledge there is some level of conflict in interacting with multiple stakeholders) due to the multi-stakeholder environment in which SuDS projects are delivered. Such tensions arise as a result of actors' varied expertise, interests and responsibilities (Singer-Brodowski, 2023). Amidst the tensions, actors may strengthen their own positions and lose the common ground, but this can also be a form of learning (Beers, et al. 2006). Learning among actors can be convergent or divergent, with divergent learning leading to a decrease in shared understanding and a step back from reaching a consensus (Stam, Van Ewijk, Chan, 2018; Scholz, 2016). Due to the scope of this research study, later in this chapter I mainly examine the convergent learning that brings about more shared understanding and helps different parties to achieve common goals, but I also touch on the divergent learning situations where professionals learn to reject the ideas behind GI projects and resist the transition.

*7.4.3.2 Learning through community engagement*

Although for this research study, I did not interview community groups, the participants (D, E and F) who personally have suffered from floods and organised local flood action groups tend to share the viewpoints of their communities. The differing positionalities, as I examined earlier in this chapter, offer me the opportunity to look into how the implementation of GI impacts communities. Hence in this section, I examine the learning between institutions and communities, considering the accounts from both the professionals who speak from a work point of view (Participant B, C, H, K and J) and those who speak on behalf of their local flood groups (Participant D, E and F).

Through analysing the transcripts, I identify some community engagement activities where communities and institutions communicate effectively, facilitating the sharing of knowledge and experience. This form of learning can take place two-dimensionally:

institutions and communities learn from each other. First of all, Community engagement is especially necessary for implementing GI projects in England, because it strengthens communities' awareness of flood risk and GI in general, allowing them to understand institutions' priorities. More community buy-in can lead to "improved treatment of facilities, lay maintenance and clearance as well as potentially greater willingness-to-pay" (Everett and Lamond, 2018, p.1). When communities are vested in GI projects, they are more likely to advocate for GI and provide on-the-ground evidence for a wider audience, facilitating the realisation of co-benefits and validating the transition to GI (Zuniga-Teran, et al. 2020; Campbell, Svendsen, and Roman 2016).

The respondents (D, E and F) who speak on behalf of their community reveal that, after relentless work, their local flood action groups are able to communicate with the authorities and voice their opinions. Also, through communicating with institutions, local groups develop a better understanding of how institutional approaches to managing flood risk affect their communities.

> *"The lead local flood authority, the County Council eventually recognized that they needed to have resident and community input onto [the flood panel]… So we got on to quite a high level of discussion and input to the right people, I think, at the time."* (Participant F, architect)

> *"[The engagement meeting] had various people from the Environmental Agency, United Utilities and other people from areas that had suffered flooding and done things about it. So they came and shared what they've done. So it basically raised people's awareness of flood risk and what you can do in that situation, but from our point of view the awareness was the thing, because it started to put the voice of the people forward to the authorities that had budgets and responsibility and the actual capability of dealing with flood*" (Participant E, civil engineer)

On the other hand, according to Participant B, C, H, K and J who speak from their work point of view, engaging with communities helps institutions to promote their strategies and circulate the knowledge that they believe communities should acquire. In turn, through community engagements, institutions are made to listen to communities'

concerns and complaints, allowing them to review the administrative barriers that demotivate the formation of new partnerships or prevent new opportunities for the uptake of GI projects (Kabisch, et al. 2016; Frantzeskaki, Wittmayer and Loorbach, 2014).

> *"Now we're trying to set up a 'friends of the park' group. So we want a group of residents who are interested in it to continue the stewardship of the park. And we're teaching them about how to manage the nature-based solutions and how they can engage in different events and do litter picking and stuff like that"* (Participant B, community engagement lead)

> *"We do a lot of work with local action groups within those to help mitigate, identify flood risk, but most of our work is about educating and empowering. So simple things like if you can engage with the community who suffer from flood risk about how not to misuse the sewer system and therefore maintain its capacity, so therefore the flood risk is reduced."* (Participant H, flood resilience specialist)

> *"I worked on a riverside park project that had a lot of stakeholder engagement, because we really wanted the public to be involved and feel like it was their project… I created a workshop with a number of stakeholders that included "friends" groups, so Friends of the Park and Friends of the River… I also worked with schools to try and get the schools involved and then did a consultation at a local cafe to ask the public what they want for the park. We were planning on restoring the ecosystems of the rivers, but [we wanted to know] what else do they want? Afterwards we created a community orchard and putting a footpath, and we also circulated a master plan, and put that in the visitor centre so people could comment on it if they wanted to."* (Participant J, project manager)

Involving communities' opinions in the planning of GI can provide the authorities with local and lay knowledge, and such knowledge about local issues can be crucial for authorities to bridge the gap in cognition and experience (Wamsler, et al. 2014; Everett and Lamond, 2018). Also, engaging communities in shaping the project planning and implementation empowers citizens to take new forms of deliberation and participation, further fostering learning (Eckersley, 2006; Kiss, et al. 2022; Wamsler, et al. 2014).

However, learning in the multi-stakeholder environment is not always harmonious and can be problematic: learning that does not increase shared understanding and thus causes conflicts, constituting what I call the non-learning situations in this study. Participant F, speaking as a member of their local flood group, shares the antithesis of community engagement and learning from communities.

> *"Unless you were flooded or your parents were flooded or your grandparents were flooded, you won't get that message passed on. But when it's passed on… there'll be marks on a bridge, they'll be marks. There's a pub in [the city in which the participant lives], it's got all the marks of the floods on it. There's that kind of local knowledge. But when it comes to assessing risk, I don't think the EA include that, not in the way that they should… I don't think they were aware that [the city] had flooded 11 times to the extent of Storm Desmond since 1770… I think they're not aware of this fact when they're thinking about management and when they're thinking about flood risk. I think they're thinking forwards, but they're thinking forwards in a blinkered way. They're not looking back and learning from what people have learned in the past."* (Participant F, architect)

This participant's reflection highlights that learning in a multi-stakeholder environment is never linear or straightforward. Such non-learning situations are not uncommon in the delivery of GI projects, which I investigate later in this chapter.

### 7.5 What has been learnt: the learning outcomes

Following the various ways of learning, and what has been examined in previous chapters, it is clear that there are a wide range of learning outcomes, many of which are pertinent to the scope of this research study. To better analyse the learning outcomes, I classify them into three types of changes: cognitive changes, which are changes in their understandings and perceptions of flood risk, GI projects, resilience; 2) behavioural changes, which are how they act and respond to situations differently; and 3) relational changes – different relations among parties involved (de Kraker, 2017; Cundill, Rodela; 2012).

Cognitive changes are observed in all the respondents. The idea that floods cannot always be prevented gradually sinks in, so professionals start to integrate this risk into shaping their views and making plans for the future. Interestingly, those who have suffered flooding (E and F) tend to be more suspicious of the efficacy of GI and prefer the reinforcement of the existing flood defence; whilst the rest of the participants tend to be more open to the trials of GI and even actively promote GI. This cognitive distinction is likely the result of their differing perceptions of flood risk in relation to their flood experience.

Behavioural changes manifest in the professionals' responses to flood risk and the consequent actions to address the risk, and such changes are closely related to the cognitive changes identified. How participants attempt to mitigate flood risk by taking different measures is a reflection of their changed views and understandings. For example, participants (D, E and F) who have suffered from floods used to wait for institutions to deal with flooding issues, but now they organise locals to actively watch water levels and send out warnings to households nearby.

Relational changes identified in the interviews manifest in the changing power dynamics between the institutions and the communities. Participants (D, E and F) who are part of local flood action groups reflect that communities used to be at the receiving end of decisions made by institutions, and they rarely had authorities listen to their concerns. However, after they self-organise and unify many more communities to speak up about their concerns, authorities now become more aware of the significance of engaging with these groups, and tend to consider communities' input.

To connect back to the overall research aim, in this research study I want to find out how GI projects are implemented to embody the notion of flood resilience. In the literature review chapter, I identified three attributes that are essential to advancing flood resilience from the evolutionary point of view, namely preparedness, adaptability and transformability.

Being prepared for flooding events enables actors to take proportionate and swift actions to reduce the damage and disruptions when a flood strikes (Forrest, Trell and Woltjer, 2019; Mishra, Mazumdar and Suar, 2009). Activities to strengthen preparedness

consist of developing evacuation and rescue plans, setting up flood warning systems, educating people to be risk aware, and offering trainings and exercises (Zevenbergen, et al. 2020; Kapucu, et al. 2013). Adaptability, on the other hand, refers to the capacity to adjust to the impacts of flooding, such as actors choosing alternatives and new approaches to adapt to flooding events, in the case of this research study, choosing GI to help urban systems to adapt rather than sticking with the old schemes. At last, transformability refers to innovative changes that are observed on cognitive and institutional fronts that are often interconnected with the actions to boost preparedness and adaptability (Mehmood, 2016; Davoudi, et al. 2013). Transformability is a critical component in evolutionary resilience not only because it symbolises the dynamics of constant evolvement and adaptation to changing situations, but because it denotes the importance of learning in enabling transformations (Sharifi, 2023; Schneider, et al. 2021; Mehmood, 2016).

### 7.5.1 Strengthened preparedness

The following covers the learning outcomes that are related to preparedness. In the research interviews, I find out that many participants brace themselves for flood risk through various means, including enhanced awareness (Participant B, C, D, E and H), evacuation planning (Participant D, E and F), flood modelling (Participant A, G and H), and river level monitoring (Participant E, F and G). As such, when a flood happens, evacuation and rescue can be carried out swiftly and resources can be mobilised accordingly (Spaans, Waterhout 2016; Kapucu, et al. 2013; Hegger et al. 2016). Enhanced preparedness benefits communities as well as institutions, in the sense that well-developed plans facilitate orderly decision-making and reduce the level of bureaucracy and chaos when faced with a flood (Spaans, Waterhout 2016; Kapucu, et al. 2013; Hegger et al. 2016). As a result, those who are at risk will get the help needed and the social and economic impact of a flood is mediated, contributing to the overall resilience.

For participants D, E and F who have suffered from flooding events, preparedness building predominantly manifests in organising local flood action groups and learn to be pre-emptive, such as making plans for rescue and evacuation (Participant D, E, F), and

actively monitoring river levels (Participant E and F), or creating a locally-based flood warden system (Participant E).

Such learning is largely the participants' response to the perceived failures and inactions of the authorities. As I mentioned previously, Participant E and F only resort to organising flood action groups after they learn that their requests to reinforce flood defence facilities are frequently ignored and they are disappointed by the institutions' preference for GI as the alternative.

> *"The EA were unable to do the kind of things that we were expecting them to do, which is why we leapfrogged them to say the Environment Agency is, nationally, culpable and we need to have those changes inserted here"* (Participant F, architect).

Therefore, building up their communities' preparedness via local flood groups is the result of them learning that the authorities are not looking after their best interest, and they thus want to take matters into their own hands rather than waiting to be protected.

A flood warden system, established by locals in Participant E's community, features volunteers taking up the rotating roles of a head warden and sub-wardens, who then organise patrols to monitor river levels during a torrential rain, and effectively disseminate flood risk information to households in the community.

> *"The wardens network is like a tree, there's a head warden and gets the message to other flood wardens over the phone. Then within an hour we'd knock on every door. So normally you get quite a few hours' notice if there's a flood. The warden system actually is very good, and now you can see what the river's doing on your phone at some stations. So for this bridge [in the participant's community] you can see where the critical water level is now. When it gets above 4 metres on the ruler there, it's time to start thinking about making defences. So anyway we proved that we could warn everybody, every household within an hour of pending trouble."* (Participant E, civil engineer)

These simple and small-scale actions, with local interests at heart, can be flexible and effective, offering these communities a sense of security and reassurance. Such actions

are a reflection of the communities' learning to brace for uncertainty and threats. The self-organisation taking place in the participants' communities enables residents to be more acutely aware of the rapidly changing flood risk and thus be more prepared for any necessary actions. The heightened preparedness as a result of learning from past experience demonstrates the resilience thinking of these actors – quicker response, more organised evacuation, faster mobilisation of resources – all contribute to the communities' resilience to the increasing uncertainty and therefore minimise disruptions.

Superficially, such learning outcomes are a result of the participants opposing the institutions' preference for GI over traditional schemes. However, the outcomes indicate that learning by the professionals is neither linear nor goal-oriented. Although such learning outcomes do not seem to relate to GI implementation, they in fact reflect how the limited benefits of GI are potentially hurting the communities as well as damaging the cause of this transition; such learning outcomes also reveal a tricky balance that the authorities must strike between sustaining the transition to GI and addressing communities' perceived flood risk, as a result of shifting away from hard engineering projects. Participant E and F's responses indicate that the resistance to GI derives from the uncertain benefits and the inherent flaws in relation to GI. To advance the cause of GI, therefore, the authorities must realise there is a justified need for carrying out certain grey infrastructure to reassure people that there are flood defences in place that, for the majority of the time, resist floods and offer protection to communities. After all, resistance is a key element of flood resilience alongside preparedness, adaptability and transformability – urban systems must be able to offer some degree of protection against and resistance to flooding events – as I argued in Chapter 2 and mentioned by multiple participants (Participant C, G, H and K).

