Towards A Thick Understanding of The Barriers to National Climate Adaptation Policy Process: The Cases of South Korea and The United Kingdom

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The candidate confirms that the work submitted is his own, except where work which has formed part of jointly-authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

Chapters 4, 5, and 6 is based on work form jointly authored publications. The publications are as follows:

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Acknowledgements

Abstract

The world is already committed to some climate change which makes climate adaptation an important response strategy. Despite the substantial progress of national climate adaptation policies, the adaptation deficit is getting wider. Barriers to adaptation have been pointed out as a reason for the adaptation deficits and analysed for about 20 years. However, previous studies have provided a limited understanding of the barriers, especially at the national level, and the research results have rarely been used in real-world adaptation policy processes. This thesis provides a thick understanding of barriers to national climate adaptation policy processes through a systematic literature review, empirical analysis using case studies, and theoretical analysis.

Through a systematic literature review, this thesis identifies eight categories of barriers to national climate adaptation policy and its process in previous studies. It also clarifies three critical limitations of earlier studies. Based on the Korean case, this thesis finds 49 factors (16 barriers, 14 origins, 19 influences) related to barriers to the national climate adaptation policy process in Korea and draws a barrier map that shows all relationships between the identified factors. This thesis identifies eight key common barriers to the national climate adaptation policy processes through a comparative analysis of the Korean and UK cases and presents potential common causal mechanisms of the barriers, with a common barrier map of the national adaptation policies. By applying a multi-loop learning theoretical framework, it analyses the social learning levels of the national climate adaptation policy of Korea and the UK. Potential solutions to address the identified barriers to national climate adaptation policy processes are suggested based on the wicked problem and social learning theory.

This thesis contributes valuable theoretical and methodological advancements to our understanding of the barriers to adaptation and practical understanding of the barriers to adaptation within the adaptation process and potential solutions to these barriers.

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Acronyms

AC	Adaptation Committee
ASC	Adaptation Sub-Committee
AR	Assessment Report
CEE	Central and Eastern Europe
CCRA	Climate Change Risk Assessment
CCC	Climate Change Committee
CIS	Commonwealth of Independent States
COPs	Conference of Parties
Defra	Department for Environment, Food and Rural Affairs
EU	European Union
GHGs	Greenhouse Gags
INDCs	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
KACCC	Korea Adaptation Centre for Climate Change
KEI	Korea Environment Institute
LDCs	Least Developed Countries
MoE	Ministry of Environment (UK)
NAP	National Adaptation Programme
NAPA	National Adaptation Programmes of Action
NCCAP	National Climate Change Adaptation Plan
NCs	National Communications
OECD	Organisation for Economic Co-operation and Development
SIDS	Small Island Developing States
SLR	Systematic Literature Review
UNEP	United Nations Environment Programme
UNFCCC	United Nation Framework Convention on Climate Change

Chapter 1
Introduction

Chapter 1
Introduction

This thesis offers a thick understanding of barriers to national climate adaptation policy processes and practical insights into solutions for the barriers. Through a systematic literature review, in-depth case studies, comparative analysis of the case studies, and theoretical analysis, it explains the barriers to national climate adaptation policy processes by answering unanswered questions in previous studies: why and how barriers occur (origins/causal mechanisms), how barriers affect adaptation policy processes (influences), how barriers interact (dynamics), and how we can overcome barriers (solutions). A thick understanding of barriers to national climate adaptation policy processes will contribute to diagnosing the current problems of national climate adaptation policy, analysing related barriers and origins, devising practical solutions for barriers and ultimately reducing the discrepancy between adaptation needs and implementation. It will also help generate a wider understanding of the wickedness of climate change adaptation.

In this chapter, Section 1.1. provides the background of this thesis and underpins the focus of this research on the barriers to national climate adaptation policy processes. Section 1.2. defines the aims and objectives of this thesis. Section 1.3. concludes this chapter by providing an outline of this thesis.

1.1. Research Background

Increased concern about adaptation and national responses

‘Adaptation’ is defined as a continuous process of adjustment in natural or human systems in response to actual and/or expected climate change (IPCC, 2014; Edwards et al., 2015; Wiliamson and Nelson, 2017). Since the early 1970s, the international community has mainly focused on the mitigation of greenhouse gases (GHGs) emissions (Pielke et al., 2007; Biesbroek et al., 2010; Preston et al., 2011). However, there is now widespread acknowledgement of the importance of adaptation given the inevitability of climate change above a certain level due to the previously emitted GHGs (Bauer et al., 2011; CCC, 2017; Fayazi et al., 2020). With the evidence of

climate change from the publication series of Intergovernmental Panel on Climate Change (IPCC) assessment reports (ARs), the international community has taken the impacts and vulnerabilities due to climate change more seriously. The international community has been continuously demanding adaptation to climate change through international agreements through the United Nations Framework Convention on Climate Change (UNFCCC) Conferences of Parties (COPs), such as the Bali Action Plan (COP13, 2007) and the Cancun Adaptation Framework (COP16, 2010). In 2015, 196 Parties at COP21 in Paris adopted the Paris Agreement. It defines a global goal on adaptation: to enhance adaptive capacity and resilience; to reduce vulnerability, with a view to contributing to sustainable development. The Agreement requires all Parties to engage in adaptation planning and implementation and communicate their efforts for adaptation through adaptation communications.

Consequently, nations are under both international and domestic pressure to adapt to climate change. Nations are required to establish adaptation policy or scheme and show their adaptation efforts to the international community through Intended Nationally Determined Contributions (INDCs) and regular official reports, Adaptation Communications, to the UNFCCC. Moreover, domestic demands for practical national adaptation actions have also been increasing as the frequency and intensity of extreme weather events have increased. Therefore, many nations are developing their formal national adaptation strategy or policy. Some nations have already developed their adaptation policy and now focus on implementing and monitoring activities, for example, the National Adaptation Programme of the UK (2013, 2018), Deutsche Anpassungsstrategie an den Klimawandel of Germany (2008), Danish Strategy for Adaptation to a Climate Change of Denmark (2008), National Climate Resilience and Adaptation Strategy of Australia (2015), Wise Adaptation to Climate Change of Japan (2008), and China’s National Strategy for Climate Change Adaptation (2016). It is expected that the number of national adaptation policies will keep increasing.

Adaptation deficits despite substantial progress of national climate adaptation policies

Since the publication of IPCC AR4 (2007), there has been substantial progress in the development of national adaptation policies and plans (IPCC,

2014). According to United Nations Environment Programme (UNEP) Adaptation Gap Report 2021, around 79 % of countries have adopted at least one national-level adaptation planning instrument, and the implementation of adaptation actions is also continuing to grow. Takayoshi and Ellis (2016) report that more than three-quarters of submitted INDCs have national-level adaptation components, but the contents greatly vary. Along with the development of national adaptation policies, the major and important roles of national policies in the progress of overall adaptation are also emphasised.

Despite the progress of national adaptation policies, recent research and reports raise questions about the practical effectiveness of national climate adaptation policies, pointing out the current 'adaptation deficit'. Literature has reported adaptation deficits across sectors and scales (Burton and May, 2004; Burton, 2009; Dupuis and Knoepfel, 2013; Ashwill and Heltbrg, 2013; Markus and Savini; 2016; Lonsdale et al., 2017; Clissold et al., 2020; Liu et al., 2020; Marcus and Hanna, 2020). The existence of the adaptation deficits' is obvious with the observation of the gap between adaptation needs/demands and adaptation actions (Gawith, 2018), and the considerably increasing losses caused by climate-related is considered explicit evidence of the adaptation deficit (Burton, 2004; Burton, 2009; Fankhauser and McDermott, 2014; Gawith et al., 2020). Moreover, the current adaptations are largely fragmented, with limited and negligible evidence (Berrang-Ford et al., 2021). Given the unprecedented rapid climate change, implementation of adaptation is not keeping pace with an ever-increasing need, and the adaptation deficit is getting wider (Eisenack et al., 2014; Lonsdale et al., 2017). These climate change issues are regarded as wicked problems (Head, 2014; Perry, 2015; Pollitt, 2015), and some define climate change as a super wicked problem (Levin et al., 2007; Lazarus, 2008)

Barriers to adaptation as a reason for the current adaptation deficit

Barriers to adaptation have received attention to explain the current adaptation deficits (Fankahuser, 2017; Simoes et al., 2017; Gawith and Hodge, 2018). A barrier to adaptation refers to a factor that can stop, delay, or divert the development and implementation of adaptation action (IPCC, 2014; Williamson and Nelson, 2017). As barriers to adaptation prevent adaptation policies and plans from linking to the implementation of on-the-ground adaptation actions and make the adaptation actions slow and

unsustainable (McNamara, 2013; Wise et al., 2014), barriers to adaptation help to explain the current adaptation deficits (Valente and Veloso-Gomes, 2020). Thus, the interest in barriers to adaptation has increased, and efforts to overcome them are urgently required with the ever-increasing need for adaptation (Eisenack et al., 2014; IPCC, 2014; Simoes et al., 2017; Clissold et al., 2020). The research community has identified a number of barriers to adaptation and suggested various barrier categories based on various scales, sectors, actors, or contexts (IPCC, 2007; Jones, 2010; Berrang-ford et al., 2011; Clar et al., 2013; Wise et al., 2014; Biesbroek et al., 2015; Williamson and Nelson, 2017; McClure and Baker, 2018; fayazi et al., 2020). Barriers to national climate adaptation policy also have been identified by a small number of studies (Mullan et al., 2013; Prabhakar et al., 2014; OECD, 2015; Henstra, 2017; Brown et al., 2018; UNEP, 2018; Russel et al., 2020).

However, despite a large volume of research results, several critical limitations of studies on barriers to adaptation are constantly being pointed out, and the current understanding of barriers to adaptation is very limited, not going beyond identifying and describing them (Prabhakar et al., 2014, Wise et al., 2014; Waters et al., 2014; Ghasemzadeh and Sharifi, 2020). The concept of barriers to adaptation has been used to only list existing impediments to adaptation policies (Dupuis and Knoepfel, 2013). It has led to barriers being dealt with as separated entities from the adaptation process, as well as the previous research results about barriers to adaptation were rarely used in the actual adaptation process (Eisenack et al., 2014; Biesbroek et al., 2015). Also, discussions on solutions to overcome the barriers to adaptation were significantly limited in previous studies (Clar et al., 2013; Eisenack et al., 2014; Liu et al., 2020). The understanding of barriers to national climate adaptation policy is worse than other levels with a lack of related research. In order to improve this situation, a research shift that aims to explain the barriers, including their occurrence, influences, and dynamics, has been urged (Eisenack et al., 2014; Waters et al., 2014; Masud et al., 2017; Clissold et al., 2020; Fatorić and Biesbroek, 2020). In addition, systematic and practical insights into overcoming the barriers within the adaptation process are needed. These research shifts and practical insights are expected to contribute to understanding barriers to adaptation deeper and ultimately reducing the current increasing adaptation deficits.

1.2. Research Aim and Objectives

The overarching aim of this thesis is to understand the barriers to national climate adaptation policy processes thicker (barriers themselves and related contexts) and to provide practical insights into overcoming the barriers. The thesis sets four objectives to achieve the aim.

Objective 1: This thesis scrutinises the characteristics of barriers to national climate adaptation policy and its process in previous studies and clarifies their limitations using a systematic literature review.

Objective 2: This thesis analyses empirical barriers to the national climate adaptation policy process of South Korea, including their origin, influence, and dynamics. It also suggests a potential approach to overcome the barriers.