> *"If we are talking about an area that is prone to heavy flooding, nature-based solutions may not be appropriate for that, or it might need a mix of green and grey. There's no reason why you can't do both"* (Participant C, project manager)

In addition, preparedness building is also identified in those participants (A, G, H and J) who have not suffered from flooding, as they start to improve flood modelling by

considering the effect of climate change on flood intensity and frequency. In such models they simulate longer-term flooding scenarios and predict the potential impact of each scenario, and adjust the emergency planning accordingly to protect lives and prevent losses. Drawing data from past extreme flooding events, these participants learn in the process of adjusting models for organising evacuation and allocating resources.

> *"As part of the climate emergency review we've updated the Strategic Flood Risk Assessment for the most recent climate change allowances… So we've got the climate change allowances modelled in to predict flooding."* (Participant A, urban planner)

> *"So within that longer term planning framework, we take into account the climate change predictions on that and use our hydraulic models. So we have a suite of hydraulic models to look at what is the impact on our system going forward. That can be the impacts of system, not just from climate change, you know, severe weather events etc., but also population growth and how do we bring that together to understand (the impact)"* (Participant G, water engineer)

> *"So our strategy now, off the back of those floods (in 2015 and 2016), is that we've basically mapped out all the flood risk against all the sewer system, based against the various flood extent maps. So the 1 in 20, 1 in 50, 1 in 100, 1 in 1000. We've applied climate change uplifts to those… We've built in climate change forecasts into the sewer capacity system and the network capacity… So we forecast using our 2D modelling how that climate change might manifest itself. And we're not just talking about general climate change. We're also talking about rainfall intensities over the one- or two-hour events and how they affect the sewer performance"* (Participant H, flood resilience specialist)

Participant G, with their engineering background, is particularly interested in how the employment of new technology benefits emergency planning. With the wider application of Artificial Intelligence in sewage systems to monitor rainwater runoff, city-wide or even region-wide data are presented in real-time, showcasing the state of the piped system before and during a rainfall with minimal human resources required. Any potential problems in the system can be identified rapidly and different scenarios are generated to help professionals make decisions ahead of any storm. Such technologies

transform the way people study and address flood risk, and greatly enhance preparedness that is essential for building up resilience.

> *"Where we're moving now is to a very proactive and responsive approach where we can actually look at signals from the network. So this may be a level sensor that says that the level in that manhole is creeping up when it's not raining, therefore something's happening in that system… So that's where we're playing in this space of Artificial Intelligence at the moment. So now we can see if something is changed, or something's changed but not so dramatically to cause a flood, and we can also see a change in the way that infrastructure is operating. Where we're also moving to is having a predictive capability that says 'actually something hasn't necessarily gone wrong yet, but based on the data that we've got, be that in situ monitoring data or theoretical computational data, there is a risk that something will happen', so we're going to look to intervene before that event happens and as a result, we can provide greater resilience to flooding…"* (Participant G, water engineer)

### 7.5.2 Improved adaptability

The interviews show that most participants (except E and F) learn, albeit in different ways, to accept and adapt to the scenarios where floods cannot be completely prevented and may cause disruptions. The learning outcomes associated with enhanced adaptability primarily manifest in the shift to widely accepting and adopting GI projects, and sometimes, at a bigger scale (catchment wide); whilst Participant E and F, as aforementioned, show more resistance to GI projects and favour traditional schemes to control floods, likely due to their personal flood experience and their professional knowledge of traditional schemes. *"…it is far more important to try and prevent it in the first place, so controlling the river, controlling the flood."* (Participant E, civil engineer).

The following section presents how GI projects are valued and promoted by many of the participants (A, B, C, G, H, J and K). Despite the different ways of adaptation, the essence is that communities and institutions take responsive actions to adjust, so that flood impacts are alleviated (Lennon, Scott and O'Neill, 2014; Lee, et al. 2021). In the face of climate change uncertainties, solely depending on grey infrastructure reduces the flexibility to modify an urban system's performance (Kapetas, Fenner, 2020). As

emphasised by respondent H, separating surface runoff from the drainage system is key to creating the capacity needed for extreme rainfall. The separation of surface stormwater is also the essence of SuDS projects that are designed to manage rainwater close to its source, mimicking natural drainage which reduces runoff through infiltration and attenuation (Jose, Wade and Jefferies, 2015; Local Government Association).

> *"The big benefit of the nature-based solutions – keeping the water out of the system and that therefore buys us capacity… so it's all about keeping the surface water out the system basically… So we actively try to promote with developers zero surface water to sewer. And that's where the likes of the SuDS and the drainage ditches and all those other things come in to just help take that shock and then attenuate the flow back into the local watercourse, wherever it might be*." (Participant H, flood resilience specialist)

This is how Green Infrastructure emerges as an alternative for enhancing adaptability. Learning from their work experience, and learning by doing, many respondents (A, B, C, F, G, H, J and K) see GI offers more flexibility due to its various forms, e.g. detention ponds, rain gardens, green roofs, swales, and its applicability at different scales, e.g. households, communities, catchment-wide. With GI in place, urban systems are more able to adjust and adapt to new circumstances that are constantly changing in a flooding event (Hegger at al. 2016; Kapetas, Fenner, 2020). Speaking from their experience, the participants offer various accounts of their learning by doing in the process of delivering GI projects, demonstrating the significance of GI in facilitating the social-technical transition of addressing flood risks.

> *"We've now learnt there are other ways to use rain gardens and swales, for example, in roadside or in the middle of the road or even at bus stops, things like that… we can put that learning into practice in different areas where we know they do have very real flooding problems."* (Participant K, project manager)

> *"SuDS provide that attenuation within the area so that the volume and the speed of floodwater flowing down the system into vulnerable communities is slowed… and then you've got overflow areas for excessive flooding events as well…"(*Participant A, urban planner)

*"[Our community engagement] shows that you don't need to have everyone understanding resilience and sustainable drainage for [the GI project] to be amazing… the way that nature-based solutions are just nice to look at, and nice to be around means it's already made a difference…"* (Participant B, community engagement lead)

*"Within Blackpool for example, quite urbanised, we've actually looked at doing surface water separation from the sewerage system and having parks effectively designated as potential flood basin. So we're doing some sort of blue-green infrastructure. Also we've got some pilot trials going on at the minute in Manchester with an outfit called Street Trees, which effectively is restoring some of those avenues of trees in urban areas that in theory help to intercept some storm flow… within an urban area, what is the purpose of building nature-based solutions? What do you want to achieve through that? So the aim is to have zero surface water entering the sewerage system."* (Participant G, water engineer)

Moreover, some respondents (C, F, G, H and J) reveal that GI projects are gradually trialled on a bigger scale. Respondents recall that as a result of learning from storms in the past few years, catchment-wide GI is gaining momentum. From a bigger picture, as they reflect, flooding events are more than random incidents taking place at a certain point of a watercourse, they can be a consequence of upstream stormwater runoff. Therefore, measures like restoring the peat that has been damaged will hold more water via natural attenuation and thus reduce the runoff.

*"Flood resilience should be about creating spaces that can deal with extremes easily, having spaces that we allow to flood so that other places can be protected… we should use a combination of methods to achieve that, some hard engineering but more nature-based solutions… we should think about resilience from a whole catchment approach."* (Participant C, project manager)

*"So we've been doing lots of work that's mainly focused on blanket bog restoration in the Pennine areas and it effectively boils down to undoing the drainage that was applied to them in 19th century. So we're effectively resetting the catchment by blocking the drainage, promoting the bog, the peat to come back into natural processes, promoting vegetation growth within the bog so that actually we retain*

*water… and it does have some benefit in terms of water retention and flood attenuation…"* (Participant H, flood resilience specialist)

*"What we're doing at the moment is… slowing the flow, attenuating, and attaining some of the flows in uplands, so peat areas, before it comes down into urbanised centres. For example, the Mersey catchments: Greater Manchester down through into Liverpool, we have a focus on that."* (Participant G, water engineer)

### 7.5.3 Enhanced transformability

As aforementioned, the learning outcomes manifest in cognitive, behavioural and relational changes, all of which signal shifts happening on multiple fronts. I analysed some of the changes that help to boost preparedness and adaptability. Behind such changes is the actors' ability to learn – reflecting on their predicaments and learning from the challenges are the key factors that facilitate and sustain changes. Such changes embody transformability in evolutionary resilience, and transformability, in turn, is perpetuated by learning.

#### *7.5.3.1 Transformability sustained by cognitive and behavioural change*

So far, this research study has identified a clear shift from preventing floods to managing flood risk strategically. Such a shift takes place in many arenas, including institutional attitudes towards flood risk and the public perceptions of flood risk. The participants (D, E and F) who have suffered flooding events come to realise that flood risk is likely to increase in future and they cannot solely rely on the authorities for complete protection. Such realisation prompts them to self-organise and take various actions to make themselves better prepared for and adapt to uncertainties. Meanwhile, for respondents (A, C, G, H and J) who speak from their work point of view, the institutions that they work for gradually embrace, and in some cases, welcome the employment of GI, as they also acknowledge that GI provides effective alternatives for addressing the uncertainty caused by climate change. The cognitive and behavioural changes that accompany the adoption and promotion of GI indicate transformability that is embedded in the process.

*"With more nature-based solutions, ecosystems are functioning in the right way so that there is climate resilience and there's enough room for water on the floodplains and within habitats."* (Participant J, urban planner)

*"Now we are trying to influence the strategic design [of GI] through planning policy and ensure that the whole development works together rather than developers dealing with their own parcels."* (Participant A, urban planner)

Additionally, I find out that systems thinking has become more prevalent among professionals (A, F, G, H and J) who seek solutions to reducing flood risk. Instead of seeing flooding events as separate incidents, they start viewing river catchments as interconnected systems, in which the damage caused to the eco-system upstream can increase flood risk downstream. Thinking from a systemic point of view allows the participants to look beyond administrative boundaries and identify the root cause of many water issues, thus accelerating the promotion and application of GI on a bigger scale.

*"We're also mindful that [floodwater] is part of the water cycle, whilst we may remove it from the sewage system, the water has to go somewhere… So one thing we're very focused on at the moment is to create enhanced holistic flood resilience, we have to work in partnership…"* (Participant A, urban planner)

*"Flood resilience thinking is one hundred percent embedded in a number of projects we've got… We now look to do catchment-wide flood management, considering from an amenity perspective, from the carbon sequestration perspective. You know, the upstream keeps the water on the peak rather than coming into the urbanised areas and so reduces the peak levels in river flows, which then increases resilience to severe weather in those urbanised areas and the impact it has on densely populated areas."* (Participant G, water engineer)

*"After Storm Desmond, we called for the institutions, including the Environment Agency, to establish an action plan for the wide catchment to be used to lobby the government to fund identified needs in flood mitigation, upstream attenuation,*

*downstream release. That was in 2016, and our vision hasn't changed really."* (Participant F, architect)

Moreover, transformability is also reflected in the change of discourse: "living with floods/water" is a notion that is often behind the employment of GI, in both England and China (Bosseler, et al., 2021; Liao, et al. 2016; House of Commons, 2015). The discourse change signals the gradual acceptance of flood risk amidst the uncertainty of climate change, also necessitates the socio-technical transition to GI as the approach to combat such uncertainty. The notion of "living with floods" also requires actors' ability to learn from the ever-changing environments and therefore justifies the critical role of learning in enhancing transformability, which in turn resonates with evolutionary resilience.

*7.5.3.2 Relational changes: the evolved power dynamics between communities and authorities*

The participants (D, E and F) who set up local flood action groups reflect that the relations between their communities and the institutions have changed: the communities used to be at the receiving end of any policies, but now with a united voice they are empowered to communicate their concerns back to the institutions, and more often than not, the local groups are invited to meetings and listened to.

The changed relations between the two parties indicate transformed power relations: local flood groups learn from their flood experience and actively mobilise all the resources to influence the institutions; on the other hand, institutions may also realise ignoring the united communities is not a viable option, so they learn from the interactions and start to value the different perspectives and input of such groups.

*"I think they [the authorities] have learned quite a lot by talking to local residents. When they organise exercises, which they do in normal times every six months or so, involving all of the emergency responders, for any sort of disaster. Now they automatically invite some of the community emergency groups to go along because they value the perspective that we can bring. So it's not just the police talking to the*

*fire brigade, talking to the city councils, there're also members of the public there, sort of chipping in putting a different viewpoint*." (Participant D, councillor)

*"The flood forum hosted by the council takes place every three months, where all these authorities are present. Our group and five or six other groups were invited in the beginning… The format [of the forum] has evolved. It started off as a big shouting match, you know, the people against the authorities and the authorities trying to satisfy our question. But it's now settled down to a format where they have a prior meeting of the agencies just amongst themselves to answer the questions that we've submitted in writing beforehand. So it's more formalised and that's three weeks before the actual forum where we actually meet, when we hear the answers. So we've sort of made a mark with that, we've come forward [with] constructive questions and they've had to really knock down an answer… because of [the many actions of the flood group] we've got quite a name for ourselves. And now when we sort of come forward with an observation or remark at the flood forum, people sort of sit up and take notice.*" (Participant E, civil engineer)

However, such transformations are neither straightforward nor linear. Participant E and F also reflect on situations where their communities' concerns are not listened to by the authorities, as I further examine the non-learning situations in the following section.