Objective 3: This thesis examines common barriers to national climate adaptation policy processes and potential common causal mechanisms through a comparative analysis of South Korean and UK cases. It also provides general and practical insights into addressing the barriers.

Objective 4: Based on the wicked problem and social learning theory background, this thesis provides a generalised framework that diagnoses social learning levels of national climate adaptation policy considering barriers to the policy process and suggests directions for potential solutions to address the barriers.

The overarching research strategy and methodology to achieve the objectives will be outlined in Chapter 3.

1.3. Thesis Outline

The remaining of this thesis is organised as follows. Chapter 2 reviews previous literature that underpins the research in this thesis and clarifies research gaps: Section 2.2. clarifies definitions of adaptation policy and adaptation policy process. Section 2.3. describes the current state of national adaptation policies and the adaptation deficit situation. Section 2.4. reviews previous studies on barriers to adaptation and draws their limitations and research demands for a thick understanding of barriers to national climate adaptation policy. Section 2.5. introduces literature that provides a theoretical

foundation, the concept of wicked problems and social learning. This chapter also establishes a theoretical base for the whole thesis as well as for developing an analysis framework in Chapter 7. Chapter 3 presents the overall research design of this thesis. It explains the research philosophy underpinning this research and outlines the multimethod approach that includes a systematic literature review, empirical analysis using case studies, and theoretical analysis.

In Chapter 4, this thesis conducts a systematic literature review to scrutinise the characteristics of barriers to national climate adaptation policy and its process in the previous literature. It evaluates the current understanding of barriers to national climate adaptation policy and its process in the literature, uncovers current limitations and clarifies critical research questions that further research should answer to improve the limited understanding of the barriers. This chapter also provides preliminary insights into barriers' origin, influence, and relationships.

To address research objective 2, Chapter 5 analyses empirical barriers to national climate adaptation policy processes through a South Korea case study. It demonstrates what barriers, origins, and influences are and maps how they interact visually. It also identifies key barriers to provide insights into prioritising barriers. With an analysis of used/suggested solutions, this chapter proposes a procedure for diagnosing problems of national climate adaptation policy and its process, understanding associated barriers and origins, and devising practical solutions for national policy-makers and stakeholders.

In order to broaden the findings in Chapter 5 and provide a more generalised understanding of barriers to national climate adaptation policy processes, Chapter 6 addresses research objective 3. This chapter examines common barriers to national climate adaptation policy processes and the barriers' characteristics through a comparative analysis of South Korean and UK cases. It draws a common barrier map to the national climate adaptation policy processes of South Korea and the UK, which shows complex interdependencies between barriers, origins, and influence, as well as potential common causal mechanisms of the barriers. Also, practical approaches and policy implications to overcome the barriers are suggested.

For research objective 4, Chapter 7 connects barriers to adaptation and the wickedness of adaptation and seeks a theoretical approach to address the barriers. It provides a theoretical framework for adaptation policy contexts based on the multi-loop learning approach, which sets criteria to diagnose the social learning levels of each category of the adaptation governance regime. Based on the research findings from Chapters 5 and 6, this chapter diagnoses social learning levels of national climate adaptation policy in South Korea and the UK and suggests directions for overcoming their barriers, aiming to move towards higher levels of social learning.

Chapter 8 demonstrates how the research objectives have been met in respective chapters. This chapter also describes how the research in this thesis contributes to improving the understanding of barriers to national climate adaptation policy processes in terms of both academic and practical policy views. Reflections on the research design, limitations of this thesis and research agenda for future research are presented in the chapter. Lastly, Chapter 9 concludes by summarising the contributions and policy implications of this thesis.

Chapter 2
Literature Review

Chapter 2
Literature Review

2.1. Introduction

This chapter outlines the landscape of previous literature that underpins the research in this thesis. It also clarifies the limitations of previous studies and research demands that this thesis will meet. Section 2.2. clarifies definitions of adaptation policy and adaptation policy process based on literature. Section 2.3. describes the current state of national adaptation policies and the adaptation deficit situation. Section 2.4. reviews previous studies on barriers to adaptation and draws their limitations. Section 2.5. introduces literature that provides a theoretical foundation of the concept of wicked problems and social learning for the whole thesis and for developing a theoretical analysis framework. More concrete and extensive descriptions of previous literature supporting the research in this thesis are also given in respective chapters. Section 2.6. summarises the literature review and draws justification for this thesis.

2.2. Definitions of adaptation policy and adaptation policy process

Although the terms ‘policy’ and ‘policy process’ sometimes have been used interchangeably in academic research and practical policy fields, there are explicit differences between research for a policy and research for a policy process. It is essential to distinguish a policy and a policy process for clear research objects, approaches, and contributions.

The Oxford English Dictionary defines a policy as “a principle or course of action adopted or proposed as desirable, advantageous, or expedient; … method of acting on matters of principle, settled practice”. In terms of public policy, a policy has been variously defined (Heclo, 1972; Jenkins, 1978; Cochran et al., 2010; Dye, 2013; Hill and Varone; 2016). However, this thesis takes Birkland's (2020) definition for the purpose of this thesis. In his book, a policy is defined as “a statement by government of what it intends to do, such as a law, regulation, ruling, decision, order, or a combination of these” (Birkland, 2020. p.6). A policy also shows what a government does not intend to do (Dye, 2013; Birkland, 2020).

Although there is no theoretically consented definition of a policy process, a policy process is generally understood as a series of steps in a cyclical model of decision-making for a government course or method of action to achieve a policy objective from the early 1950s (Howlett and Giest, 2015). A five-stage policy process model is most widely used, which includes agenda setting, policy formulation, decision-making, policy implementation, and policy evaluation (Benson and Jordan, 2015; Howlett and Giest, 2015; Shiffman, 2016).

In the latest IPCC Assessment Report (AR6) in 2022, adaptation is defined as "in human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment of actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects" (IPCC, 2022, p.AⅡ-2). The report also defines adaptation options as "the array of strategies and measures that are available and appropriate for addressing adaptation. They include a wide range of actions that can be categorised as structural, institutional, ecological or behavioural" (IPCC, 2022, p. AⅡ-3). A result of successful adaptation means that society has a robust and reasonable process of building climate resilience and reducing the vulnerability to negative effects of climate change (Ashwill and Heltberg, 2013), which is oriented towards long-term livelihood security (Daze et al., 2009).

There is no official definition of adaptation policy, but Dupuis and Knoepfel (2013) stress that adaptation policy definition should include climate change impacts in its problem definition, based on the theoretical definition of a policy. Therefore, given the definitions of a policy and adaptation above, this thesis adopts Burton et al.'s (2002) adaptation policy definition. Adaptation policy is defined as "actions taken by governments including legislation, regulations and incentives to mandate or facilitate changes in socio-economic systems aimed at reducing vulnerability to climate change, including climate variability and extremes" (Burton et al., 2002, p.146). Based on the adaptation policy definition, an adaptation policy process can be defined as a series of steps in a cyclical model of decision-making for a government course or method of action to mandate or facilitate changes in socio-economic systems aimed at

reducing vulnerability to climate change, including climate variability and extremes. Thus, an adaptation policy process is conceptualised as a five-stage process: 1) identifying climate hazards, 2) assessing vulnerability and risk, 3) choosing adaptation measures and policy instruments, 4) implementing and 5) monitoring and evaluation (ICLEI Canada, 2013; Bednar et al., 2019).

2.3. National Climate Adaptation Policy and Adaptation Deficit

2.3.1. Increased concern about adaptation

Adapting to a changing climate is one of the major concerns across the world (Massey and Huitema, 2013; Moss et al., 2013; IPCC, 2014). Given the unavoidable consequences of climate change, despite international endeavours for mitigating GHG, adaptation has grown to be an important policy agenda in recent decades (Bauer et al., 2011; CCC, 2017; Fayazi et al., 2020). Since the early 2000s, with the publication series of IPCC ARs (3rd, 2001; 4th, 2007; 5th, 2014; 6th 2022), the international community has taken the impacts and vulnerabilities due to climate change more seriously, and actions to adapt have been implemented. The United Nations Framework Convention on Climate Change (UNFCCC) has made meaningful progress for adaptation through Conferences of Parties (COPs), such as 'The Bail Action Plan (COP 13, 2007)' and 'The Cancun Adaptation Framework (COP16, 2010)'. Most recently, through the Paris Agreement (COP21, 2015), a global goal on adaptation was established as "enhancing adaptation capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of temperature goal (Article 7:1) (UN, 2015, p.9)" and parties agreed to an enhanced transparency framework for adaptation action (Kato and Ellis, 2016). The Agreement requires all Parties to engage in adaptation planning and implementation and communicate their efforts for adaptation through adaptation communications. Adaptation communications may include information on its priorities, implementation and support needs, plans, and actions.

2.3.2. National responses and the current state of national climate adaptation policy

Although developing countries are expected to be most affected by climate change, adaptation issues are important for both developing and developed countries (Helgeson and Ellis, 2015). Countries are under both international and domestic pressure to adapt to climate change. They are required to establish a climate change adaptation policy and report their adaptation efforts to the international community through Intended Nationally Determined Contributions (INDCs) and regular official reports (Adaptation Communications) to UNFCCC. Moreover, domestic demands for practical governmental actions for adaptation have also been increasing as the frequency and extent of extreme weather events have increased. According to these pressures, adaptation has become a national policy agenda that cuts across government departments and sectoral boundaries (Burton, 2005). Countries are developing their formal national adaptation strategy or policy, and many countries have already implemented their adaptation policy and now focusing on monitoring and evaluating their policies. Also, the momentum will continuously increase.

Since the publication of IPCC AR4 (2007), there has been substantial progress in the development of national climate change adaptation policies and plans (IPCC, 2014). According to United Nations Environment Programme (UNEP) (2018), by November 2018, at least 162 countries handle national-level adaptation through a total of 110 laws and 330 policies as well as, officially, 40 Annex1 countries reported adaptation measures in their seventh national communications. Also, 11 national adaptation plans were indicated in adaptation information from Non-Annex1 countries[1]. According to Takayoshi and Ellis (2016), more than three-quarters of submitted INDCs have adaptation components, but their contents vary greatly, and only a limited number of countries have specific adaptation aims, actions or quantitative indicators.

[1] https://unfccc.int/non-annex-I-NCs

2.3.3. Roles of national climate adaptation policy

The Organisation for Economic Co-operation and Development (OECD) defines national level policy as below.

National level: it concerns agencies at the national level with a cross-sectoral reach. It includes bodies with policy and planning authority and functions at the scale of an entire country and cutting across sectoral boundaries. Policy decisions taken at this level potentially affect all sectors and all parts of a country. … The 'national level' (which could also be termed 'central level') encompasses authorities or organisations with nationwide responsibilities (OECD, 2009, p.66).

A number of studies stress that national-level adaptation policy plays essential roles in adapting to climate change (OECD, 2009; Biesbroek et al., 2010; Storbjork and Hedren, 2011; Mullan et al., 2013; Eisenack et al., 2014; Waters et al., 2014; Berrang-Ford et al., 2014). Adger et al. (2009a) maintain that governments have a role in steering society toward long-term outcomes and give major objectives of public policy to adapt to climate change, and WRI (2009) stresses five major functions of a national adaptation system: assessment, prioritisation, coordination, information management, and climate risk reduction. IPCC (2014) summarises the roles of national climate adaptation policy. It creates legislations and regulations for adaptation, provides adaptation policy frameworks that guide decisions at sub-national levels, determines policy priorities, provides systematic and standardised data and information to help plan and stimulate adaptation, coordinates different sectors and adaptation actors, provides and protects public goods, distributes resources, and protects vulnerable groups (IPCC 2014). Also, Mullan et al. (2013) stress that national climate adaptation policy could have advantages in three aspects: taking advantage of the economics of scale in many parts of adaptation planning such as climate modelling, evidence provision and technical analysis of adaptation measures, considering equity concerns within existing policy frameworks or in specific adaptation policies and clarifying and codifying adaptation efforts which are sometimes informal and unconnected. Some studies argue that national governments are key actors to intervene and deal with existing barriers by changing legislation or providing more resources (Ford and Pearche, 2010; Measham et al., 2010). Given the pace and extent of changes that individuals cannot manage with self-interest and the adverse effects of climate change that we have not experienced (Berkhout, 2005; Mullan et al., 2013), the importance of the roles of national climate adaptation policy is more emphasised.

However, recent research and reports raise questions about the practical effectiveness of national climate adaptation policy, pointing out the ‘adaptation deficit’.

2.3.4. Adaptation deficit

The existence of ‘adaptation deficit’ is explicit with the observation of the gap between adaptation needs and adaptive actions (Gawith, 2018), which IPCC defines as “the gap between the current state of a system and a state that minimises adverse impacts from existing climate conditions and variability” (IPCC, 2014, p.839). Burton (2004) uses the term first to explain the high levels of losses from climatic factors under the situation without adapting to a changing climate, and it now usually describes the lack or ineffectiveness of adaptation measures to reduce vulnerability to climate change (Ashwill and Heltberg, 2013). Ngo et al. (2019) distinguish between adaptation deficits at macro and micro levels. Adaptation deficit at macro level, such as a country, is a situation where a country experiences a lack of institutional, financial and technological means to implement its adaptation processes. Micro level adaptation deficit refers to a set of individual factors that can aggravate the vulnerability to climate change, such as gender, age, health, social status, ethnicity, and class. The term, adaptation deficit, is interchangeably used with ‘implementation deficit’ in terms of adaptation policy, which refers to the disconnection between the impact or risk of climate change assessment activities and the achievement of concrete actions (Dupuis and Knoepfel, 2013; Bednar et al., 2019). Liu et al. describe it as “the gaps between the required and proposed measures and between the proposed measures and the action taken” (Liu et al., 2020, p.1451). Some literature also links the adaptation deficit to a ‘development deficit’ under changing climate conditions (Hallegatte et al., 2016; Gawith and Hodge, 2018). ‘Adaptation gap’ is also used interchangeably with ‘adaptation deficit’. UNEP (2014) introduces the term, ‘adaptation gap’, and defines it as “the difference between actually implemented adaptation and societally set goal, determined largely by preferences related to tolerated climate change impacts, and reflecting resource limitations and competing priorities” (UNEP, 2014, p.xii).

Even though adaptation policies are advancing in many counties, there is a consensus on the adaptation deficit. The adaptation deficit issue is common in both developed and developing counties, which raises questions about the

effectiveness of national climate adaptation policy. Literature has reported adaptation deficits across sectors and scales (Burton and May, 2004; Burton, 2009; Dupuis and Knoepfel, 2013; Ashwill and Heltbrg, 2013; Markus and Savini; 2016; Lonsdale et al., 2017; Clissold et al., 2020; Liu et al., 2020; Marcus and Hanna, 2020). Adaptive potential or adaptive capacity do not necessarily translate into adaptation actions (Adger and Barnett, 2009; Repetto, 2009). Also, identified adaptation needs have not always been adequately addressed, and a mismatch between adaptation needs and the funds available for adaptation has been reported in both developed and developing countries (Fankhauser and McDermott, 2014; IPCC, 2014; Valente and Veloso-Gomes, 2020). The adaptation deficit is obvious; the increasing losses caused by climate-related hazards are considered explicit evidence of the adaptation deficit (Burton, 2004; Burton, 2009; Fankhauser and McDermott, 2014; Gawith et al., 2020). UNEP also has reported adaptation gaps in various sectors through their Adaptation Gap Reports (1st, 2014; 2nd, 2016; 3rd, 2017; 4th, 2018; 5th, 2020; 6th, 2021) and suggested frameworks to assess adaptation gaps. In addition, given the unprecedented rapid climate change, implementation of adaptation is not keeping pace with an ever-increasing need, and the adaptation deficit is getting wider (Eisenack et al., 2014; Lonsdale et al., 2017).

Although the reasons underlying the adaptation deficit are not completely identified or addressed by the literature to date (Dupuis and Knoepfel, 2013), ‘barriers’ to adaptation have received attention to explain the adaptation deficit (Fankahuser, 2017; Simoes et al., 2017; Gawidh and Hodge, 2018).

2.4. Barriers to National climate adaptation policy

2.4.1. Barriers to adaptation

The interest in factors that hinder adaptation has increased with the increasing attention given to adaptation and adaptation measures. There are three reasons for the increasing attention to the factors: 1) the climate change threats raise questions regarding whether societies have the capacity to adapt, 2) there is sufficient agreement that factors that impede the adaptation process will always emerge, 3) there is a need to define and understand the factors and the contexts where they are identified specifically (Dapilah and Nielson, 2019). Recent experience of adaptation across the world has

demonstrated the presence of factors hampering adaptation processes (Esteve et al., 2018). However, there is considerable ambiguity about the concept and definition of the factors (Dow et al., 2013). Adaptation scholars have used different, often ill-defined, terms to describe the factors, for example, problems, limitations, challenges, constraints, and barriers, and sometimes the terms are used synonymously without consistent definitions (Clar et al., 2013, Biesbroek et al., 2013; IPCC, 2014). Now, two terms are mainly used in the research field: limit and barrier.

'Limit' refers to a level or a point at which adaptation objectives cannot be secured from intolerable risks of climate change through adaptive actions (Dow et al., 2013; Barnett et al., 2015; McNamara et al., 2017). IPCC defines a limit as "A limit is reached when adaptation efforts are unable to provide an acceptable level of security from risks to the existing objectives and values, and prevent the loss of the key attributes, components, or services of ecosystems" (IPCC, 2014, p.393). Swart et al. (2009) divide limits into biophysical limits and social limits. Biophysical limits are insurmountable and inherent to the system, and social limits are mutable subjective and socially constructed (Adger et al., 2009a; Dow et al., 2013). The limits constitute the physical or social thresholds or tipping points at which a society or individual can address the impacts of climate change within their adaptive capacity. The thresholds are different according to a level of intolerable risks which is actor-specific and related to material characteristics of the risks and individually shaped and culturally shaped perception of those risks (Dow et al., 2013). One can distinguish between hard limits that will not change and soft limits which could change over time (IPCC, 2014).

'Barrier' to adaptation refers to a factor that can stop, delay or divert the development and implementation of adaptation actions (IPCC, 2014; Williamson and Nelson, 2017). Concretely, barriers to adaptation are conceptualised as impediments that prevent building and mobilising adaptive capacity, hinder adaptation policy implementation, lead to policy failure, constrain stakeholder engagement, or prevent utilising new frameworks and tools to support adaptation (Biesbroek et al., 2013). Barriers to adaptation can be overcome with detailed efforts, sufficient skills, creative management, changes of thinking, prioritisation, and related changes of resources, land uses, institutions, etc. (Swart et al., 2009; Moser and Ekstrom, 2010). Barriers are, in general, seen as dynamic and context-dependent on sectoral, spatial

and temporal scales, socio-economic structures, financial, cultural and policy realms, and the importance and severity of each barrier vary across the contexts, as well as change over time (Adger et al., 2007; Swart et al., 2009; Prabhakar et al., 2014; Ghasemzadeh and Sharifi, 2020). Given these attributions, Eisenack et al. define a barrier to adaptation as below.

1) an impediment (2) to specified adaptations (3) for specified actors in their given context that (4) arise from a condition or a set of conditions. A barrier can be (5) valued differently by different actors, and (6) can, in principle, be reduced or overcome. In this definition, conditions are the attributes of adaptation, actors, and their context (Eisenack et al., 2014, p.868).

Barriers are becoming increasingly prominent in empirical research on adaptation across sectors and scales (Waters et al., 2014), and the importance of understanding and overcoming them is emphasised. Identifying and resolving barriers are required to ensure that societies are resilient in the face of climate change and to enhance adaptive capacity (Jones, 2010; Liu et al., 2020), which will ultimately prove beneficial for the adaptation outcomes (Moser and Ekstrom, 2010).

Since 2007, the research community has identified many barriers to adaptation and suggested a diversity of categories through desk studies and case studies (IPCC, 2007; Jones, 2010; Berrang-ford et al., 2011; Clar et al., 2013; Wise et al., 2014; Biesbroek et al., 2015; Williamson and Nelson, 2017; McClure and Baker, 2018; fayazi et al., 2020). A myriad of barriers to adaptation has been identified based on various scales, sectors, actors, or contexts (Inderberg and Eikeland, 2009; Lorenzoni et al., 2009; O'Brien, 2009; Dessai et al., 2009; Jones, 2010; Jones and Boyd 2011; Buurman and Babovic, 2016; Howarth et al., 2017; Porter and Dessai, 2017)[2]. Waters et al. (2014), Lonsdale et al. (2017), and Liu et al. (2020) argue that there are common barriers to adaptation across scales, sectors, and places; such as lack of resources, lack of information and knowledge, lack of leadership, insufficient techniques, and competing priorities. Also, various categories or clusters of barriers to adaptation are suggested and used according to researchers and cases. For example, Biesbroek et al. (2011) suggest seven clusters of barriers to adaptation based on characteristics of the barriers: conflicting timescales, substantive, strategic and institutional uncertainty, institutional crowdedness and voids, fragmentation, lack of awareness and

[2] Conceptual and practical barriers (perception), Institutional barriers, Knowledge gap, uncertainty barriers climate information barriers, values, etc.

communication, motives and willingness to act, and resources. IPCC (2014), in chapter 16 of the Working Group Ⅱ report, classifies the barriers into knowledge, awareness and technology constraints, physical constraints, biological constraints, economic constraints, financial constraints, human resource constraints, social and cultural constraints, and governance and institutional constraints. Mercado et al. (2020) suggest broader categories: governance barrier, social barrier, technological resources barrier. Some studies suggest frameworks or tools for identifying barriers to adaptation and their categories. The distinction between barriers to general adaptation, adaptation policy, and an adaptation process is not clear in previous studies. However, there were a few efforts to distinguish them. For example, Moser and Ekstrom (2010) try to focus on barriers to an adaptation process. They suggest a systematic framework to identify barriers to adaptation with three major elements: actor, system, and context. Through document analysis, they identify many barriers in each phase of an adaptation process and its causes.