**7.6 The non-learning situations**

As I have argued, the employment of GI represents a socio-technical transition that requires learning on many fronts. For example, some participants learn that solely relying on old measures cannot deal with increasing flood risk (Participant C, G, H, J and K), and uncertainty and volatility are becoming the norms under climate change (Participant A, E, F, G, H and J). Such learning can lead to the aforementioned enhanced preparedness, adaptability, and transformability. However, the learning process is neither linear nor harmonious – I have examined the conflicts and tensions between multiple actors in previous chapters. In chapter 5 about the challenges facing GI in England, Participant E and F who speak on behalf of their communities acknowledge that traumatising flooding events leave many residents wanting certainty and reliability, so there is resistance to employing GI as the alternative to traditional schemes. *"What I'm*

*looking at now is the prevention of flooding rather than resilience… it is far more important to try and prevent it in the first place, so controlling the river, controlling the flood."* (Participant E, civil engineer).

Institutions also have different levels of tolerance of the uncertain benefit realisation of GI, as reflected by Participant G, H, J and K. The tensions between utilising known technologies and trialling new practices suggest actors' often conflicting attitudes towards learning the unknown. *"Only in some river catchments where there isn't anything else you can do, there is more acceptance of nature-based solutions… but in where I work, because there is still quite a lot of opportunities for traditional schemes, it's much harder to convince people that we should be using nature-based solutions… it tends to be on the list but quite far down."* (Participant J, urban planner).

Participant G admits that the inherent issues of GI obstruct effective learning:

> *"I think there are a combination of factors as to why that scale of Green Infrastructure isn't maybe as big as it could be. Green Infrastructure is something new, when something is new, there will always be that scepticism. The uncertainty in when and how you realize the full potential and benefits of Green Infrastructure is the other factor in that. You know, you can't necessarily go onto the Internet and find a design manual that says it will deliver you X benefits for the cost of Y, because there's a whole range of different scenarios that need to be taken into account. Also it's a very different design process than what a lot of hard engineering solutions would be."* (Participant G, water engineer)

Respondent F offers a reflection on the intriguing dynamics between institutions and their flood action group:

> *"I think there is a tendency for the authorities to feel 'we are the experts, therefore we should be leading'. There is perhaps a feeling that if they start asking for information from a community then they're giving an indication that they're actually not as expert as they should be, which is wrong, because, you know, you can be an expert and still remain open to all avenues of information… The institutions should be less proud, they*

*should start to think out of the box in terms of flood history and in terms of what local people are telling them."* (Participant F, architect)

Such reflection can trigger many interesting debates such as the legitimacy of learning – "whose learning matters", as well as the power relations between institutional knowledge and lay knowledge. Due to the scope of this research study, however, here I only focus on the case that institutions ignore new information outside their focus, and choose to hold onto their own expertise whilst rejecting possibilities of learning from the communities. This phenomenon connects back to what cognitive lock-in mechanism – actors are trapped in their siloed mentality due to stable routines and being surrounded by similar mindsets, so that they are to some extent blind to new developments or varied opinions outside their scope (Geels, 2019; Goldstein, et al. 2023; Seto, 2016).

Nevertheless, Participant F, G, H, J and K indicate that they are aware of the non-learning situations and start to reflect on the hurdles that prevent the learning process:

*"Different organisations and local authorities will always have different expectations about the level of certainty, monitoring, the benefits [about GI]… as much as we'd like everything to be very well aligned, in reality it never quite aligns as effectively as you might think… But we are reflecting on some of those differences in partnership discussions" (Participant H, flood resilience specialist)*

*"We completely understand where [the disagreements] come from because the budgets in the council are tight, [some of the institutions] can't really afford to take these risks… But hopefully once we make sure [the GI project] works well, they will then be more acceptable of it, so I think this is all part of the learning for everyone."* (Participant K, project manager)

*"If their [Green Infrastructure's] benefits realization and the monitoring associated with that are not defined upfront, they [funders] will ask questions once something is delivered 'Well does it work then? Can we scale this? Can we deliver this elsewhere?' And it's why I think when it comes to flood resilient schemes, there are huge number of pilots, but actually really large-scale schemes of that nature, really integrated schemes are less common, because inherently they have less certainty than very heavy*

*civil-engineered projects. You know, look at Thames Tideway in London, massive infrastructure being delivered there to address flood resilience in London, whereas a more sustainable choice from a carbon impact perspective might be Green Infrastructure. But the way that you maintain that Green Infrastructure, and the way that Green Infrastructure responds to changing weather events etc. are less clear than the more traditional solution."* (Participant G, water engineer)

On the surface, non-learning of this kind may not be conducive *to* the transition, nor does it help to enhance resilience. However, the above reflections of the respondents already suggest another type of learning is taking place, i.e. learning the reasons for non-learning. Acknowledging the hurdles to further learning can also be an important lesson for professionals, so that some reflections of the root cause to non-learning may take place and solutions may be found. In other words, the learning of non-learning is beneficial to building up resilience.

Similarly, Participant F whose community has been flooded offers the following observation:

*"so flood risk management appears to be reactive in this country. We seem to have a system where somewhere is flooded, pour some money in, send in the agency, sort that problem out -- so it's reacting to events. What it's not doing is looking at rivers and catchments in total, it's not looking at the history of flooded areas to see what's going wrong in the past which would give us an indication to how to solve it in the future."* (Participant F, architect)

In this case, even if the authorities have not taken the right approach to addressing flood risk, the respondent's account is a validation of the critical reflection taking place on the individual level, this "learning from the non-learning" is essential for forging the connection between identifying problems and advancing evolutionary resilience – if such learning is valued by stakeholders and utilised for constant improvement.

### 7.7 Chapter conclusions

This chapter is developed to explore the learning process and outcomes in the implementation of GI projects. Following the professionals' situated strategic wisdom I investigated in the previous chapter, this chapter takes a step further to examine in detail what the respondents have learnt in relation to flood resilience, and showcases how the learning outcomes impact resilience.

This chapter firstly explores the various ways of learning demonstrated by the professionals. I found out flood experience can be a significant trigger for some participants to learn profound lessons: such experience shapes individuals' perception of flood risk and impacts their responses to future flooding events. Additionally, I found that learning by doing is a further demonstration of the professionals' situated strategic wisdom that guides them through various predicaments and reinforces their ability to learn. Moreover, learning in the multi-stakeholder environment is challenging because of the tensions and conflicts that may arise, as is examined in Chapter 5. Nonetheless, working in the multi-stakeholder environment also allows professionals to communicate and share knowledge with peers, and interact with communities to foster mutual learning.

The rich learning process leads to a wide range of learning outcomes. To connect the learning outcomes back to the overall research aim, I focused on analysing the outcomes that contribute to preparedness, adaptability and transformability, which are the key attributes of evolutionary resilience that centres on continuous learning.

Preparedness is embodied in many examples: local flood action groups take actions to monitor river levels and set up flood warden systems; institutions take into account climate change uncertainty and update the flood modelling and forecasting models accordingly. Such actions boost preparedness by enabling respondents to act pre-emptively before a flood strikes, reducing the level of disruption. Adaptability, on the other hand, manifests in the many trials of GI as the alternative to the flood defence facilities, and, importantly, in the shift to catchment-wide flood risk management utilising GI. Furthermore, the cognitive and behavioural changes taking place to enhance preparedness and adaptability imply transformability that is embedded in such changes,

but transformability also manifests in the changed power relations between different parties: local flood groups are more able to communicate with the institutions and make an input in shaping decision-making. The above learning outcomes, through enhanced preparedness, adaptability and transformability, are conducive to the transition to GI and beneficial for flood resilience, but such outcomes also emphasise and validate the critical role of learning in the literature of socio-technical transitions and evolutionary resilience.

However, some learning outcomes, superficially, create more hurdles for adopting GI and lead to more resistance to the shift to flood resilience. As I examined in Chapter 5 about the tensions between the professionals in England, I stated that flood experience is a significant contributing factor to the professionals' varying positionalities. In this chapter I followed that divide in positionalities and further investigated how the experience of flooding events can shape what they learn from their situations and how the lessons they take away influence their perceptions and decisions. For those who have personally experienced flooding events, such experience has set them apart from the rest of the respondents: they are less convinced by the intended benefits of GI and more inclined to hold onto the traditional schemes; they self-organise and take various actions to protect their communities; they unite together to question the authorities and speak up for their local interests. Flooding events have left them wanting more certainty, stability and reassurance; therefore, they prefer reinforcing flood resistance and are suspicious of the transition to GI.

Such learning outcomes appear to be "non-learning" for the cause of GI, but I argued that the "non-learning" is a different form of learning – participants have learnt that GI projects may not deliver the results they need in an acceptable time frame for them. This realisation is also a kind of learning, albeit to the disadvantage of implementing GI. Such learning can be crucial for professionals to view flood resilience from a different lens. If the root cause of "non-learning" can be taken into account to shape policies accordingly, actors are able to generate more approaches to advancing resilience.

# Chapter 8 Conclusions

## 8.1 Summary of arguments

This chapter first summarises what the thesis has achieved in terms of answering the research questions, before explaining how the seemingly different research findings are, in fact, logically connected and thus contribute to my overarching research question – "How is Green Infrastructure implemented by professionals to embody resilience in flood risk management?". At the end of the chapter, a conceptual diagram mapping the relations between learning and flood resilience is presented to illustrate the interrelated and self-reinforcing loops of learning that are critical to evolutionary resilience. Furthermore, building on the research findings, this chapter elaborates the contributions to the literature, notes the limitations, and identifies areas that require further research.

In the literature review (Chapter 2), I outlined that evolutionary resilience does not seek equilibria, but instead emphasises the ability to constantly adapt, evolve and grow, which aligns with the nature of urban systems that do not maintain an equilibrium (Boschma, 2015; Christopherson et al., 2010; Simmie, Martin, 2010). Hence, I argued that evolutionary resilience, with its focus on learning to adapt and evolve, is the most suitable perspective to study flood resilience in the complex and dynamic systems of cities. In this research study I find that some professionals' ability to learn ensures that they overcome various challenges through dynamic adaptation and continuous reflexivity, manifesting as their situated strategic wisdom. In doing so, they develop the mentality of learning and brace for future events. Learning is therefore foregrounded as the critical element to enhance flood resilience, resonating with the evolutionary perspective and validating my argument. This argument also stimulated me to critically evaluate the challenges confronting the professionals, and allowed me to investigate their responses and actions through the lens of evolutionary resilience. In doing so, I was able to address the two sub-questions: *"What are the challenges facing professionals in the process of implementing GI projects in the two countries?"* and *"How do professionals operate in the face of predicaments to overcome the difficulties and deliver GI projects?"*

In Chapter 2 I also argued that the implementation of GI is a socio-technical transition. Multiple participants' accounts in this study indicate that this transition to GI brings about not just employment of new technologies, but transformations on many fronts, including citizens' mindset, the relations between key stakeholders, and institutional flood planning. Hence, my argument is upheld. Additionally, through the lens of socio-technical transition, I was able to bring in concepts like "lock-in" to further scrutinise the challenges facing the professionals. The transition perspective allowed me to examine the learning outcomes as changes taking place on cognitive, behavioural, and relational fronts. In doing so, I was able to connect such changes to the attributes of flood resilience, namely preparedness, adaptability, and transformability. Hereby, the third sub-question is answered: *"What is (not) learnt in the process of delivering GI projects, and how do the learning outcomes impact overall resilience?"*

Building on the first two arguments, I then contended that learning is the bridging concept that links the studies of evolutionary flood resilience and the socio-technical transition in the context of implementing Green Infrastructure. I supported this argument by demonstrating that learning not only plays a central role in evolutionary resilience, but also catalyses the transition to GI. This argument has contributed to the creation of the diagrams (Figure 8.1 and 8.2) at the end of this chapter, exhibiting that resilience is an iterative process with learning being a self-reinforcing mechanism.

### 8.2 The barriers to the implementation of Green Infrastructure

The first sub-question focuses on examining the challenges facing professionals in both China and England when delivering GI projects. This research study, through an extensive literature review as well as in-depth interviews, shows that the implementation of GI projects in the two countries faces an array of challenges on many fronts. Some of these challenges are not well documented in existing literature, such as the multiple conflicts and tensions amongst the actors, especially in China's context where there is little research attention on the power struggle between high-profile technocrats.

### 8.2.1 The obstacles related to regulation and legislation

The SCPs in China has state backing with regulations and top-down enforcement, and consequently, SCPs have been adopted in dozens of cities across the country. However, as identified in the literature and also reflected by the interviewees, the guidelines for building a 'sponge' city is far too generic due to the fact that the national programmes borrow novel ideas and concepts from other similar projects, e.g. Low Impact Development (LID) from the US and SuDS from England, with little consideration of regional differences in geography, climate, and precipitation (Griffiths, et al. 2020; Chan, et al. 2018;). In other words, the guides have to be adapted to local conditions by professionals with the necessary expertise. This 'one size fits all' strategy is deemed as impractical and poses challenges to local authorities that are responsible for turning the unfit guidelines into functioning projects that deliver intended outcomes (Chan, et al. 2018; Lashford, et al. 2019). As revealed in Chapter 4, the inadequacies in the designing standards can easily lead to quality problems in the projects, due to the lack of skilled labour and expertise in project supervision. Moreover, the interviews also reveal that too much political attention has been on completing GI projects but not enough on monitoring their performance or subsequent maintenance, which in the end will hinder the realisation of the expected benefits.

Whilst in England, there are a series of problems facing SuDS in relation to the lack of legislative support and regulations. At the time when the research interviews were conducted, there was no statutory status for SuDS, which means SuDS mostly rely on local actors, e.g. councils, organisations, and land developers, to implement them when conditions allow (Lashford, et al. 2019). The absence of statutory status left many questions unanswered – namely the ownership of SuDS projects, the cost of maintenance, and the monitoring and assessment of these projects. Local champions who have taken up GI then have to face the unclear responsibilities and potential clashes over differing agendas, delaying GI delivery and restraining the realisation of benefits. The many problems further discourage potential local actors to trial SuDS projects, exacerbating the fragmentation of GI and hindering the integration of small-scale projects with the wider catchment.

Moreover, the myriad of problems deriving from the lack of legislation and regulation strengthens the path dependency on the traditional schemes and thus restrains the possibility of a transition. Since the old way of operation and vested interests are deeply entrenched, the learning ability of the political leadership and agents is important – the learning of why these barriers exist and how to clear the hurdles against the uptake of SuDS. As I have noted, the latest policy development has made incorporating SuDS a legal requirement for all new builds in England – a significant step forward for the wider rollout and upscale of SuDS.

### 8.2.2 The uncertainty and shortage of funding

In Chapter 2 I also have noted the financial difficulties that confront the uptake and upscale of GI projects. In China, despite national funding for SCPs, project financing remains an issue because central government only plan to fund pilot SCPs for the initial few years before requiring cities to seek private financing; whereas in Britain, no special funds are targeting SuDS projects and GI projects remain dependent on local actors to promote and support. Based on the literature, further investigations in this research demonstrate that funding for GI is a major constraint in both countries that may dampen the hope for a sustained transition to GI.

The problems in financing GI are, in many ways, intrinsically related to the barriers related to regulation and legislation. The first issue is scarcity of the necessary funds. Funding opportunities in England can be sporadic and short-term oriented, due to the non-statutory status and the absence of an overriding strategy from the government. Without institutional support, even if local actors can find their own ways to pull together funding, the lack of sustainable funding schemes for the longer term remains a bottleneck that restrains the wider rollout of GI. Consequently, GI projects in England are usually small-scale and locally based as opposed to targeting catchment-wide flooding issues. As for SCPs in China, the number of cities qualified for the second round of funding from the central government is reduced, signalling a gradual scale back of national funding. Although city governments are encouraged to seek financing from the private sector, I have found that profitability in relation to GI projects is uncertain, and this uncertainty deters the private sector from investing in GI.

Moreover, funding may also be negatively impacted by difficulties in realising the benefits of GI projects. For SCPs in China, city governments have to demonstrate the performance of GI projects meet the assessment threshold set by the central government (which is not available to the public) to qualify for further funding, and only a handful of cities from the first round of funding continue to be funded in the second round (Fu, et al. 2022). Similarly, participants in England reveal that the uncertainty around the expected benefits discourages potential funders from investing in GI projects. As emphasised by multiple accounts, GI projects represent a shift in flood risk management, and thus request a cognitive change as well – the mentality that sees GI as a novel practice that is fundamentally different to traditional schemes, and that requires new ways of assessing their efficacy. Judging GI on the basis of metrics set for grey infrastructure does not contribute to justifying GI. Inherently, this second issue is interconnected to the first one and they are mutually reinforcing – no sufficient funding for longer-term project monitoring and assessment leads to doubts and caution among professionals and institutions, further restraining the amount of funds and the funding opportunities.

However, as aforementioned, the recent legislative change to support SuDS is a positive signal for the future of GI projects. Land developers are now required to cover the cost of equipping new builds with SuDS, but it is not yet clear who takes the responsibility for maintenance and monitoring after project delivery.

### 8.2.3 Conflicts and tensions amongst professionals

One serious challenge that has been identified in both countries is the conflicts and tensions amongst the stakeholders, including between professionals, between different institutions, and even between different teams within the same institutions.

As I have argued, the implementation of GI is a socio-technical transition that requires changes on many fronts and the gradual phasing out of the old paradigm, which naturally impacts the incumbent interests and causes contention. Multiple accounts from the interviews reveal the prevalence of conflicts – the scale of such conflicts can be a serious hurdle to the rollout or upscale of GI projects.

Superficially, the implementation of SCPs in China has largely gone smoothly because of the directive from the central government, but the interviewees delivering local projects often remain unconvinced and even critical of the projects for the cost and uncertain benefit. Although individuals' objection at the local level do not pose a threat to SCPs, the discord between different factions of professionals in the industry could escalate and induce negative publicity for SCP. As explored in Chapter 6, the open letter from those denouncing Yu and his "sponge" city signals the power struggle over the flood risk discourse, and shows that the incumbent interests do not hesitate to mobilise the public and the media to obstruct a transition from the current paradigm. Some of the floundering projects in pilot cities further draw the public attention and media scrutiny. Even in China's authoritative top-down policymaking environment, clashes between the high-profile technocrats dampen the hope for a transition to GI.

In England, through the interviews with the participants who also represent their local flood action groups, it becomes clear that there are heightened tensions between communities that were flooded before and institutions handling flood risk management. The contention damages the communities' trust in institutions and undermines the institutional push for a transition to GI. Additionally, issues like the lack of monitoring of GI projects and the follow-up cost of maintenance mean that GI projects do not always deliver the expected benefits, further exacerbating communities' distrust in GI and reinforcing their reliance on the traditional schemes. Moreover, according to the few respondents who spoke from their communities' point of view, the power relations between institutions and communities can be highly imbalanced – institutions may feel complacent with their own expertise and knowledge and therefore dismiss communities' voices.

Such conflicts of interest are also identified within the same organisation, with respondents revealing that different departments may have differences over the ways to managing flood risk – GI and traditional schemes can be in competition. As professionals make their judgements based on their expertise, those from an engineering background are more inclined to seek quantitative evidence and thus reject GI projects, whilst those with knowledge in ecology and environmental science tend to back GI as the alternative way forward.

The conflicts and tensions between stakeholders in two countries reveal the complex power dynamics in the process of a transition (Seto, et al. 2016; Thorne, et al. 2018; Van Buuren, Ellen and Warner, 2016), and some of the tensions echo the lock-in mechanisms examined in the literature review, such as the incumbents are defending their interests in relation to the traditional schemes, whilst the uncertain benefit realisation deters actors to take on the risk of employing GI. The conflicts and tensions are frequently encountered and both countries share similar challenges despite different social contexts, which pose a question to not only professionals but the authorities about how to sustain a transition in the face of these challenges.

### 8.3 The roles of strategic operators in facilitating the delivery of GI

After exploring the obstacles constraining the rollout of GI projects, the second sub-question follows up by asking how professionals overcome the challenges and push ahead with the GI projects. In my research into a prominent figure, Kongjian Yu, who has been championing novel ideas of addressing urban flood risk and lobbying authorities to take on his visions, I dissect how he manoeuvres astutely to overcome the challenges and promotes his philosophy of "sponge city" that gives rise to a paradigm shift. As examined, the policymaking process in China is often opaque and arbitrary, relying on a few at the top of the power hierarchy to mandate certain policies. The power-laden, authoritarian way of governance means there is little room for civic activism and grassroots movements that aim to shape public policies as are often seen in England. The Chinese context seems difficult for any novel practices to take place, because the political elites have vested interests in the existing system, and experts enjoy the monopoly of discourse about flood risk management.

Such challenges make it extraordinary that SCPs as a novel practice to boosting flood resilience was taken on by the central government. The shift was no coincidence but was pushed by calculated efforts from key agents like Yu, who acts with their situated practical wisdom. In Chapter 6, I identified Yu's strategic moves: 1) invoking a historical imaginary that enable audiences to resonate with old Chinese wisdoms and philosophies exhibited by ancestors; 2) (re)producing and reinforcing his image through media and binding himself with the popular discourse of flood risk management; 3) targeting key

political elites and active networking; 4) utilising the institutional power to break up the path-dependency.

Yu gradually garners attention from both media and authorities after some of his iconic projects in his early years won prestigious awards on the global stage. When interviewed by media from home and abroad, Yu takes the opportunity to promote his visions for flood resilience, which reject the traditional schemes and call for bold and novel design that prioritises GI. In doing so, he invokes a historical imaginary where, before the industrialisation and urbanisation take place in China, ordinary villagers could "live with floods" with minimal disruptions, building an emotional and nostalgic connection with the audience, i.e. the general public as well as technocrats. The historical imaginary allows Yu to justify the seemingly novel ideas through ancient wisdoms practiced by ancestors for generations. After his ideas find their roots in cultural and historical soil, he then contrasts his advocacies to the dominating, heavily engineered grey infrastructure which he argues are borrowed from western industrial practices. Therefore, he successfully shifts the narratives from introducing novel practices to challenge the norms to applying ancient Chinese wisdom to wrestle with Western inventions.

Utilising the platform provided by media, both domestically and internationally, Yu relentlessly advances his beliefs and becomes increasingly critical of what he sees as wrongdoings in urban planning in China. The constant making and (re)producing of his image – controversial yet intriguing – has led to more press coverage and readership, thus more promotion of himself and his ideas. The accolades and media interviews are mutually reinforcing, enabling him to be the representative for the paradigm shift. After establishing himself as a globally well-respected expert who diagnoses problems within the existing systems and champions change, Yu is empowered to communicate to officials and influence them. As he admits, the best way to effect a change in cities is to persuade the mayors, and that is what he aims for: through formal networking and informal socialising, Yu works his way into the political elite circle. As a result, he embarks on projects in major cities that deliver his vision before he is invited to contribute to national policymaking. Eventually, the concept of "sponge city" is incorporated into a national policy for realising the goals of Ecological Civilisation.

The top-down, authoritarian decision-making in China's context poses a great challenge for change agents to advance their cause, but Yu is not deterred and manages to utilise the system to work in his favour. As he concludes, what he only needs is to change the mind of officials who have a final say in policies. He relies on the administrative power, which created the old regime of grey infrastructure dominance in the first place, to break up the impasse and prompt a paradigm shift. The research into Yu illuminates how a strategic operator works in the context of China with the aim of promoting GI. Exploiting the power relations in the system gives Yu a unique negotiating position – internationally recognised professional, understanding Chinese traditional wisdoms, and engaging with political elites. All the actions demonstrate his situated strategic wisdom that requires outstanding experience and skills, which is key for change agents to navigate the challenging situations in a socio-technological transition.

Conversely, in England there is a lack of prominent figureheads like Yu that champion a change in a high-profile manner, because of the different policymaking and funding environment. GI projects often happen as a bottom-up initiative, with a wide range of organisations and funders involved. Meanwhile, communities' pushback may also influence if and when a GI project can be delivered. Therefore, the agents pushing for change tend to come from some organisations, local councils, and the wider communities.

As examined, the institutional challenges primarily stem from the institutional lock-in or path dependency. The institutional lock-in, as identified by the respondents, is a result of multi-fold causes, such as the uncertain benefits of GI, the risk of failing to deliver GI due to unfamiliarity, and in contrast, the existing know-how and talents in the planning and construction of grey infrastructure. These factors combined mean that institutions are less likely to favour GI.

The interviews with participants demonstrate how they work strategically to overcome the various barriers. Faced with the lack of funding for GI projects, and no long-term funds for monitoring and maintenance, strategic operators learn to utilise every funding opportunity to support GI, which requires them to be highly opportunistic in seeking funds and linking programmes together. For example, one respondent connects urban

regeneration programmes with GI projects in the form of a 'sponge' park, delivering a green space to boost the regenerated area with the features of SuDS that manage flood water. Similarly, another interviewee said that they try to link mandatory schemes, such as biodiversity net gain, to SuDS features so that projects get approved and funded more easily. Also, some manage to connect SuDS to land management schemes that legally request landowners to maintain the GI schemes in the long term.

When it comes to challenges involving multiple stakeholders, these agents also demonstrate their phronesis in overcoming the difficulties. For instance, when knowing landowners may be suspicious about implementing GI on their land, one respondent works with charities and organisations with local presence to earn landowners' trust and create long-term visions for the project, improving their image in the eyes of landowners and sustaining amicable working relations. On another front, to address the tensions with the public, some respondents choose to actively engage with communities and listen to their concerns, such as creating a 'friends' group of the projects that enhance residents' sense of ownership of the project, and in some cases making changes to projects after public consultation, making the public feel their voice is heard and valued.