2.4.2. Barriers to national climate adaptation policy and its policy process

Only a small number of studies have identified barriers to national-level adaptation policy and its policy process (Mullan et al., 2013; Prabhakar et al., 2014; OECD, 2015; Henstra, 2017; Brown et al., 2018; UNEP, 2018; Russel et al., 2020). Agrawala and van Aalst (2005) identify five major barriers to mainstreaming climate change, particularly adaptation, through case studies linking climate change and development in natural resource management of six countries. OECD (2009) identified 15 barriers to national climate adaptation policy and suggested four barrier categories (Table 1). In 2012, OECD found that countries clearly face common challenges and drew six key challenges of national climate adaptation policy through a policy forum on adaptation in OECD countries: dealing with uncertainty and long time frames, improving the information on natural hazards, clarifying local government roles and responsibility, improving emergency management arrangements, better integration of planning and building regulation, managing risk to existing settlements (OECD, 2012). Helgeson and Ellis (2015) emphasise that a lack of resources (financial and human) is the greatest barrier to adaptation policy at a national level. Bauer et al. (2011) indicate four major barriers that national governments encounter when they develop and implement adaptation policies (adaptation policy process): governments have to address current and future climate change effects that 1) cut horizontally across different policy sectors,

and 2) vertically across different levels of government, 3) are uncertain and 4) concern a broad range of non-state actors who often lack capacity to adapt (Bauer et al., 2011). Marcus and Hanna (2020), based on a survey from 11 countries, show that there are five barriers that are common in national adaptation processes: lack of coordination, lack of political will, lack of funds, lack of non-monetary resources (technical, medical, human), and unavailability of information.

Table 1 Barriers to national climate adaptation policy

Category	Barrier
Improve availability and quality of climate information	– Inadequate infrastructure for weather and climate monitoring – Limited technical and computing capacity for climate change and impacts modelling – Lack of adequate methodologies and data for assessing vulnerability to climate change – Little or no information on costs and benefits of adaptation measures
Incorporate adaptation considerations within national development policies	– Climate change adaptation is still not viewed as a development issue and consequently is not a high priority – Mismatch in terms of timescales over which many climate change impacts might manifest themselves and the much shorter time horizons of many development policies – Disconnect between the stakeholders engaged in the formulation of development policies and the climate change community – Lack of financial resources to undertake the required additional analyses
Government-wide approach	– Climate change still pigeon-noted as the remit of the Environment Ministry – Lack of incentives to change existing structures and practices – Lack of specific information on how climate changes would impact core government

Category	Barrier
	functions and regulations – Rigidities and inertia in regulatory frameworks
Incorporate adaptation considerations within donor policies and processes.	– Adaptation is still a low priority within donor agencies themselves and is usually compartmentalised within small teams dealing with environmental issues – Donor processes are intended to support partner priorities. Therefore, to the extent adaptation is a low priority for partner governments, the role of donors in raising its profile is somewhat limited – Multiplicity of donor-supported capacity-building efforts on screening for climate risks and implementing adaptation

Source: OECD, 2009

2.4.3. Adaptation deficit and barriers to adaptation

Barriers to adaptation help to explain the current adaptation deficits (Valente and Veloso-Gomes, 2020). Barriers prevent adaptation plans from linking to the implementation of on-the-ground measures, and they also make adaptation actions slow and unsustainable (McNamara, 2013; Wise et al., 2014). With the barriers, the discrepancy between the ever-increasing need for adaptation and the implementation of adaptation measures becomes deteriorated, and meeting adaptation demands will be more difficult (IPCC, 2014). Therefore, overcoming the barriers is pivotal to reducing the adaptation deficit (Simoes et al., 2017). Although a barrier-free process is unrealistic, efforts to overcome barriers to adaptation are urgently required (Clissold et al., 2020). Eisenack et al. (2014) emphasise that identifying and analysing barriers to adaptation and appropriate solutions to overcome them contribute to reducing the adaptation deficit. IPCC (2014) also stresses that many interested parties must overcome resource, institutional and capacity barriers for implementing adaptation plans. However, previous studies, for about the last 20 years, have provided a limited understanding of the barriers and little advice to practical adaptation processes.

2.4.4. Limitations of previous research on barriers to adaptation

Although existing studies on adaptation barriers have provided a broad empirical and conceptual base, there are critical limitations to providing practical help for the adaptation process in reality. Recent studies have conceptualised the limitations as ‘black boxes’ of barriers to adaptation (Biesbroek et al., 2015; Eisenack et al., 2015; Wellstead et al., 2018).

First, previous studies on barriers to adaptation focused on only compiling lists of the barriers and describing them, which have provided a limited understanding of them (Prabhakar et al., 2014, Biesbroek, 2014; Ghasemzadeh and Sharifi, 2020). The concept of barriers to adaptation has been used to list existing impediments to adaptation policy (Dupuis and Knoepfel, 2013), and endless lists of barriers have been suggested with their context-dependent nature (Waters et al., 2014). This previous research approach and concept of barriers prevent it from explaining and understanding them, as a result, the previous research results have been rarely used in the actual adaptation policy process (Wise et al., 2014; Waters et al., 2014; Biesbroek et al., 2015). Researchers pointed out the underlying functionalist assumptions inherent in the existing research approach (Biesbroek et al., 2015; Wellstead et al., 2018). They assume that identifying the barriers will lead to devising solutions to overcoming the barriers, but they are not supported in reality (Wellstead et al., 2018). Biesbroek et al. argue that “the biggest barrier to adaptation might very well be the concept of barriers itself and how it is currently being used in studying adaptation decision-making” (Biesbroek et al., 2015, p.494).

Secondly, critical questions about the barriers’ underlying causes, short- and long-term consequences, and internal dynamics remain unanswered, although these questions have been constantly raised since the early 2010s (Moser and Ekstrom, 2010; Biesbroek et al., 2013; Eisenack et al., 2014; Waters et al. 2014; Fayazi et al., 2020; Ghasemzadeh and Sharifi, 2020). As previous discussions have focused little on barriers’ origins or causal mechanisms, it was limited to explaining how and why the barriers occur in the adaptation process, beyond describing the barriers themselves (Dupuis and Knoepfel, 2013; Wise et al., 2014; Wellstead et al., 2018; Liu et al., 2020). Although it is clear that the barriers affect the whole process of adaptation (Fatorić and Biesbroek, 2020), previous studies could not explain how barriers

are linked to the adaptation decision-making process and how barriers affect adaptation policies and actions. It has led to that the barriers have been dealt with as entities isolated from the actual adaptation process (Biesbroek, 2014). In addition, diverse barriers interact with each other in an adaptation process (Valente and Veloso-Gomes; 2020), but explanatory approaches for internal dynamics or relationships between barriers to adaptation are limited in previous studies (Biesbroek et al., 2015; Spires and Shackleton, 2018). Some recent studies have tried to show the relationships between barriers to adaptation (Fatoric and Biesbroek, 2020; Fayazi et al., 2020; Mercado et al., 2020), the research results are still too limited to provide practical help to the actual adaptation process or deal with the barriers as isolated entities. A few studies tried to explain the barriers' origins or influences, but they mostly apply to the unique context or case, with little ground yet for generalisation (Eisenack et al., 2014).

Third, there is a lack of generally applicable knowledge of barriers to adaptation. Researchers have conducted different levels of analysis and used different research methods and theoretical backgrounds to identify barriers. Thus, the results of the previous studies are highly fragmented, and it is difficult to compare and generalise the findings for each actor, sector, or scale (Biesbroek et al., 2011; Biesbroek et al., 2013; Valente and Veloso-Gomes, 2020). This situation only lists the barriers to adaptation, not helping to address them systematically (Waters et al., 2014). There is a need for generalised knowledge of barriers to adaptation for a broad set of cases to address them explicitly and systematically (Eisenack et al., 2014).

Fourth, as Biesbroek et al. (2015) assert, there is a mismatch between academic models and the policy realities in research on barriers to adaptation; the results of academic research on barriers have barely been used in practical adaptation decision-making or adaptation policy processes. Some factors are hindering in some cases, whereas they would be beneficial in other contexts, but previous studies did not pay sufficient attention to explaining these different contexts (Eisenack et al., 2014). In other words, barriers have different priorities and importance according to actors, sectors, or scales, but most previous studies did not consider such different value judgements (Waters et al., 2014). Thus, despite a large number of research on barriers to adaptation, too much-generalised research results have not been practically

used in the real adaptation process of each adaptation level (e.g. national, local, private).

Lastly, with the lack of understanding of the origins, influences, and dynamics of the barriers to adaptation, devising concrete and practical solutions for the barriers was significantly limited in the previous studies (Clar et al., 2013; Eisenack et al., 2014; Liu et al., 2020). In previous studies, it was not clear what each stakeholder needs to do and what needs to be addressed first to overcome the barriers. Thus, the barriers to adaptation reoccur in every phase of the adaptation process.

In terms of barriers to national-level adaptation, as most research on barriers to adaptation has been conducted with local, community or individual cases, our understanding of barriers to national climate adaptation policy is more limited than other levels. Despite clear evidence of barriers to national climate adaptation policy and its policy process, the importance of understanding them has been overlooked. The majority of previous studies on national climate adaptation policy have dealt with the policy in the implementation research field, which moves away from the notion of barriers to adaptation (Biesbroek et al., 2015). Even though the studies that were mentioned in Section 2.4.2. analyse the barriers to national-level adaptation, these results are very fragmented and also have similar limits that are presented above. In addition, official documents from developed countries do not show the barriers to their adaptation policy and policy process. For example, in Annex1 countries' NCs, there is no evidence of barriers to their adaptation policies or policy processes, but existing studies present that the developed countries also experience similar barriers (OECD, 2009; Biesbroek et al., 2010; Bauer et al., 2011; OECD, 2012; Mullan et al., 2013; Prabhakar et al., 2014; Russel et al., 2020).

These limitations make it challenging to overcome the barriers to adaptation, which leads to persistent adaptation deficits. Despite the urgency of identifying and overcoming the barriers, adaptation policy processes at the national level are repeatedly experiencing barriers. Moreover, the nature of climate change adaptation that includes diverse sectors, multi-level stakeholders, multi-disciplinary studies, complex interactions between them, and uncertain climate and social changes makes it more complex and difficult to address the

barriers. Climate change adaptation in this situation is regarded as a ‘wicked problem’.

2.5. Wicked Problems and Social Learning

2.5.1. Climate change adaptation, a super wicked problem

Climate change meets all definitional features of ‘wicked problems’ (Pollitt, 2015). Rittel and Webber (1973) introduced the term ‘wicked’ to describe the nature of social policy problems. Wicked problems have common features: complexity, uncertainty, interdependency, difficulty, a lack of knowledge, complex engagements, controversy, and so forth (Lazarus, 2009; Carlile et al.,2013; Brown, 2015; Perry, 2015; van Epp and Garside, 2019). There is no single root cause of the wickedness and no single best approach to address such problems (Head and Alford, 2015), and non-traditional approaches are required to deal with them. Climate change issues, especially its policy aspect, possess all these features (Pollitt, 2015; Gupta, 2016). In addition, they include additional features: time is running out, no central authority (institution), those seeking to end the problem are also causing it, and hyperbolic discounting (Levin et al., 2009, 2012; Lazarus, 2009).

Climate change adaptation has received attention as a super wicked problem (Levin et al., 2009; Collins and Ison, 2009; Lazarus, 2009; Jones and Preston, 2011; Fisher and Dodman, 2019). Adaptation is a cross-sector and multi-scale decision-making process and has inherent uncertainty associated with climate impacts and the consequences of adaptation measures. Also, as the benefits of adaptation can take considerable time to become evident, it is hard to see and access its outcome within a short-term timeframe. Thus, we must act on incomplete and often conflicting information with intertwined different values and perceptions. Each adaptation approach is unique for each context, and it is affected by existent but mostly unknown interdependencies between natural, technical and social phenomena (Perry, 2015; Termeer, 2016; Mudombi et al., 2017; Russel et al., 2020). Moreover, adaptation has higher wickedness than climate change mitigation. Mitigation progress can be measured through Carbon dioxide (CO2) emission reduction, and UN members set emission targets in their National Determined Contributions (NDCs). Whereas adaptation does not have a single overarching international

or national goal, and there is no single unit of measurement to judge its progress (Brown et al., 2018).