A wide range of accounts from both countries signal the key role of phronesis, or situated practical wisdom, in enabling agents to overcome various difficulties, promoting GI projects, and assisting the socio-technological transition to flood resilience. Although this indicates how crucial it is to have skilful actors working strategically to realise the goals, it also paints a slightly pessimistic picture of the future of GI. It is because of the vital roles of the strategic operators that make the implementation of GI so uncertain and prone to failure. These skilful actors rely on their experience, knowledge, and ability to learn to gauge the ever-changing situation and shape their strategies accordingly, which means some may succeed with what they intend to do whereas others fail. In addition, the paradigm shift is only the beginning, to sustain the transition means more strategic operators are needed across many more fields, so the shortage of such actors will be a bottleneck for the spread and upscaling of GI projects.

### 8.3.1 Discussions of Yu's unique position in China's context

I believe the success of Yu is a combination of China's political structure, social and economic development at the time when Yu's career took off, and his situated strategic wisdom on top of his knowledge and expertise. None of these factors are applicable to England's context.

First of all, the top-down, authoritarian policy-making system in China means that policymakers are unlikely to listen to some expert in the field (Bakir, 2023; Qiaoan and Teets, 2020; Gilley, 2012). However, Yu's prominent education and work experience allow him to draw the media's attention and create an outspoken image of himself to the public. In doing so, Yu stands out and he is thus able to build networks with officials at different levels. Yu's strategic wisdom guides him through the opaque and undemocratic policymaking environment. In comparison, the process of creating and shaping important environment policies in England is fundamentally different: the authorities do not have a monopoly of determining policies.

Additionally, the timing of Yu's achievement is key. In the 1990s, Yu acquired his PhD degree from Harvard University and accumulated his work experience in architecture firms in the US (Biboum, Rubio and Calzada, 2020; Green, 2021; Park People, 2022). That was the time when China was rapidly going through urbanisation, with cities expanding – providing an open canvas for Yu's ideas about "sponge" to be experimented in dozens of such cities (Guan, et al. 2018). This contrasts with England, where there is no intensive urban expansion in the same period and the built-up areas are difficult to retrofit GI projects.

Moreover, Yu's background and expertise enabled him to stand out in 1990s China when there was a shortage of educated and qualified experts in urban planning and landscape architecture (Zweig, 2006; Miao, et al. 2022). All of the trial projects in Yu's early years offer valuable knowledge that feeds back to the formation of a more systematic philosophy of his own. Throughout the years, his ideas have evolved and his projects have since won him numerous accolades internationally and, therefore, recognition within the industry. In England's context, Yu's background would not stand out in the face of fierce competition in the field.

### 8.4 The learning process and learning outcomes

The last sub-question is to find out what is learnt by the agents, and how the learning outcomes impact flood resilience overall. Although there were a number of restraints in interviewing experts in China, the information acquired still paints a picture of various ongoing learning processes. Even without a universally accepted translation, the concept of resilience has made its way into actions, including the making of emergency evacuation plans and carrying out drills more regularly in communities. I also found a shift of attitude towards improving non-engineering methods in flood risk management, such as upgrading flood forecast models based on the previous extreme flooding events and considering the climate change uncertainty in model-building. Such activities resonate with preparedness building evidenced in the literature, and enhanced preparedness is a critical component of advancing resilience.

Interviews with participants in England show that learning is happening on multiple fronts. There are primarily three types of learning identified in the research: learning from flood experience, learning by doing/through trial and error, and learning via the interactions between multiple stakeholders. For those who have experienced flooding events in their communities, they started to think and operate differently after reflecting on their flood experience. Additionally, some actors learn from taking actions to manage flood risk, be it embarking upon a GI project for the very first time, or creating a flood action group from scratch. Through trial and error, they have accumulated knowledge and honed their skills. Lastly, learning in a multi-stakeholder environment, such as community engagement and communications among institutions, is a power-laden process full of power struggles and requires agents to rely on situated practical wisdom to navigate.

Whilst the ways of learning differ, many of the learning outcomes observed from participants in England can be grouped into categories corresponding to the elements of resilience – learning outcomes that boost preparedness, improve adaptation, and prompt transformation. Some actors have learnt to be better prepared for flood risk, with numerous actions demonstrating their preparedness: making evacuation and rescue plans, updating flood modelling methods and design standards to consider

climate change uncertainty, and creating flood warden systems in communities to actively monitor river levels. Such actions enable communities and institutions to quickly respond to flooding and take organised steps to minimise the impact. With heightened preparedness, actors are more acutely aware of flood risk and more able to plan ahead before any flood strikes.

Some respondents have also learnt to be more adaptive to the threat of flooding, choosing GI as the alternative and making necessary changes to adapt to uncertainty. Although the learning agents experience different predicaments, they come to realise that the old paradigm of grey infrastructure cannot cope with the increasingly uncertain and volatile future with climate change, thus taking on the new initiatives of GI to confront the changing situations.

Transformation signals a shift from old practices and mentality to form new responses and actions to address the increasing flood threat due to climate change. I identified a mindset change exhibited by the participants that is moving towards accepting that floods may happen again and therefore focusing on finding ways to mitigate the risk rather than seeking to prevent floods completely. The changed thinking also leads to respondents' changed ways of responding to floods, which is to focus more on the preparedness and adaptation stage, becoming more interested in GI rather than sticking with the traditional schemes. Overall, the research into the learning process and outcomes discovers ongoing and flourishing learning activities among respondents, suggesting some agents are forming a learning mentality: learning the importance of learning in the face of uncertain and unfamiliar situations, and learning to gradually embrace the inevitability of change.

### 8.5 Discussions of (non) learning

Even though the data analysis chapters are developed around different themes, and answer the research questions from different perspectives, the chapters are inherently cohesive and logically connected. The key element that threads them together is learning. As Chapter 4 and 5 discuss the challenges facing the professionals in the process of implementing GI, these challenges are in fact obstacles against transitional change. To some extent, such obstacles are associated with barriers to learning and the

non-learning scenarios. Chapter 6 focuses on the strategic practical wisdom of the professionals, which reflects the agents' ability to learn and accumulate knowledge in response to their predicament. Chapter 7 then explicitly examines the many forms of learning and learning outcomes.

Chapter 4 and 5 demonstrate the challenges facing GI projects in both China and Britain. In China's case, on the surface, SCPs have gained state backing and been carried out all across the country, but in reality there is a cacophony amongst professionals regarding the uncertainty of delivering expected benefits and the political meaning vested in the projects. The discord between different factions of professionals, as we saw in the battle between Yu and Li, and in the research interviews, indicate the widespread resistance in the transition to GI: Yu and some of the research participants reject the officially designated SCPs whilst Li and other technocrats refuse to concede there are flaws in the SCPs and dismiss the criticisms.

This type of resistance appears to signal their non-learning mentality: they resist changes taking place as part of the transition, and instead, they hold onto their old beliefs of what should be done. However, I contend that this apparent non-learning is essentially another type of learning: the learning that is not conducive to the transition to GI. This "learning to resist changes" does not invalidate the learning process taking place, and this level of non-learning derives from the inherent problems accompanying the SCPs in China. Chapter 4 shows that some professionals may have learnt that, after dealing with GI projects, they prefer the traditional schemes that are known and less risky. As has been reflected, the uncertain benefit realisation of GI projects and the lack of expertise in the field discourage professionals on the frontline, and understandably, they remain unconvinced by the new and favour the old paradigm. In other scenarios, such as when grey infrastructure can provide the protection needed whilst the design standards for GI do not fit the geography and climate, it is not surprising that professionals wish to stick with what they see as the most suitable option. The various forms of non-learning in fact reflect that the actors have learnt the flaws and inadequacies of GI and therefore made decisions against the transition.

In England's case, some of the obstacles can be associated with the lock-in mechanisms. In the interviews I have found out that some professionals are likely to hold onto all the human capital and experiences related to the old paradigm and therefore do not want to give away easily, they therefore defend their beliefs in grey infrastructure; or they favour the certainty and reassurance provided by the traditional schemes and feel no need to change to GI. Such a mentality resonates with the lock-in mechanisms I reviewed in literature (Eitan and Hekkert, 2023; Klitkou, et al. 2015; Seto, et al. 2016).

Again, such lock-ins appear to reflect the non-learning of the professionals, but reasons for non-learning are associated with the disadvantages of GI projects. The interviews with some respondents whose communities have been flooded shed light on the grim reality: some households have been traumatised after suffering multiple flooding events in a short span of time, all they want is to have the protection and security that are perceived to be provided by grey infrastructure; whereas organisations with limited funds tend to be risk averse and want to see benefits delivered in the short term, so GI projects are unlikely to be their first option.

These non-learning situations indicate the complexity embedded in the transition to GI, and showcase that boosting flood resilience is unlikely to be linear. The interconnected learning and non-learning situations render it difficult to judge who learnt the "right" lesson. One key factor of Foucauldian discourse analysis is that there is no single 'truth', which is echoed here by the myriad of lessons learnt by professionals. It is not the intention of this thesis to pass judgement as to what the actors should learn, or what the 'right' lessons are. Instead, I argued that non-learning should not be plainly dismissed just because the learning outcomes undermine the direction of the transition, because non-learning in many cases exposes the potential weaknesses of GI, and an examination of the rationales behind non-learning can be an important lesson for actors seeking to enhance resilience.

Chapter 6 centres on the roles of strategic operators as they navigate predicaments to advance their agendas for GI. Some of the challenges, as elaborated above, are connected to the lock-in mechanisms and path dependency. To break the impasse, the learning agents in both countries rely on their situated practical wisdom to adjust their

tactics and mobilise resources. China's political and social contexts make it arduous for Yu to push through his advocacy of "sponge city", and yet he managed to achieve that by taking advantage of the authoritarian policymaking process. Reflecting on his interactions with authorities and officials throughout the years, Yu has learnt that persuading officials at the top of a power hierarchy is the most efficient way to initiate changes, and the significantly asymmetrical power relations between officials and scholars mean that he needed to stand out amid other experts in the field. Hence, he employed tactics of being bold and outspoken in media coverages, invoking a historical imaginary to resonate with the national agenda of Ecological Civilisation, and marketing his projects through international platforms. He has also learnt the importance of networking and socialising with the political elites so as to be given a seat at their table in shaping policymaking.

In contrast, respondents in England make different attempts to overcome the barriers. Some learn to be opportunistic when funding is limited and short-term, such as combining different schemes into one with SuDS features built in, or flexibly utilising funds they have acquired to implement small scale projects; whereas others learn how to convince stakeholders to get onboard with the novel practice that lacks the backing of quantitative data. Moreover, seeing the strained relations with the public, some reflect on their ways of interacting with stakeholders and keep trying out new approaches to engage communities, thus moderating the hostility and directing the engagement towards mutual learning. So overall, the agents in both countries demonstrate clear patterns of constant learning from and adapting to the predicaments facing them, and their situated strategic wisdoms allow them to advance their goals.

In Chapter 7, I further investigate how agents learn and their learning outcomes. The enhanced preparedness, continuous adaptation, and ongoing transformations on multiple fronts – all validate that learning does make an impact on resilience, and therefore, learning comes to the centre stage in this research study. Learning is the core element that underlies the four data analysis chapters, and is the link that threads the whole thesis together. Hence, I conclude that learning is the key to enhancing resilience, and resilience is therefore a constant process of reflexivity and learning.

### 8.6 The diagrams: resilience as an iterative learning process

To demonstrate the central role of learning in this research study, I have created the following Figure 8.1 and 8.2. Figure 8.1 illustrates the different types of learning based on three triggers. Reactive learning refers to situations where actors learn from flood experience: a flooding event serves as an important trigger that stimulates actors to draw lessons from the suffering, and reflect on their old ways of operation. Secondly, there is proactive learning, which refers to agents taking a self-initiated approach to advance their knowledge, including taking lessons from the interactions with multiple stakeholders, or learning by doing. Moreover, there is a scenario where agents learn opportunistically or tactically to navigate the predicaments they are in, as demonstrated by their situated strategic wisdom where they learn from the changing predicaments.

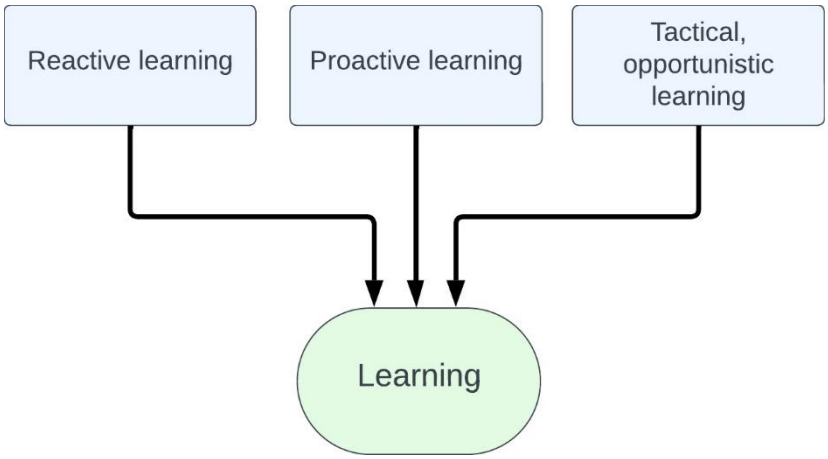


Figure 8.1 Triggers that instigate learning

Figure 8.2 presents the intricate connections between learning and resilience, demonstrating that resilience is an iterative learning process. Routes 1 and 2 display some of the common learning outcomes examined in this research study, albeit in different manners: professionals learn to boost preparedness and take on GI projects to enhance adaptability, where some of their learning outcomes lead to transformations on many fronts. Such learning outcomes contribute to advancing flood resilience.