National climate adaptation policy and its policy process explicitly present the wickedness of climate change adaptation. National climate adaptation policy involves a wide range of horizontal (cross-sectoral) and vertical (multi-level) stakeholders. Also, under inherent uncertainty and ambiguity of adaptation, national-level adaptation policy makes key decisions for general adaptation in a national society. The key decisions include creating legal frameworks that guide decisions for adaptation, providing climate information and projection, directing actions of sectors and sub-national actors, protecting vulnerable groups and providing budgets and financial support (IPCC, 2014). Thus, almost every step of a national climate adaptation policy process experiences issues related to complexity, uncertainty, interdependency, difficulty, a lack of knowledge, complex engagements, and controversy. Moreover, as national climate adaptation policy, generally, has a lower priority than other political and economic issues, the wickedness would be enhanced. These common features of wicked problems have a clear and deep connection with the barriers to adaptation mentioned above sections.

Some previous studies have linked adaptation policy with the concept of a wicked problem (Dewulf and Termeer, 2015; Perry, 2015; Termmer et al., 2015). However, there is still a lack of fundamental understanding of what makes the wickedness of adaptation policy and how we can reduce the wickedness in the policy process. Especially, there is no attempt to interpret national climate adaptation policy as a wicked problem yet.

Generally, wicked problems are seen as associated with three aspects: social pluralism (multiple interests and values of stakeholders), institutional complexity (the context of inter-organisational cooperation and multi-level governance), and scientific uncertainty (fragmentation and gaps in reliable knowledge) (Head and Alford, 2015). Given the feature, there is no scientific best solution to solve or fix a wicked problem, but a wicked problem can be managed or addressed through negotiations among relevant stakeholders (Rittel and Webber, 1973; Head and Xiang, 2016; Head, 2019). Head (2014) says, “wicked problems such as climate change adaptation are managed, debated, and constantly renegotiated rather than solved. Iterative and

adaptive approaches are therefore necessary for developing sustainability policies and for tackling the policy innovation challenges arising from climate change" (Head, 2014, p.675).

2.5.2. Social learning for adaptation

2.5.2.1. Social learning theory for wicked problems

The term social learning has arisen in response to a growing recognition of learning occurring through situated and collective engagement with others and its potential to deal with the complexity and uncertainty of a problem, a wicked problem (Henly-Shepard et al., 2015; Orsato et al., 2019). Social learning is defined as a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks (Reed et al., 2010). It requires multiple stakeholder groups to share, integrate, and create knowledge together (Ensor and Harvey, 2015), emphasising cycles of collective learning, action and reflection beyond individuals (Keen et al., 2005). To find consensus in defining a complex challenge and its potential solutions, social learning involves different stakeholders who have different values and perspectives (Webler et al., 1995; Wals et al., 2009; van Epp and Garside, 2019). It leads to the acquisition of new experiences, information and skills, sense-making, and forming a new understanding and value of reality through iterative learning cycles over time periods (Muro and Jeffrey, 2008; Vulturius and Gerger Swartling, 2015). These approaches of social learning include the key factors for better addressing wicked problems (governance, communication, coordination, and learning) and policy study themes and provide practical help to public policy fields. Since the 1980s, social learning has been applied in the governance of the natural resource management research field, especially in water, food and forest (Collins and Ison, 2009; Reed et al., 2010; Cundill and Rodela, 2012; Tran et al., 2020). Recently, the concept of social learning is also used in the context of climate change (Ensor and Harvey, 2015; van Epp and Garside, 2019).

2.5.2.2. Social learning for climate change adaptation

Social learning has recently gotten increasing attention as a promising approach to coping with adaptation issues because it enhances the adaptive capacity of actors in changing situations. Climate change adaptation requires reflection on its successes and failures and the integration of knowledge from diverse disciplines and sectors; thus, dynamic learning is essential for

adaptation (Sterman, 1994; Shaw and Kristjanson, 2013; Mudombi et al., 2017). In this regard, social learning provides considerable insights into enhancing adaptive capacity, multi-stakeholder engagement, involving different values and perspectives, and considering dynamics and interconnection (Fisher and Dodman, 2019). In theoretical social learning processes for adaptation, these aspects emerge simultaneously; interacting stakeholders who have different values, beliefs and cultures co-produce knowledge, resulting in relational and cognitive changes and improved actors' capacities in iterative processes (Muro and Jeffry, 2012), and it makes stakeholders be able to anticipate a problem, collect and share knowledge, and reflect and develop a shared vision for action by participating in decision-making (Blackmore, 2007; Tschakert and Dietrich, 2010; Henly-Shepard et al., 2015). This participation leads to understanding adaptation issues going beyond the individual stakeholders to become situated within wider social units or communities (Reed et al., 2010; Mudombi et al., 2017), as a result, society's capacity for climate change adaptation is enhanced. In this process, adaptation is understood as a co-evolutionary process involving situated and collective engagements, knowledge and institutional arrangements (Henly-Shepard et al., 2015). Collins and Ison (2009) suggest a conceptual case for 'adaptation as social learning', which addresses the uncertainty, interconnectedness and complexity inherent in adaptation decision-making. They assert that social learning can be understood as a governance mechanism or policy instrument for climate change adaptation (Collins and Ison, 2009). Albert et al. (2012) also emphasise that social learning is a critical element for generating and implementing effective adaptation strategies. Therefore, it is theoretically and practically reasonable to explore a way to understand and address the climate change adaptation problems defined as super wicked problems through the social learning theoretical approach.

Nevertheless, the literature on social learning commonly points out that evidence to support the theoretical arguments is insufficient (Lebel et al., 2010; van Epp and Garside, 2019). Ensor and Harvey (2015) emphasise limitations of the current social learning studies: a lack of evaluation tools for social learning in system-oriented approaches and a limited range of evaluation approaches for climate change adaptation. The relationship between social learning and adaptation is usually mentioned in the studies focusing on natural resource management (Blackmore et al., 2016; Johannessen et al., 2019), organisational adaptive capacity building (Pelling

et al., 2008), or suggesting theoretical tools (Pahl-Worstl, 2009; Tàbara et al., 2010). Yet, it is hard to find evidence of applying the social learning approach to real-world adaptation policies or adaptation actions.

2.6. Justification for The Thesis

Based on the literature review, this section clarifies the research needs and justification for this thesis. The overview in Section 2.3. has provided two important insights. First, it has been recognised that research on national climate adaptation policy and its policy process is essential for overall adaptation progress. Given the roles and functions of national climate adaptation policy, a clear and in-depth understanding of national climate adaptation policy and its policy process leads to improvements of frameworks, legal basis, and resources allocations. Also, as the number of national adaptation policies is increasing, practical research on the problems of the policy and its policy process and potential solutions is required. Secondly, although national-level adaptation policies have substantially progressed in the last 15 years (IPCC, 2014), the adaptation deficit is observed and getting wider (Eisenack et al., 2014; Lonsdale et al., 2017). However, there are no studies yet to specifically find the reasons for the adaptation deficit in national adaptation policies. In this regard, this thesis aims to address the current shortcoming in our understanding of barriers to national climate adaptation policy and its process through empirical and theoretical analysis. In order to provide a deeper and more practical understanding of diverse barriers comprehensively, this thesis more focuses on the barriers that affect the national adaptation policy processes than on a national adaptation policy as a single adaptation measure. Based on the research results, it will contribute to planning/implementing adaptation policies and actions more effectively and ultimately improving the adaptation deficit situation.

To break through the current adaptation deficit, overcoming barriers to adaptation is critical, and the literature review in Sections 2.4. has indicated a number of key research demands for further research on barriers to adaptation. First, there have been calls for a research shift from merely identifying/enumerating barriers to adaptation to explaining the barriers' characteristics (Waters et al., 2014; Clissold et al., 2020). It involves explanations of barriers' occurrence, influence, and dynamics (Eisenack et al.,

2014; Esteve et al., 2018; Clissold et al., 2020; Braunschweiger and Pütz, 2021), which will lead to opening up the black boxes behind barriers to adaptation (Biesbroek et al., 2015; Eisenack et al., 2015; Wellstaead et al., 2018). Secondly, further research on barriers to adaptation is required to be closer to real-world contexts to provide practical contributions. Barriers need to be considered in the actual adaptation process, not isolated entities (Biesbroek, 2014). In other words, bridging the conceptual understanding of barriers to adaptation and the actual adaptation processes is required. Thirdly, producing generally applicable knowledge of barriers to adaptation is required beyond context-specific and fragmented knowledge (Dupuis and Knoepfel, 2011, 2013; Eisenack et al., 2014). Reflecting that different actors, sectors, and scales have different priorities or importance of barriers to adaptation, it needs to distil and compare research results according to different actors, sectors, or scales (Swart et al., 2014). Also, research approaches based on sociology and policy science are demanded to generalise and theorise knowledge and understanding of barriers to adaptation (Dovers and Hezri, 2010; Biesbroek et al., 2011; Dupuis and Knoepfel, 2011, 2013). Fourth, further research is required to suggest more practical solutions to address the barriers to adaptation (Wise et al., 2014). The suggested solutions need to involve explanations and understandings of the barriers' origins, causal mechanisms, influences and relationships (Esteve et al., 2018; Valente and Veloso-Gomes, 2020; Braunschweiger and Pütz, 2021). Lastly, as most previous research on national climate adaptation policy has focused on implementation aspects, the notion of barriers to national level policy has not been considered. With the clear evidence that countries, across contexts, are experiencing barriers to planning and implementing their adaptation policy (OECD, 2012; Mullan et al., 2013; Prabhakar et al., 2014; Russel et al., 2020), more research on barriers to national climate adaptation policy and its policy process is required to advance the current limited understanding of barriers to national-level adaptation.

Section 2.5. has set the theoretical background for the whole thesis and drawn important research demands based on the concept of wicked problems and social learning. First, previous studies have not provided a fundamental understanding of what makes the wickedness of adaptation and how it can be reduced. Secondly, despite the relevance between social learning and adaptation issues, empirical evidence is insufficient to support the theoretical arguments yet (Lebel et al., 2010; Ensor and Harvey, 2015; van Epp and

Garside, 2019). Thirdly, national climate adaptation policy has not been considered through the lens of wicked problems and social learning, even though the literature has presented the potential of a theoretical approach based on social learning. Lastly, although potential alternatives or approaches to manage or address a wicked problem have been theoretically suggested in previous research, research that provides practical help to addressing a wicked problem through connection with policy studies and real evidence supporting the research are required. This thesis, therefore, aims to provide a better understanding of the wickedness of national climate adaptation policy through analysing related barriers to adaptation policy. In addition, by applying a theoretical framework of social learning to case studies, this thesis aims to provide empirical evidence for supporting the theoretical arguments as well as a generalised approach for suggesting directions of solutions for overcoming the barriers. Ultimately, it will provide a practical approach to addressing a wicked problem with a robust theoretical foundation.

Chapter 3
Methodology

Chapter 3
Methodology

This chapter elaborates on the most appropriate approach to research barriers to national adaptation policy processes and to explain how and why barriers occur, how barriers affect adaptation policy processes, and how they can be addressed. It presents the research philosophy underpinning the research in this thesis and outlines the multimethod approach consisting of a systematic literature review, empirical case studies, and a theoretical analysis. It also explains the positionality of the research and research ethics. More detailed explanations of data collections and analysis methods are given in the respective chapters.