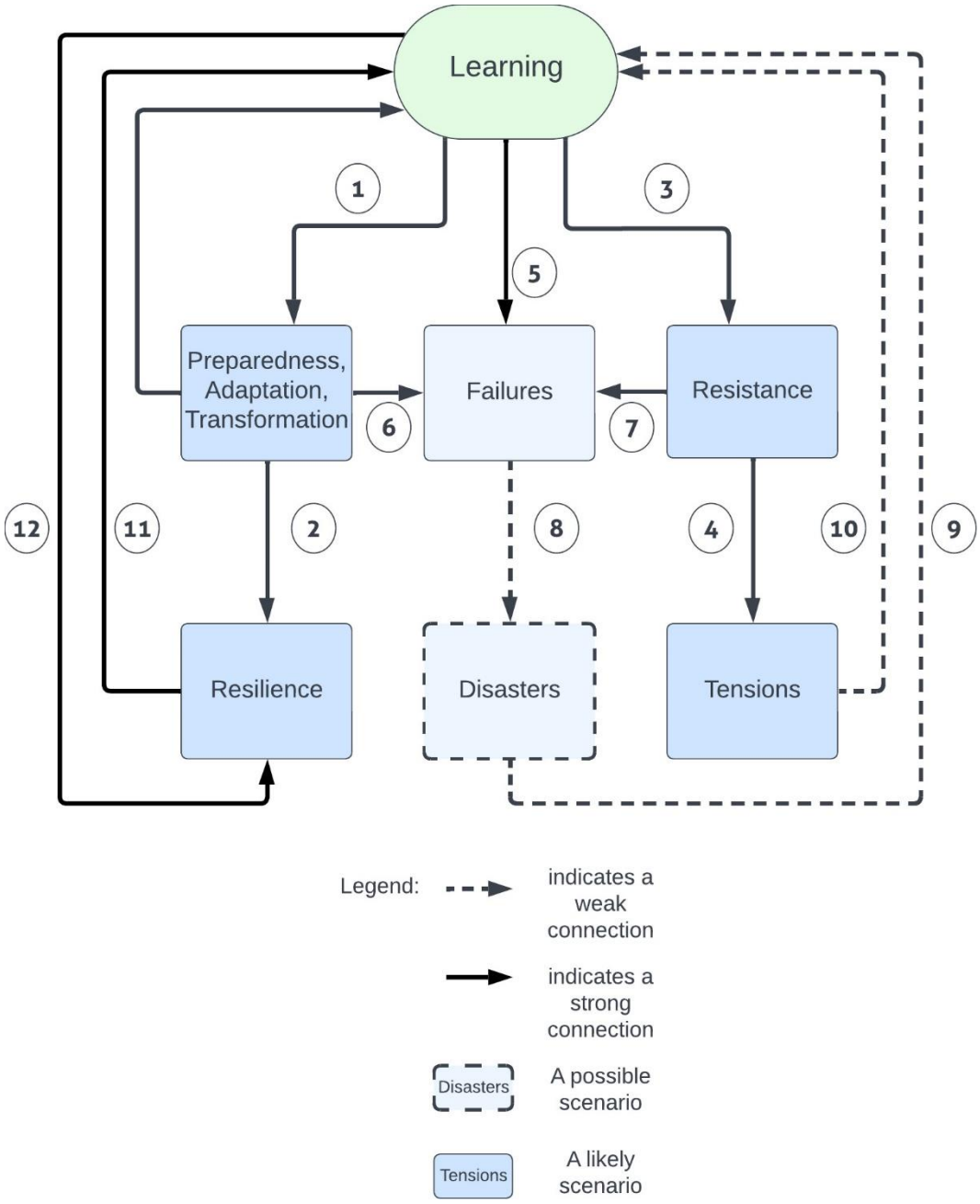


Figure 8.2 Resilience as an iterative process of learning

However, learning does not necessarily lead to positive outcomes. As I found out in Chapter 4 and 5, one of the challenges facing GI in both countries is that professionals may be resistant to adopting GI projects or endorsing the paradigm shift. Route 3 shows the resistance derives from learning – actors may learn that there is uncertainty about GI's benefit realisation, and therefore reject any novel practices. This route also links to the lock-in mechanisms that were examined before. Resistance often leads to tensions

between different stakeholders. For example, in England some communities are dismayed by the institutional preference for GI, as shown as Route 4.

Other than the explicit scenarios for learning, other likely scenarios also include non-learning, or learning failures, as Routes 5, 6, and 7 suggest. Generally, Route 5 refers to when agents fail to learn from challenges, proactively or opportunistically, as they stick with their old ways of operating. An example for this scenario is that Participant F in England recalls that after suffering a major flood for the first time, their communities believed it was an unfortunate weather event and there was nothing that could be done about it. There are two more dimensions regarding learning failures – Routes 6 and 7. Route 6 shows the scenario where agents attempt to build up preparedness, adaptability, or transformability, but their efforts yield a negligible impact on boosting resilience. Such a scenario is exhibited in the example of some pilot cities in China trialling SCP without delivering the intended benefits. On the other hand, Route 7 is manifested in the scenario where some professionals learn that GI does not deliver the results they expect and therefore they choose to reject the transition to GI and call for reinforcement of the traditional schemes.

So far, the routes mentioned in the diagram have covered the majority of the research findings in the data analysis chapters, namely the challenges facing the professionals, their learning process and learning outcomes. However, rather than establishing a linear and straightforward correlation between learning and (non-) resilience, I have further identified multiple feedback loops connecting learning with all the elements in the diagram. In a scenario of actors failing to learn from flood risk, or failing to act in support of flood resilience measures, when a flood strikes they may scramble to respond as a result of low preparedness or adaptation. Such flooding events may become disasters that devastate communities. However, disasters are not necessarily the end of the process, because it is possible that, albeit by paying a prohibitive cost, actors are spurred to learn from the failures and/or the disasters, seeking solutions to rectify the mistakes made. In this research study, I have examined that a severe flooding event in Zhengzhou, a pilot city for SCPs, ends up triggering public backlash and the central government investigation into the root cause of the disaster, exposing the wrongdoings in the funding and construction phase of the projects. This example is depicted in Routes 8 and 9,

where reflections from a disaster contribute to the learning process, although the experience of Participant F, in which a community failed to learn from a previous flood, questions how strongly such an event affects learning. Hence, I use the dashed lines to show the relatively weaker link between failures, disasters, and learning.

A similar link, Route 10, is also identified, illustrating that tensions and conflicts between multiple stakeholders can also benefit reflexivity and learning. This route represents many non-learning situations in England where participants reflect on the reasons leading to the impasse. They acknowledge that some barriers are inherent to the novel nature of GI and the transition accompanying the application of GI. Such reflections are significant lessons for the stakeholders involved, and can be used to shape policymaking on the basis of identified problems. However, this route greatly depends on agents' situated strategic wisdom to rise above the confrontations and facilitate the necessary communications, so a dashed line to represents the possible linkage instead.

Routes 11 and 12 are the highlights of the research findings. Route 11 indicates that resilience nurtures further learning. As a result of actors' various forms of learning, resilience is advanced through increased preparedness, adaptability and sustained transformability. The positive changes accompanying the enhanced resilience bring a substantial impact on actors and thus stimulate and empower them to continue learning. This route is a rewarding loop that encourages the thinking of learning, and fosters actors to learn "the learning". I noticed a few cases of the participants in England representing this route. For example, Participant K, who trials GI projects for the first time, is impressed by the co-benefits and then becomes a promoter of GI by sharing the knowledge with colleagues. In doing so, the respondent continues learning more from implementing other GI projects and communicating with other stakeholders.

Route 12 is a feedback loop that demonstrates that resilience is an iterative process of learning, building on all the connections between the multiple elements. This route indicates that learning can take place in many settings, from those positive learning processes that directly contribute to the attributes of resilience, to the seemingly unlikely scenarios for learning to happen, such as the conflicts between actors and flooding disasters. Depending on the participants' situated strategic wisdom, the

reflections and lessons generated from the tensions and traumatising floods can be utilised to inform the policymaking process and thus lead to tangible changes that benefit resilience. In this scenario, Route 12 then connects back to Route 11, reflecting the establishment of the thinking of learning and the habit of learning. As such, agents with the learning mentality are empowered to actively review the shortcomings of their old ways of operation and the systemic weaknesses in the traditional schemes; they are more open to accepting the inevitability of transitions from the status-quo, and thus more able to rise above the challenges to capitalise opportunities for change.

Hence, Routes 11 and 12 capture the essence of evolutionary resilience that focuses on the constant evolvement through learning. Resilience is enhanced because of the learning of "learning", the recognition of change entailing uncertainty and volatility, and the embrace of change as a necessity for urban systems to survive shocks. Hence, as the diagram shows, resilience is a process of constant learning, and to be resilient, actors must learn that a mentality open to learning is key.

This diagram is a qualitative exploration rather than based on a large amount of evidence, as a consequence of the limited number of participants involved. The links between different elements are partly speculative, and may be influenced by the participants' backgrounds, the geographical locations, and the interview questions I asked. Therefore, the routes I conceptualised are a result of my interpretation of the data as well as my positionality in conducting this study. It is not the intention of the research to emphasise the likelihood of the links between the elements of learning and resilience. Rather, the diagram is a visualisation of what I found out through data analysis – detailing what the participants have suggested and reflected on. The diagram demonstrates the existence of the connections between the different elements, even though some routes are only concluded from a few participants. Again, the existence of such connections does not equate to the prevalence of them, as I only drew the conclusions from a small number of research interviews. Therefore, I present the diagram as a basic structure, or a road map, for any future researchers who are interested in exploring the relations between evolutionary resilience and learning. It is likely that future research will add more routes to this diagram or find stronger connections between some elements than others based on more empirical evidence.

## 8.7 Contributions of the thesis

In the existing literature, there is insufficient research on the professionals' roles and perspectives on the implementation of GI in relation to flood resilience, and little is known about how their learning impacts resilience or shapes a transition in the context of GI. This research study consists of detailed accounts of professionals from both China and England, providing in-depth analyses of the various perceptions of flood resilience, differing stances on GI, and intriguing insights into their experience of learning. Specifically, I first examined the myriad obstacles facing professionals in the delivery of GI projects, and exposed both similar and distinct challenges in the contexts of China and England, enriching the literature by offering empirical evidence for the comparisons of GI projects in the two countries. I then focused on how professionals navigate the predicaments to demonstrate their strategic wisdom and ability to learn. Particularly, the employment of Foucauldian discourse analysis on the Chinese experts' remarks allowed me to challenge the dominant discourse about GI and flood resilience, and reveal the hidden power dynamics that impact how actors think and behave. In doing so, I contribute to the debate on whether GI is the alternative to the traditional schemes and how GI impacts flood resilience. Lastly, I investigated what the professionals learnt in the process of overcoming the barriers and implementing GI, with the aim to fill in the research gap where only the learning by niche actors have been well studied whilst other forms of learning are overlooked. I investigated learning by professionals from different backgrounds, including niche innovators such as Yu and the incumbents who show doubts about GI. I also gave focus to the non-learning situations amongst actors to shed light on the complex power dynamics, and elaborated that non-learning, or learning against taking up GI, can also be a form of learning that can contribute back to enhancing flood resilience. My particular focus on the various forms of learning therefore fills the research gap by providing a rich analysis of the contentious learning process by incumbents and the often-dismissed non-learning.

The exploration of learning by the professionals and the learning outcomes enabled me to see the critical role of learning in both flood resilience and transition studies, and hence, I argued that learning is the bridging concept that connects the two different bodies of knowledge. The detailed analysis of learning also enabled me to conceptualise

a diagram (Figure 8.2) illustrating the relations between learning and resilience, making a theoretical contribution to the current literature. The diagram showcases that flood resilience from an evolutionary point of view is an iterative process consisting of multiple feedback loops with learning at the centre. Building on this conceptualisation, I hence argued that resilience is not some end point that can be eventually reached, but rather it is a dynamic and ever-evolving state that emphasises self-reinforcing loops of learning. Figure 8.2 also places focus on the learning failures: rather than dismissing such failures, I argued that failures can still generate lessons for actors and potentially contribute to learning, thus forming a feedback loop to further enhance learning. Moreover, the diagram also maps the conflicts to depict the situations where actors resist learning, so I contended that tensions may still be able to enrich the learning experience, and, through learning from conflicts, actors can advance resilience.

### 8.8 Limitations and future research

This research study, from the very beginning (i.e. research design stage), has been significantly impacted by the COVID-19 pandemic. I had to make a number of changes regarding research scope, aim, and methodologies to adapt to the uncertainties and volatilities posed by the pandemic. For example, because of the travel restrictions in place in China for more than three years, fieldtrips for data collection were not possible. Otherwise, I could have conducted ethnography on project sites to deepen my understanding of the situations of GI on the frontline. Therefore, I have since adapted the research design and changed the focus to explore professionals' viewpoints about GI projects in both China and England, aiming to examine how the differing social and political environments lead to challenges and affect the implementation of GI.

In order to complement the data shortage from China, I carefully collected a wide range of documents that later enabled an in-depth Foucauldian discourse analysis about the Chinese experts' claims and advocacies. The application of FDA revealed the power struggles embedded in the process of implementing SCPs and highlighted the extraordinary manoeuvre of Yu in utilising his strategic wisdom to promote the concept of "sponge city". Such analysis stimulated me to pay close attention to the situated practical wisdom demonstrated by professionals in both countries, and therefore

allowed me to find out the intricate connections between professionals' learning and evolutionary resilience.

Overall, the relatively small number of participants made me conduct an in-depth analysis of the available data and scrutinise the role of learning in enhancing flood resilience. I was therefore able to formulate diagram 8.2 to show the interconnections between elements such as learning, conflicts, resistance and resilience. These research findings, as aforementioned, are not an indication of the prevalence of the interrelationships, but a conclusion of the qualitative exploration based on the methodologies and my interpretation. This research study then provides a structured roadmap for any researchers who are interested in further investigating evolutionary resilience in relation to actors' learning.

Specifically, there are a few aspects that require future research to further explore and generate findings:

1) This research study investigates the GI projects in both England and China and analyses the challenges facing actors, but the landscapes in both countries are changing. In China, the second round of government funding for SCPs is ending, and local governments are being encouraged to lean towards collaboration with private sectors and reduce dependency on central government subsidies (Fu, et al. 2022). This trend will greatly impact the future of SCPs in China, particularly because, as has been demonstrated, the benefit realisation of GI projects is uncertain, and the risk of failure is higher than traditional schemes. How the shortage of central government funding will shape the uptake and delivery of GI remains unknown, so this issue will require future study. Similarly, in England the recently updated legislation that requires SuDS to be installed in all new builds upturns the current landscape, because the statutory status of SuDS is likely to stimulate a new wave of implementing SuDS. Due to the limited time frame of this research study, the impact of this change falls outside its remit, therefore further research is much needed to investigate how the changed landscape influences the different GI schemes in the two countries.

2) Although I identified the many different learning outcomes and grouped the outcomes on the basis of resilience attributes, other areas warrant examination, such as the

potentially different depths of learning exhibited by actors, namely, superficial learning and deep learning. It is worthwhile to discover how the different depths of learning impact the overall resilience from an evolutionary point of view. This demands a thorough examination of the learning agents to see if the lessons they learnt have made any impact on their future decision-making, or whether the learnt experience contributed to shaping policies in practice.

3) In the literature review chapter I found that in transitions studies, the learning at the regime level and by incumbents is understudied. Although in this research study I offered detailed accounts of learning by both the incumbents, for example professionals in England, and the niche actors such as Yu in China, I did not make a clear differentiation between the various actors based on the three levels of the multi-level perspective (MLP). Even though I do not think the MLP is best suited for studying such a transition, it would still be intriguing for future research to specifically examine the actors' viewpoints and perceptions by considering the contrast between niche actors and the incumbents. Particularly, how similar or different are the lessons learnt by the actors, and how do they respond to the potentially contrasting lessons when interacting with one another.

4) I explored the non-learning situations exhibited by some of the actors, and I thus argued that non-learning is in fact another form of learning: learning that GI does not deliver the outcomes that are needed. I also believe non-learning does not necessarily result in a negative impact on the socio-technical transition of GI. Instead, the non-learning situations shed light on the drawbacks of implementing GI in specific scenarios and stimulate key stakeholders to jointly think of possible solutions. In this regard, gaps still remain for future research on the learning that is not conducive to the transitions, especially on learning that takes place in tensions. As literature shows (Stam, van Ewijk, Chan, 2023), learning can happen even in intense situations like conflicts, but more empirical evidence is required to know how this type of learning can impact the socio-technical transition of GI.

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# Appendix I

**Participant information sheet**

For further information about how Lancaster University processes personal data for research purposes and your data rights please visit our webpage: www.lancaster.ac.uk/research/data-protection

I am a PhD student at Lancaster University and I would like to invite you to take part in a research study titled "Flood resilience: exploring the role of learning in the employment of Green Infrastructure". Building up urban resilience to flooding becomes increasingly critical in the face of climate change. As a result, Green Infrastructure, such as Sustainable Drainage Systems (SuDS), Sponge City Programmes, are being widely applied as resilient practices to tackle floods. This study explores professionals' perceptions of flood resilience, and their learning experiences in the course of delivering a resilient project.

Please take time to read the following information carefully before you decide whether or not you wish to take part.

**Why have I been invited?**

I have approached you because you have relevant knowledge about flood resilience and/or are involved in delivering a flood resilient project. The interview would cover themes including:

- The work you do in relation to flood resilience
- Your learning experience in the course of delivering a flood resilient project

I would be very grateful if you, or someone in your team, would agree to take part in this study.

**What will I be asked to do if I take part?**

If you decided to take part, this would involve the following:

Interviews: you will be invited to have an online interview with me, during which you will be asked about your viewpoints on flood resilience-related subjects and/or your experience in helping deliver a flood resilient project. The interview is expected to last around 30 to 45 minutes.

For later analysis, every interview will have to be audio-recorded. Please note that any personal information you share will be anonymised and any information that could lead to identifying you by the general public will not be used in the research, but your professions or positions may need to be mentioned in the thesis or future publications because the work you do has an impact on your perspectives and opinions. To further

protect your identity, you will be given a number code in the research analysis (e.g. Interviewee no.3), and only general labels and descriptors will be used to refer to your professions/positions, such as 'urban planner', 'senior management', 'civil engineer'

**What are the possible benefits from taking part?**

If you take part in this study, your insights will contribute to our understandings of how resilience and flood resilience practices are perceived among professionals, and enable us to examine the role of learning and knowledge production in the delivery of a flood resilient project. By sharing your perspectives, we are more likely to know what impact learning has on overall flood resilience. On the other hand, the research findings from this study may also help you understand more about flood resilient projects from the lens of "learning", so a summary of research findings will be sent to you after the completion of the study.

**Do I have to take part?**

It's completely up to you to decide whether or not you take part. Your participation is voluntary and you are free to withdraw before, during and within four weeks after the interview, without giving any reason.

**What if I change my mind?**

As explained above, you are free to withdraw during the interview or within four weeks after the interview by emailing me. If you decide to withdraw, I will extract any data you contributed to the study and destroy it. Data means the information, views, ideas, etc. that you and other participants will have shared with me. However, it is difficult and often impossible to take out data from one specific participant when this has already been anonymised or pooled together with other people's data. Therefore, you can only withdraw up to 4 weeks after taking part in the study, by emailing me.

**What are the possible disadvantages and risks of taking part?**

It is unlikely that there will be any major disadvantages to taking part. The only 'cost' is the time you invest in the interview.

**Will my data be identifiable?**

After the interview, only I, the researcher conducting this study will have access to the data you share with me. I will keep all personal information about you (e.g. your name and other information that can identify you) confidential: every participant will be given a non-identifying number code in the research, and your personal information will be kept separately from interview transcripts.

When writing up my PhD thesis or paper for publication, what you have told me may be quoted, your name will not be disclosed but your profession and/or position may

need to be stated. Full anonymity cannot be guaranteed in this case, but you will not be identified by the general public

**How will my data be stored?**

Your data will be stored in encrypted files (that is no one other than me, the researcher, will be able to access them) and on password-protected computers and OneDrive. The audio-recording of the interview will be deleted once the transcription is finished.

I will store hard copies of any data securely in locked cabinets in my office. I will keep data that can identify you separately from non-personal information (e.g. your views on a specific topic).

In accordance with University guidelines, I will keep the data securely for a minimum of ten years.

**How will we use the information you have shared with us and what will happen to the results of the research study?**

I will use the data you have shared with only in the following ways:

I will use it for academic purposes only. This will include my PhD thesis and potential publications as journal articles. I may also present the results of the research study at academic conferences. When writing up the findings from this study, I may need to use anonymised quotes, i.e. your exact words

**Who has reviewed the project?**

This study has been reviewed and approved by the Faculty of Science and Technology Research Ethics Committee.

**What if I have a question or concern?**
If you have any queries or if you are unhappy with anything that happens concerning your participation in the study, please contact me: Jingran Wang, PhD candidate
Email: j.wang74@lancaster.ac.uk
Address: LG504, LEC 1, Lancaster Environment Centre, LA1 4YQ

Supervisor: Professor David Tyfield Email: d.tyfield@lancaster.ac.uk
Address: B521c, B - Floor, LEC 1, Lancaster Environment Centre, LA1 4YQ

If you have any concerns or complaints that you wish to discuss with a person who is not directly involved in the research, you can also contact: Professor Philip Barker, Head of Department. Email: p.barker@lancaster.ac.uk

**Thank you for considering your participation in this project.**

# Appendix II

## Sample Interview Schedule

Section 1: Your work and flood resilience

1. Can you talk about the work you did in relation to flood resilience?

2. In your opinion, what is the rationale behind Green Infrastructure?

(What makes you choose to implement Green Infrastructure?)

(What do you think are the specific benefits of Green Infrastructure?)

3. What are your/your organisation's priorities in tackling flood risk?

4. What does the concept of flood resilience mean to you in your field?

5. In what ways do you think your projects/Green Infrastructure help to enhance flood resilience?

6. What were the difficulties you faced in implementing this project/in your work to address flood risk?

Section 2: Learning and power dynamics in delivering projects

1. Who are the major stakeholders you worked with?
   How would you describe the working relationship between you and them?

2. When there was disagreement between you and other stakeholders in decision-making process, what did you do to address the disagreement?

3. What are the important lessons you learnt in delivering this project/in your work to address flood risk?

4. How did you communicate with other stakeholders about what you have learnt? Were there any obstacles that prevented you from sharing your knowledge?

# Appendix III

## The full list of collected documents

### 1. Documents collected from China

| Platforms / Media | Subject |
|---|---|
| The Ministry of Housing and Urban-Rural Development | 海绵城市建设技术指南<br>[The Construction Guideline of Sponge City]<br>https://www.mohurd.gov.cn/gongkai/zhengce/zhengcefilelib/201411/20141103_219465.html |
| The Central Government, The State Council | 国务院办公厅关于推进海绵城市建设的指导意见<br>[Guiding Policies on Promoting the Construction of Sponge Cities]<br>https://www.gov.cn/zhengce/content/2015-10/16/content_10228.htm |
| The Ministry of Housing and Urban-Rural Development | 住房和城乡建设部办公厅关于进一步明确海绵城市建设工作有关要求的通知<br>[Requirement on further clarifying the requirements for Sponge City construction]<br>https://www.gov.cn/zhengce/zhengceku/2022-04/29/content_5687999.htm |
| The Central Government, The State Council | 关于开展系统化全域推进海绵城市建设示范工作的通知<br>[Requirement on carrying out systematic and comprehensive promotion of Sponge City construction]<br>https://www.gov.cn/zhengce/zhengceku/2021-04/26/content_5602408.htm |
| The Ministry of Housing and Urban-Rural Development | 住房城乡建设部办公厅关于印发海绵城市建设可复制政策机制清单的通知<br>[A list of replicable policy mechanisms for Sponge City construction]<br>https://www.gov.cn/zhengce/zhengceku/202405/content_6951553.htm |
| The Central Government, China Daily | 党的十八大报告<br>[Full text of President Hu's report at 18th Party Congress]<br>http://language.chinadaily.com.cn/2013cnencpctps/2012-11/19/content_17141197.htm |
| The Central Government, People's Daily | 中央城镇化工作会议在北京举行 习近平李克强作重要讲话<br>[Xi Jinping delivered an important speech at the central urbanization work conference in Beijing]<br>http://cpc.people.com.cn/n/2013/1215/c64094-23842466.html |
| 新华社 Xinhua News (State-owned) | 海绵城市让生活更"自然"<br>[Sponge City makes life more "natural"]<br>https://www.gov.cn/xinwen/2019-06/04/content_5397420.htm |
| 新华社 Xinhua News (State-owned) | 海绵城市建设如何带来"会呼吸"的生活?<br>[How does Sponge City bring about a "breathing" life?]<br>https://www.gov.cn/xinwen/2021-05/11/content_5605852.htm |