3.1 Research Philosophy

This thesis adopts pragmatism, which recognises that there are many different ways of interpreting the world and undertaking research, and a single point of view cannot ever give the entire picture of the world or truth and that there may be multiple realities (Saunders and Lewis, 2012). Researchers should use the philosophical and/or methodological approach that works best for providing tentative answers to one's research questions under the view of pragmatism (Tashakkori et al., 1998; Johnson et al., 2007). Focusing on the consequences of research and the research questions, it is often associated with mixed methods (Kaushik and Walsh, 2019). The reasons for adopting pragmatism for this thesis are threefold. Firstly, to address research questions about what barriers to national climate adaptation policy are, what their characteristics are, and how we can overcome them, it needs to use flexible and comprehensive research methods. In this sense, pragmatism provides adequate research philosophical background. Pragmatism allows researchers to address their research questions with any methodological tool available, which is the most appropriate, using the pragmatist credo of "what works" (Shaw et al., 2010; Kaushik and Walsh, 2019). Rather than choosing a dichotomy between post-positivism and constructivism (Yvonne Feilzer, 2010; Morgan, 2014), it permits a more comprehensive approach to a research problem (Shaw et al., 2010). Secondly, this thesis approach and pragmatism are well aligned in terms of both foci on human experiences and actions. The thesis analyses barriers to national climate adaptation policy through stakeholders' experience of the barriers and actions to overcome them.

Pragmatic approaches also focus on human action and experience (Goldkuhl, 2012). In the view of pragmatism, knowledge consists of warranted beliefs that result from actions and experience (Morgan, 2014). Kaushik and Walsh also emphasise

This world is a world of unique human experiences in which, instead of universal truths, there are warranted beliefs, which take shape as we repeatedly take actions in similar situations and experience the outcomes. Our warranted beliefs are produced by the repeated experiences of predictable outcomes (Kaushik and Walsh, 2019, p.255).

Lastly, the philosophy underpinning pragmatism is well suited to research on barriers that are socially constructed and context-dependent. Pragmatism accepts that there are multiple realities and truths depending on contexts; the reality is based on the environment and can only be revealed through human experience, and knowledge and reality are socially constructed within some specific context (Tashakkori et al., 2008; Creswell et al., 2011; Morgan 2014).

3.2. Methodological design and approach

3.2.1. Multimethod design

Based on the philosophy of pragmatism, this thesis takes a multimethod approach. Although previous studies have suggested various typologies and definitions for the multimethod approach (Johnson et al., 2007), this thesis adopts Driessnack et al.'s definition:

Multiple methods or multimethod design is when two or more research projects are conducted, each complete in itself, to address research questions and/or hypotheses, a topic, or a program. As with mixed methods, the studies may be a combination of quantitative methods, qualitative methods, or both. The projects can be implemented concurrently or sequentially (Driessnack et al., 2007, p.1047).

In a multimethod research design, data is collected and analysed using different methods in each research project that is independently planned and conducted within the same paradigm, which allows researchers to explore diverse perspectives and uncover relationships that exist between complicated layers of multifaceted research questions (Shorten and Smith, 2017; McKendrick, 2020). Multimethod research provides stronger results through triangulation of findings, can answer broader research questions, compensates for the various weakness of single research methods, tells a

more comprehensive, complete and convincing story, and provides a holistic understanding of phenomena (Davis et al., 2011).

This thesis adopts a multimethod research design which consists of three phases of data collection and analysis. Each phase links to one or two of the research objectives described in Section 1.2. and utilises different data collection and analysis methods. Figure 1 presents a schematic diagram of the overall design of this thesis. It shows that each phase uses different methods to achieve each research objective and that the multimethod approach is comprehensively designed to achieve the overarching research aim. Through the separated but sequential phases, it can achieve congruence with data triangulation to enhance research credibility, extend the comprehensiveness of research, and seek an explanation for emergent findings (McKendrick, 2020).

An overview of the different research objectives, questions, data collection and analysis methods are summarised in Table 2. The detailed description of the data collection and data analysis methods for each research objective is explained in the respective chapters. The following sections justify the use of selected methods in each chapter.

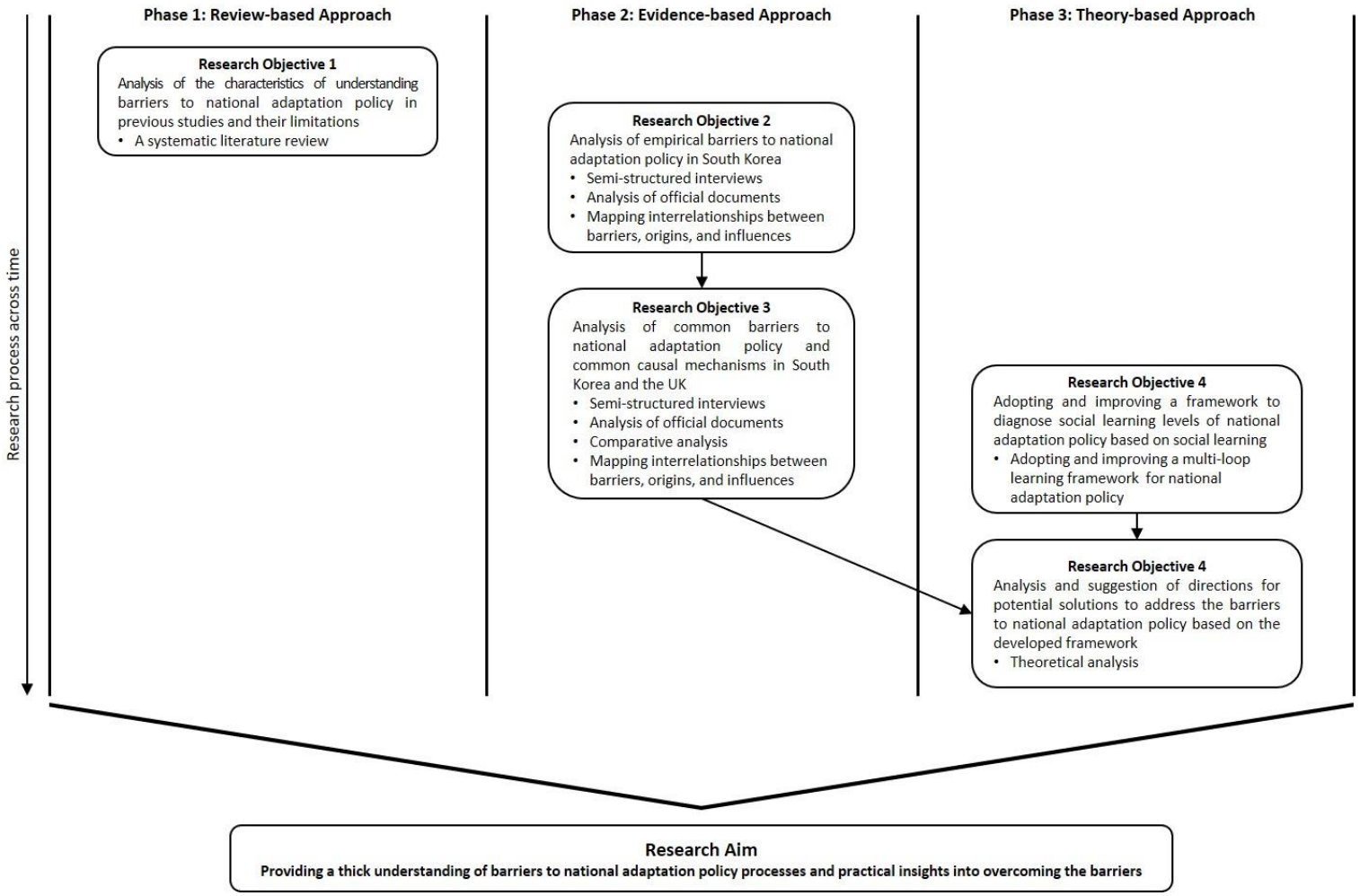

Figure 1 Overview of the research design

Table 2 Overview of the research objectives and the respective data collection and analysis methods

Objective	Question	Data collection	Analysis method
1. Analysis of the characteristics of barriers to national climate adaptation policy in previous studies and their limitations	What are the barriers to adaptation policy at the national level?	- Peer-reviewed articles in Web of Science and Scopus	- Systematic literature review
	What are the characteristics of the barriers?		
	What are the limitations of previous research on barriers to national climate adaptation policy?		
2. Empirical analysis of barriers to national climate adaptation policy in South Korea	What are the barriers to national climate adaptation policy and their origins and influence?	- Semi-structured interviews (South Korea) - Official documents related to national climate adaptation policy (South Korea)	- Thematic coding of interviews - Qualitative content analysis - Mapping interrelationships between barriers, origins, and influences
	How do the barriers, origins and influences interact?		
	What can policy-makers and stakeholders do to address the barriers?		
3. Analysis of common barriers to national climate adaptation policy and potential common causal mechanisms in South Korea and the UK	What are the common barriers to national climate adaptation policy processes in Korea and the UK	- Semi-structured interviews (South Korea, the UK) - Official documents related to national climate adaptation policy (South Korea, the UK)	- Thematic coding of interviews - Qualitative content analysis - Comparative analysis with two cases - Mapping interrelationships between barriers, origins, and influences
	What are the characteristics of the common barriers and their origin and influence?		
	How can we approach to reduce and overcome the barriers at the national level?		

Objective	Question	Data collection	Analysis method
4. Diagnosis of social learning levels of national climate adaptation policy and suggestion of directions for potential solutions to address the barriers based on social learning	How can social learning theory be used in the national climate adaptation policy contexts regarded as super wicked problems?	- Literature review	- Adopting and re-defining a theoretical framework
	What are the social learning levels of national climate adaptation policy in South Korea and the UK?	- Information and findings gathered through objectives 2 and 3	- Framework analysis based on multi-loop learning
	What directions for potential solutions to overcome the current barriers can be suggested based on social learning theory, especially the multi-loop learning approach?	- Information and findings gathered through objectives 2 and 3 - Findings from the framework analysis	- Reflection on the combined findings - Drawing suggestions based on the multi-loop learning approach

3.2.2. Systematic literature review (SLR)

Traditional literature reviews have limitations related to intentional and unintentional bias in the data selection, interpretation and organisation of content; thus, systematic review methods that apply rigorous, objective and transparent steps and criteria for reaching conclusions are increasingly used (Biesbroek et al., 2013). Although there are various definitions of an SLR (Martinic et al., 2019), this thesis takes Higgins et al.'s definition:

A systematic review attempts to collate all empirical evidence that fits pre-specified eligibility criteria in order to answer a specific research question. It uses explicit, systematic methods that are selected with a view to minimising bias, thus providing more reliable findings from which conclusions can be drawn and decisions made (Higgins et al., 2009, p.6).

An SLR needs to include six elements: i) research question ii) sources that were searched, with a reproducible search strategy (naming of databases, naming of search platforms/engines, search date and complete search strategy) iii) inclusion and exclusion criteria iv) selection (screening) methods v) critically appraises and reports the quality/risk of bias of the included studies vi) information about data analysis and synthesis that allows the reproducibility of the results (Martinic et al., 2019). An SLR is considered a valuable research methodology for an uncertain research area. While previous research has been conducted on an issue, it is known that there is a wide range of research on a subject, but key questions remain unanswered, and a general overall picture of the evidence in a topic area is required to direct future research efforts (Petticrew and Roberts, 2006). Therefore, given the previous studies on barriers to adaptation and their limitations described in previous sections, an SLR is the most appropriate approach to see the current overall understanding of barriers to national climate adaptation policy and its process.

This thesis conducts an SLR to comprehensively collect and analyse barriers to adaptation policy and its process at the national level and their attributions in previous studies. As a summary and assessment of the status of knowledge on a given topic or research question, SLRs are increasingly used in the climate change field (Berrang-Ford et al., 2011). However, only small numbers of SLRs focusing on climate change adaptation have been conducted (Ford et al., 2011; Hofmann et al., 2011; Biesbroek et al., 2013; Lorenz et al., 2014; Spires et al., 2014; Berrang-Ford et al., 2015; Sud et al., 2015; Sherman et al., 2016). Also, as described in Section 2.4., although there is a large number of studies on barriers to adaptation, there are important questions that are

unanswered yet, and there is no SLR that focuses on barriers to national-level adaptation. In this respect, an SLR is an ideal methodology for collecting data and analysing barriers to adaptation policy and its process at the national level and their attributes in previous research, systematically minimising bias.

3.2.3. Case study

This thesis adopts a case study methodology based on a comparative and actor-centred approach suggested by Eisenack et al. (2014). A case study allows researchers to explore a phenomenon within its context using a variety of data sources and understand multiple facets of the phenomenon through a variety of lenses (Baxter and Jack, 2008). Also, it is well suited to the philosophical foundation and multimethod approach explained above.

Whilst various definitions of a case study have been suggested in the literature (Bennett, 2004; Gerring, 2004, 2006), this thesis takes Yin's definition, which describes well the purpose of this thesis, "A case study is an empirical method that investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident" (Yin, 2018, p.49). A case study is considered when the focus of the study is to answer "how" and "why" questions, researchers cannot manipulate the behaviour of those involved in the study, and researchers want to address contextual conditions that are related to the phenomenon under study (Yin, 2003; Baxter and Jack, 2008). According to Bennett (2004), case study methods have considerable advantages relative to other research methods. It includes 1) the operationalisation and measurement of qualitative variables, 2) the heuristic identification of new variables or hypotheses, 3) the examination of potential causal mechanisms within particular cases or contexts, 4) the historical explanation of cases, and 5) the incorporation of complex relations. In this regard, a case study is the best research methodology to achieve the research objectives of this thesis. Especially, it can provide answers to "how" and "why" questions related to barriers to adaptation which are important but remain unanswered. Also, this methodology makes it possible to investigate potential causal mechanisms of the barriers and adaptation policy problems and complex relations within particular contexts. Among the various case study types, this thesis takes an explanatory case study, which seeks to answer a question that sought to explain the presumed causal links in real-life

exploration that are too complex for the survey or experimental research approaches (Yin, 2003; Baxter and Jack, 2008). This thesis goes beyond only identifying and describing the barriers (thin description). Through an explanatory case study, it explains barriers to national climate adaptation policy, including their origins, influences, potential causal mechanisms, and interrelationships (thick description). To complement limitations of a case study and draw cross-case conclusions, this thesis adopts a multiple-case study design for research objective 3. A single-case study is criticised because its findings are contingent only under specified conditions, and its dependence on a single case makes it incapable of providing a generalising conclusion (Tellis, 1997; Bennett, 2004). However, a multiple-case study can compensate for this limitation to some extent. A multiple-case study enables researchers to explore similarities and differences between the cases; thereby, it increases the robustness and reliability of the evidence created from the study (Baxter and Jack, 2008). A multiple-case study also makes it possible to draw a set of cross-case conclusions (Yin, 2018).

As stated above, this thesis uses a case study methodology that is based on a comparative and actor-centred approach. A comparative and actor-centred approach is the best approach to advance our understanding of adaptation barriers and generate transferable findings (Eisenack et al., 2014). Firstly, comparative research designs can contribute to understanding better the multiple conditions that create barriers, identify clear evidence, and explain the interdependencies of barriers. Also, comparative research would provide a conceptual synthesis of how barriers combine into common patterns, which include underlying causes, resulting effects and mediating mechanisms. Secondly, barriers to adaptation can be identified through the experiences of actors who participate in the adaptation process, and most barriers are related to the actors themselves. Barriers can only be addressed and overcome by actors and their actions (Eisenack et al., 2014). Therefore, this thesis uses semi-structured interviews to collect data and conducts a comparative analysis with a multiple-case study for objectives 2 and 3.

Eisenack et al. (2014) also suggest time-sensitive approaches to explain dynamically interlinked barriers to adaptation and assess strategies to overcome barriers over time. However, this thesis does not adopt a time-sensitive approach considering that a national climate adaptation policy usually has a five-year policy period, and the research period of this thesis is

not long enough to analyse changes between policy periods. This will be addressed as a limitation of this thesis in Chapter 8.

3.2.3.1. Case selection for a multiple-case study

This thesis sets criteria for case selection for a multiple-case study, considering how it can provide a thick understanding of barriers to national adaptation policy processes. Most comparative analyses on national adaptation policy and its process in previous studies have been conducted based on cases that have similar economic, political, cultural and climatic backgrounds, for example, the Least Developed Countries (Kuruppu and Wilie, 2015), European Union (Biesborek et al., 2010) or western countries in OECD (Bauer et al., 2012). However, it is necessary to compare cases across economic, political, cultural and climatic backgrounds for a deeper and more practical understanding of the barriers to national adaptation processes, which can provide more generalised insights and contributions. Therefore, the criteria for case selection are set as below.

- Countries that stably establish and implement national adaptation policies with a clear legal basis
- Countries that have enough and sufficient experience in national adaptation policies and related barriers through at least two policy cycles
- Countries that provide sufficient official data on national adaptation policies, including policy documents, legislation, and related research reports
- Comparing countries in Europe and Asia that can represent each continent in terms of responding to climate change for different economic, political, cultural and climatic backgrounds
- Comparing Annex1 country and non-Annex1 country for different levels of approach for climate change response.

Based on the criteria, this thesis chooses Korean and UK cases as the most appropriate cases for the purpose of the thesis. Both countries have clear and robust legislation for national adaptation policy. Korea's national adaptation policy is based on the 'Framework Act on Low Carbon, Green Growth (2010)', and UK's national adaptation policy is based on the 'Climate Change Act 2008'. Korea has implemented its national adaptation policy since 2010, and the third national adaptation policy (2021-2025) is in progress. The UK

published their first national Climate Change Risk Assessment in 2012, based on this, the first Nation Adaptation Programme was implemented in 2013. The third Climate Change Risk Assessment was conducted in 2021, and it is expected that the third National Adaptation Programme will be published in 2023. Thus, both countries have sufficient experience of national adaptation policies and related barriers. Also, there are a number of official documents related to national adaptation policy, which are provided by the Korean and UK governments, government departments, official advisory organisations, official supporting organisations or government research institutes, and the official documents are open to the public. Section 3.2.5. explains more about the official document analysis. Based on the world-leading legislative framework in the Climate Change Act and progressive actions for climate change response, the UK is regarded as one of the world leaders in climate change mitigation and adaptation (Fankhauser et al., 2018; POST, 2019). The UK's approach to adapting to climate change has had a great influence on other European countries, and it plays a role as a guideline for national adaptation policy establishment in other countries (Swart et al., 2009; Massey and Huitema, 2013; Biesbroek et al., 2018). Korea also has been playing a leading role in tackling climate change among Asian countries since 2008, when the county set 'Low-carbon green growth' as its national vision. Among Asian countries, Korea firstly established a legislative framework for climate change response, including local-level adaptation, and published a detailed national adaptation policy and government department across adaptation strategies, which was a very progressive movement in Asia (Park, 2013; Park et al., 2014). Korea also held the first UNFCCC Global Adaptation Week in 2019 and joined the Global Commission on Adaptation in 2020. Under UNFCCC, the UK is in the Annex1 country group and has significant responsibility for climate change responses from the Kyoto Protocol (1997), whereas Korea is in the non-Annex1 country group and has less responsibility for climate change responses than the UK. Besides, there are many differences between national adaptation policies and their processes in Korea and the UK, which will be explained in later chapters.

Given the criteria and differences between Korea and the UK, this thesis considers that focusing on their commonalities related to barriers to national adaptation policy processes through a comparative analysis can provide generalised insights into understanding and addressing the barriers, across economic, political, cultural and climatic backgrounds.

3.2.4. Theoretical analysis

Based on social learning theory, this thesis adopts and re-defines a theoretical framework to diagnose social learning levels of national climate adaptation policy, considering identified barriers to the policy process, and it suggests directions for overcoming the barriers (research objective 4). To do this, it takes the 'multi-loop learning' approach.

As explained in Section 2.5., social learning has been suggested to address wicked problems, including key factors to address a wicked problem. Various approaches were used in previous studies on social learning for climate change adaptation (Mudombi et al., 2017; Fisher and Dodman, 2019; van Epp and Garside, 2019). Among the various approaches of social learning, this thesis considers that the 'multi-loop learning' approach is a reasonable approach in terms of theoretical and practical aspects, including key factors for addressing a wicked problem. The multi-loop learning approach highlights that learning is not linear, but it is an iterative process with multiple feedbacks or learning loops (Henly-Shepard et al., 2015) and includes three loops of learning processes. After Argyris and Schon (1974) first introduced single- and double-loop learning in the organisational theory field, many authors from various research fields have developed the concept of triple-loop learning (Swieringa and Wierdsma, 1992; Isaacs, 1993; Flood and Romm, 1996; Peschl, 2007; Pahl-Wostl, 2009; Nicolaides and McCallum, 2013; Kwon and Nicolades, 2017). Each learning level and category for adaptation policy is explained in detail in Chapter 7.

The multi-loop learning approach also provides proper theoretical insights into addressing barriers to adaptation policy processes at the national level. The multi-loop learning approach emphasises that three learning loops play an important role in detecting and correcting errors or problems that actors face (Argyris and Schon, 1996). Pahl-Wostl (2009) also stresses that, in three learning loops, only when lower-level barriers are encountered and overcome, higher levels of social learning can be attained. Thus, the underlying concept of multi-loop learning is consistent with the purpose of this thesis, and it is expected that addressing barriers to adaptation with the approach will provide potential results in adaptation contexts. Also, it would lead to a deeper understanding of the wickedness of climate change adaptation.

In Chapter 7, this thesis adopts and re-defines a theoretical framework for adaptation policy contexts from Pahl-Wostl's (2009) conceptual multi-loop learning framework. In the same chapter, by analysing barriers to national climate adaptation policy processes with the framework, this thesis diagnoses the current social learning levels of the policy and suggests what directions stakeholders of the policy need to take to overcome the barriers.

3.2.5. Documentary data analysis

This thesis also analyses official documents related to the national adaptation policy and its policy process in Korea and the UK, to understand the national adaptation policy contexts in both countries and find evidence of interviewees' responses in Chapters 5 and 6 as well as results of the theoretical analysis in Chapter 7.

The documentary materials include legal documents (Acts, enforcement ordinances, governmental regulations), policy and policy action plan documents, official national climate change risk assessment reports, national adaptation progress reports, research reports from official supporting organisations or advisory organisations, policy promotion brochures from governments, etc. The list of documentary materials is given in Appendix D.