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|---|---|
| 新华社<br>Xinhua News<br>(State-owned) | 30 个海绵城市建设试点近半数现内涝 城市“海绵化”成效几何?<br>[Nearly half of the 30 pilot cities have experienced flooding. What is the effectiveness of Sponge City construction?]<br>https://www.gov.cn/xinwen/2016-07/26/content_5095036.htm |
| 经济日报<br>Economy Daily<br>(State-owned) | 海绵城市建设难以求速效<br>[Difficult to achieve quick results in Sponge City construction]<br>https://www.gov.cn/xinwen/2016-10/14/content_5118858.htm |
| 央视新闻<br>China Central Television<br>(State-owned) | 住建部公布第二批“城市双修”试点名单<br>[The Ministry of Housing and Urban-Rural Development announced the second batch of pilot cities for ecological repairing and regeneration]<br>https://news.cctv.com/2017/04/18/ARTIrKHgKjaCOBvd9IH17DIm170418.shtml |
| 新华社<br>Xinhua News<br>(State-owned) | 韧性城市，韧在何处<br>[Resilient cities: what are they resilient to]<br>http://www.xinhuanet.com/politics/2020-12/17/c_1126870988.htm (Accessed: 23 June 2021) |
| 人民日报<br>People's Daily<br>(State-owned) | 河南郑州“7·20”特大暴雨灾害调查报告公布<br>[Investigation report on the July 20 torrential rain disaster in Zhengzhou, Henan Province]<br>http://politics.people.com.cn/n1/2022/0122/c1001-32337146.html |
| 人民日报<br>People's Daily<br>(State-owned) | 国务院调查组相关负责人就河南郑州“7·20”特大暴雨灾害调查工作答记者问<br>[The State Council investigation team answered questions about the July 20 torrential rain disaster in Zhengzhou, Henan]<br>http://politics.people.com.cn/n1/2022/0122/c1001-32337147.html |
| 人民日报<br>People's Daily<br>(State-owned) | 俞孔坚在北林大和母校师生共话城市森林与生态修复<br>[Kongjian Yu discusses urban forests and ecological restoration with academics and students of his alma mater at Beijing Forestry University]<br>https://www.peopleapp.com/rmharticle/30002183948 |
| 中国经济周刊<br>China Economy Weekly (State-owned) | 全国 30 个海绵城市试点 19 城又出现内涝，试点失败了？<br>[19 of the 30 Sponge City pilot cities have experienced flooding again. Have the pilot programmes failed?]<br>https://www.thepaper.cn/newsDetail_forward_1524846 |
| 新京报<br>Beijing News<br>(State-owned) | 打造“海绵城市”别忽视民间水利工程 （2016）<br>[Don't ignore private water conservancy projects when building a "sponge city"]<br>https://www.bjnews.com.cn/detail/155150657914075.html |
| 潮新闻<br>Tide News<br>(State-owned) | 专访俞孔坚：“海绵城市”如何栖居现代人的诗意<br>[Interview with Kongjian Yu: How does the “Sponge City” improve urban life?]<br>https://tidenews.com.cn/news.html?id=665726 |
| 中国城市网<br>China City Network<br>(State-owned) | 暴雨后的深思：城市综合防灾减灾体系如何建立<br>[Reflections after the rainstorm: How to establish a comprehensive urban disaster prevention and mitigation system]<br>https://www.zgcsb.com/news/shouYe/2021-08/17/a_330859.html |
| 三峡日报<br>Sanxia Daily<br>(State-owned) | 用“生态服务”理念建人水和谐之城<br>[Kongjian Yu: using the concept of "ecological service" to build a harmonious city between people and water]<br>https://www.turenscape.com/news/detail/1772.html |
| 建筑实践<br>Architecture Practice<br>(Independent) | 俞孔坚：“海绵城市”与城市生态韧性<br>[Kongjian Yu: “sponge city” and urban ecological resilience]<br>https://mp.weixin.qq.com/s/vfz1UZ4Nv5VRgbu-p7pSTw |

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|---|---|
| 设计杂志<br>Design<br>(Independent) | 俞孔坚：景观设计必须是“真善美”的<br>[Kongjian Yu: Landscape design must be "truthful, kind and beautiful"]<br>http://designmag.cn/ |
| 景观中国<br>Landscape China<br>(independent) | 俞孔坚：中国设计必须妥善解决当下中国问题<br>[Kongjian Yu: Chinese design must properly solve the current Chinese problems]<br>http://www.landscape.cn/interview/1082.html |
| 凤凰网<br>Phoenix News<br>(Independent) | 北大教授俞孔坚：城市减排应坚持自然优先的规划理念<br>[Kongjian Yu: urban emission reduction should adhere to the planning concept of giving priority to nature]<br>https://i.ifeng.com/c/82Phn35FjDQ |
| 谷德设计<br>GUDE Design<br>(Independent) | 访谈专辑第十二期 – 俞孔坚 （2016）<br>[GUDE interviews Kongjian Yu]<br>https://www.gooood.cn/gooood-interview-12-kongjian-yu.htm (Accessed: 9 April 2023) |
| 建筑知识<br>Architecture Knowledge<br>(Independent) | 以土地之名——土人设计首席设计师俞孔坚专访<br>[In the Name of the Land: an interview with Kongjian Yu]<br>https://www.turenscape.com/news/detail/1771.html |
| 澎湃<br>The Paper<br>(Independent) | 俞孔坚：在城市里建造“新桃源”<br>[Kongjian Yu: Building a “New Paradise” in cities]<br>https://www.thepaper.cn/newsDetail_forward_25152849 |
| 澎湃<br>The Paper<br>(Independent) | “海绵城市”的是是非非<br>[The pros and cons of "sponge city"]<br>https://www.thepaper.cn/newsDetail_forward_13707723 |
| 澎湃<br>The Paper<br>(Independent) | 当极端天气成为常态，城市如何弹性应对？<br>[When extreme weather becomes the norm, how can cities be resilient?]<br>https://www.thepaper.cn/newsDetail_forward_29459921 |
| 澎湃<br>The Paper<br>(Independent) | 河南暴雨启示录：我们该如何应对超标暴雨<br>[Heavy rain in Henan: how should we deal with heavy rain exceeding standards?]<br>https://www.thepaper.cn/newsDetail_forward_13730172 |
| 澎湃<br>The Paper<br>(Independent) | 防洪基础设施要灰色还是绿色？<br>[Grey or Green Infrastructure for flood defence?]<br>https://www.thepaper.cn/newsDetail_forward_13780515 |
| 澎湃<br>The Paper<br>(Independent) | 专家：建设海绵城市总体上是惠民举措，正面作用更大<br>[Experts: Sponge City is generally a measure to benefit the people and has a greater positive effect]<br>https://www.thepaper.cn/newsDetail_forward_13866388 |
| 财新<br>Caixin<br>(Independent) | 专家：莫因发生洪涝就将“海绵城市建设”一笔抹杀<br>[Don’t write off “sponge city” easily just because of floods]<br>https://china.caixin.com/2016-07-07/100963904.html?originReferrer=caixinsearch_pc |
| 财新<br>Caixin<br>(Independent) | 建成海绵城市，就不会被淹了吗？<br>[If we build a “sponge city”, will it not be flooded?]<br>https://datanews.caixin.com/2021-07-26/101745817.html?originReferrer=caixinsearch_pc |

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|---|---|
| 财新<br>Caixin<br>(Independent) | 京津冀特大洪水背后，如何科学泄洪?<br>[After the severe flood in Beijing, Tianjin and Hebei: how to discharge flood water scientifically?]<br>https://zhishifenzi.blog.caixin.com/archives/269328?originReferrer=caixinsearch_pc |
| 财新<br>Caixin<br>(Independent) | 特别报道：预防城市内涝<br>[Special report: preventing urban flooding]<br>https://weekly.caixin.com/2024-08-03/102222999.html?originReferrer=caixinsearch_pc |
| 财新<br>Caixin<br>(Independent) | In Depth: China's Sponge City Failings Show the 'Arduous' Task of Adapting to Climate Change.<br>https://www.caixinglobal.com/2021-11-09/in-depth-chinas-sponge-city-failings-show-the-arduous-task-of-adapting-to-climate-change-101802504.html |
| 财新<br>Caixin<br>(Independent) | Cover Story: How Historic Rainfall Overwhelmed Zhengzhou.<br>https://www.caixinglobal.com/2021-07-26/cover-story-how-historic-rainfall-overwhelmed-zhengzhou-101745293.html |

**2. Documents from international media**

| Platforms / Media | Subject |
|---|---|
| Bloomberg | *Why China Wants to Build Something Called 'Sponge Cities'*<br>Available at: https://www.bloomberg.com/news/articles/2015-11-23/why-china-wants-to-build-environmentally-friendly-sponge-cities |
| Bloomberg | *After 500 Years Trying to Tame Fatal Flood, China Builds Sponge Cities*<br>Available at: https://www.bloomberg.com/news/features/2020-08-13/after-500-years-trying-to-tame-fatal-floods-china-builds-sponge-cities |
| The New York Times | *Turning Cities Into Sponges to Save Lives and Property*<br>Available at: https://www.nytimes.com/2022/03/28/climate/sponge-cities-philadelphia-wuhan-malmo.html |
| The New York Times | *As China boomed, it didn't take climate change into account. Now it must.*<br>Available at: https://www.nytimes.com/2021/07/26/world/asia/china-climate-change.html?action=click&module=Spotlight&pgtype=Homepage |
| The New York Times | *He's Got a Plan for Cities That Flood: Stop Fighting the Water.*<br>Available at: https://www.nytimes.com/2024/03/28/climate/sponge-cities-kongjian-yu.html |
| BBC | *The man turning cities into giant sponges to embrace floods*.<br>Available at: https://www.bbc.co.uk/news/world-asia-china-59115753 |
| BBC | *How Asia's 5,000-year-old rice terraces are inspiring modern flood control.*<br>Available at: https://www.bbc.co.uk/future/article/20240805-how-ancient-rice-terraces-inspire-flood-resilience-in-asian-cities |

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|---|---|
| The Guardian | *Slow water: can we tame urban floods by going with the flow?* Available at: https://www.theguardian.com/environment/2022/jun/07/slow-water-urban-floods-drought-china-sponge-cities |
| The Guardian | *Turning cities into sponges: how Chinese ancient wisdom is taking on climate change.* Available at: https://www.theguardian.com/artanddesign/2018/mar/21/turning-cities-into-sponges-how-chinese-ancient-wisdom-is-taking-on-climate-change |
| The Guardian | *China's 'sponge cities' are turning streets green to combat flooding* Available at: https://www.theguardian.com/world/2017/dec/28/chinas-sponge-cities-are-turning-streets-green-to-combat-flooding |
| TIME | *A Force of Nature* Available at: https://time.com/archive/6676809/a-force-of-nature-4/ |
| CNN | *As flooding increases, these cities are designed to work with – not against – the water. Here's how they're doing it.* Available at: https://edition.cnn.com/2023/03/26/world/flooding-cities-water-design-climate-intl |
| Associated Press | *As climate warms, a China planner advocates "sponge cities".* Available at: https://apnews.com/article/floods-entertainment-asia-beijing-climate-and-environment-54f2b3282cad5ce8f165914f38023bdb |
| Euronews | *What are sponge cities and could they solve China's water crisis?* Available at: https://www.euronews.com/green/2022/10/22/china-s-sponge-cities-are-a-revolutionary-rethink-to-prevent-flooding |
| World Economic Forum | *This Man Is Turning Cities Into Giant Sponges To Save Lives* Available at: https://www.weforum.org/stories/2019/08/sponge-cities-china-flood-protection-nature-wwf/ |
| The Sydney Morning Herald | *Chinese landscape architect plants ancient solutions to a modern dilemma.* Available at: https://www.smh.com.au/entertainment/art-and-design/chinese-landscape-architect-plants-ancient-solutions-to-a-modern-dilemma-20180412-h0yomz.html |
| MIT Technology Review | *The architect making friends with flooding.* Available at: https://www.technologyreview.com/2021/12/21/1041318/flooding-landscape-architecture-yu-kongjian/ |
| The American Society of Landscape Architects (ASLA) | *Kongjian Yu: China's Olmsted* https://dirt.asla.org/2013/01/29/kongjian-yu-chinas-olmsted/ |
| The American Society of Landscape Architects (ASLA) | *Kongjian Yu Wins 2020 Sir Geoffrey Jellicoe Award* https://dirt.asla.org/2020/10/08/kongjian-yu-wins-2020-sir-geoffrey-jellicoe-award-read-full-speech/ |

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|---|---|
| The American Society of Landscape Architects (ASLA) | *Interview with Kongjian Yu, Designer of the Red Ribbon, Tang He River Park.*<br>Available at: https://www.asla.org/contentdetail.aspx?id=20124 |
| The American Society of Landscape Architects (ASLA) | *Kongjian Yu Defends His Sponge City Campaign.*<br>Available at: https://dirt.asla.org/2021/08/04/kongjian-yu-defends-his-sponge-city-campaign/ |
| Architecture Norway | *Landscape Planning in China: Floods and Water Management*<br>*An interview with Kongjian Yu*<br>Available at: https://www.architecturenorway.no/questions/cities-sustainability/kongjian-yu/ |
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