3.3. Positionality and Ethical Consideration

3.3.1. Positionality

Positionality refers to the stance or positioning of the researcher in the social and political context of the study, which includes dimensions of culture, class, gender, age, political or social identity, as well as values and world view of the researcher (Coghlan and Brydon-Miller, 2014). The position set by a researcher affects every part of the research process, and the researcher's own subjectivity will be reflected in any subsequent reporting of research findings (Bourke, 2014). Schoenberger (1991) warns that research knowledge could undergo a filtering process that leads to misinterpretation. Thus, demonstrating positionality means "An act of self-reflection that considers how one's own opinions, values, and actions shape how data is generated, analysed and interpreted" (Jafar, 2018, p.324). By acknowledging a

researcher's subjectivities, positionality defines the boundaries within which the research was produced, provides an opportunity to increase the validity of the research conclusions, and ultimately represents a space where objectivism and subjectivism meet (Bourke, 2014; Jafar, 2018).

When making contact with research participants for the interviews, I introduced myself as a PhD student from the University of Leeds. Also, I explained my professional background in the field of national climate adaptation policy before I commenced postgraduate research, especially referring to my work experience of participating in the 2nd national climate adaptation policy process of South Korea at a governmental research institute. Also, I made it clear that I don't work for the government at the moment. Participants of this thesis's interviews were experts or civil servants who have participated or participated in the process of national climate adaptation policy in South Korea and the UK. It is important to establish trust with the participants (Bourke, 2014). The similar professional experience with the interviewees was beneficial. Interviewees realised that they and I have a common understanding of the importance of this research topic based on the experiences of the barriers to adaptation, and it helped interviewees to feel easy to talk more beyond the given questions in the interview protocol.

Whilst my position was the 'insider' while collecting interview data to draw deeper and more practical evidence, I intended to be the 'outsider' to interpret the data for an objective analysis. For this, I developed barrier categories and analysis frameworks based on previous literature, and I tried to quote as much as possible exactly what the interviewees responded, in order to maintain an objective tone. However, it cannot be completely ruled out that my experience of the barrier in the process of Korea's 2nd national climate adaptation policy and my subjectivity did not affect data analysis, interpreting and presenting research findings.

3.3.2. Research ethics

As Chapter 5 and 6 of this thesis requires human participants' involvement, relevant ethical reviews and risk assessments were completed before the interview data collection commenced. Ethical review was approved by the Environment and LUBS (AREA) Faculty Research Ethics Committee, University of Leeds (AREA 18-071), and it covered key concerns about

interview participant recruitment and consent process and data protection, confidentiality and anonymisation.

When I recruited participants for the interviews, an introductory email was sent to potential participants. The email included a brief overview of the research and interview aim, information about data protection, interview question samples, and the contact of primary research. Detailed information about data protection, confidentiality, anonymisation, and recording was provided at the start of the interview in both countries, and interview participants wrote and signed a consent form (see Appendix C).

Chapter 4
Towards a Deeper Understanding of Barriers to National Climate Change Adaptation Policy: A systematic review

Chapter 4
Towards a Deeper Understanding of Barriers to National Climate Change Adaptation Policy: A systematic review

4.1. Introduction

Adapting to a changing climate and managing climate risks are increasing concerns across the world (Moss et al., 2013; IPCC, 2014). Evidence of climatic changes and increasing frequency and intensity of extreme weather events is mounting, as recognised in the Assessment Reports (AR) of the Intergovernmental Panel on Climate Change (IPCC). It is also clear that climate change will accelerate under current and projected greenhouse gas emissions (Bauer et al., 2001; Adger et al., 2007; CCC, 2017). As the importance of adaptation has been emphasised through international agreements (Lesnikowski et al., 2017), the functions and roles of national-level adaptation actions also have been emphasised (see Section 2.3.3.). Also, a number of national adaptation policies and plans have been developed since 2007 (IPCC, 2014). Despite the substantial progress of national climate adaptation policy, issues related to the effectiveness of national adaptation policies have been raised, and the adaptation deficit is getting wider.

Barriers to adaptation are pointed out as one of the major reasons for the adaptation deficit (Simoes et al., 2017; Valente and Veloso-Gomes, 2020), but barriers to adaptation policy have been largely overlooked in national adaptation processes (Waters et al., 2014; Biesbroek et al., 2015). Most research on barriers to adaptation has focused on barriers to adaptation actions at the local or project level. Research on national climate adaptation policy has been mostly carried out in the field of implementation research, which has moved away from notions of barriers to climate change adaptation (Biesbroek et al., 2015). Yet, nations are experiencing a variety of barriers that significantly hinder the effectiveness and efficiency of their adaptation policies (Agrawala and Van Aalst, 2005; OECD, 2009; Bauer et al., 2011; Park, 2013; Biesbroek et al., 2014; IPCC, 2014; Mullan et al., 2013). Although many studies have been published on barriers, we don't really know what barriers to national climate adaptation policy exist, what the origins and influence of these barriers are, and how they can be overcome (Biesbroek et al., 2011; Eisenack et al., 2013; Waters et al., 2014). This is quite odd considering the

significant roles of national policy for adaptation and the number of resources and efforts put into it. Section 2.4.4. identified two critical research gaps. First, the number of research on barriers to national climate adaptation policy is too small compared to the research focusing on adaptation actions and barriers to them at the local or project level. Although there is some research on barriers to national climate adaptation policy, they are highly fragmented and difficult to produce general knowledge. Second, as previous research focused on only identifying the barriers and describing them, assuming that identifying the barriers will lead to devising solutions to overcoming the barrier, they have produced limited insights into what national-level stakeholders specifically can do to address the barriers.

In order to address these research gaps, this chapter reviews the barriers to national climate adaptation policy using a systematic literature review (SLR). It will scrutinise the characteristics of barriers in the published literature by categorising them and analysing their origins, impacts, and presented solutions for overcoming them. It also will clarify the key knowledge gaps in the literature and suggest future research priorities to help support national climate adaptation policy processes. The three main research questions this chapter seek to answer through the SLR are 1) what are the barriers to adaptation policy at the national level? 2) what are the characteristics of the barriers? 3) what are the limitations of previous research on barriers to national climate adaptation policy?

4.2. Methodology

4.2.1. Key terms

With the term “national climate adaptation policy”, it refers to a formal national policy for identifying medium- and long-term adaptation needs and developing and implementing strategies and programmes to address them (UNFCCC). It includes national adaptation policies labelled ‘national adaption policy’, ‘national adaptation plan’, ‘national adaptation strategy’, ‘national adaptation programme’, as well as ‘national adaptation programmes of action (NAPAs). A barrier to adaptation is an impediment to specified adaptations for specified actors in their given context that arises from a condition or a set of conditions (Eisenack et al., 2013). A barrier can be valued differently by different actors. In light of this definition, “a barrier to national climate adaptation policy” refers

to an impediment to national climate adaptation policy for a nation in the nation's specific context. A barrier to adaptation can be overcome with concrete efforts, creative management, new ways of thinking, prioritisation, and changes in resources, land uses, institutions, etc. (IPCC, 2007; 2014; Moser and Ekstrom, 2010; Dow et al., 2013; Biesbroek et al., 2013, Biesbroek, 2014). It is different from 'limits', which also hinder adaptation, but cannot be overcome (Adger et al., 2008; Clar et al., 2013).

4.2.2. Systematic literature review (SLR)

SLR is a valuable research methodology when some research has been conducted on an issue, but key questions remain unanswered, and an overall picture of the evidence in a topic area is needed to direct future research efforts (Petticrew and Roberts, 2006). SLRs are increasingly used in the field of climate change to synthesise and assess the status of knowledge on a given topic or research question (Berrang-Ford et al., 2011; Ford et al., 2011; Spires et al., 2014). Indeed, several SLRs focusing on climate change adaptation have been conducted (Berrang-Ford et al., 2011; 2015; Ford et al., 2011; Hofmann et al., 2011; Biesbroek et al., 2013; Philip et al., 2013; Lorenz et al., 2014; Porter et al., 2014; Spires et al., 2014; Sud et al., 2015; Sherman et al., 2016). However, to date, no SLR has focused on barriers to national climate adaptation policy. The methodology is also useful to find key answers to research gaps and research questions above. By systematically collecting and analysing research on barriers to national climate adaptation policy, it is possible to identify barriers to adaptation policy at the national level and their common characteristics so as to contribute to a knowledge base on the barriers. It can also help diagnose the limitations of current research and clarify future research directions so as to foster national climate adaptation policy processes. Thus, this chapter conduct an SLR following the seven stages of SLRs suggested by Petticrew and Roberts (2006): 1) define the question that the review is setting out to answer, 2) determine the types of studies that need to be located in order to answer the question, 3) carry out a comprehensive literature search to locate those studies, 4) Screen the results of that search based on the inclusion/exclusion criteria, 5) critically appraise the included studies, 6) synthesise the studies, 7) disseminate the findings of the review (see Petticrew and Roberts, 2006 p.27).

4.2.3. Document selection

This chapter used Scopus and Web of Science for searches, and the choice of search keyword combinations was based on an initial review of relevant literature[3]. The keywords and keyword combinations used in the searches were: [Barrier* OR Constraint* OR Obstacle* OR Limit*] AND [Climat* chang*] AND [Adapt*] AND [Nation*]. To include synonyms of barriers to adaptation, 'constraint', 'obstacle', and 'limit' were also used. Although the concept of 'limit' is different from 'barrier' as mentioned above, 'limit' was used as a keyword because some studies use the terms interchangeably. After searching, it excluded the literature which focuses on factors that cannot be overcome.

The terms 'barrier' and 'limit' were first used in Chapter 18 of the IPCC Working GroupⅡ contribution to the AR3, which reviewed research on climate change research published in the latter half of the 1990s (IPCC, 2001). Accordingly, it set the literature publication period from January 1995 until June 2018 (when this SLR is conducted) in order to cover all possible related studies since the terms were used. Also, it searched for peer-reviewed journal articles to review the literature, which is subjectively evaluated, although there are related reports and grey literature publications from such as OECD or UNFCCC. The other criteria used for the inclusion and exclusion of articles to the SLR are presented in Table 3.

The searches conducted in Scopus and Web of Science using the above keyword combinations yielded an initial list of 2,234 articles. The first screening applied the inclusion and exclusion criteria to the title, keywords, and abstract of the articles in the initial list, which reduced the number of articles to 195. The use of inclusion and exclusion criteria to the full text of these 195 articles, then left 18 articles to the sample.

[3] References in IPCC AR4 ch17, 18, 19, and AR5 ch14, 15, 16, 17
Results of searching 'Climate change' AND 'Adaptation' AND 'Systematic review' at Web of Science

Table 3 Criteria for inclusion and exclusion of articles

Criteria	Excluded	Included
Date of publication	Articles published prior to January 1995	Articles published between January 1995 – July 2018
Language of Publication	Articles that were published in language other than English	Articles published in English
Main theme of publication	Articles that did not give attention to barriers to climate adaptation, Articles that focused on general barriers to climate adaptation, or barriers at global level or sub-national levels (local, community, etc)	Articles that focused on barriers (limits, constraints, obstacles) to climate adaptation at national level
Availability of article	Articles that are not available in the Web of Science and Scopus	Articles that are available in the Web of Science and Scopus
Study subject	Articles that focused on barriers to adaptation measure or projects at global or sub-national level (main actor is not a nation or nations)	Articles that focused on barriers to a whole process of national climate adaptation policy (main actor is a nation or nations)
Type of article	Grey literature such as conference proceedings or reports of an institute	Only peer-reviewed and published articles

4.2.4. Analysis

Qualitative content analysis was performed on four aspects of the articles: 1) general information on the article, 2) the conceptualisation of the barriers to adaptation, 3) characteristics of the identified barriers, and; 4) solutions for overcoming the barriers (see Table 4). This chapter examined how the articles

conceptualise the barriers to adaptation by analysing the used terms and definitions in the articles. In order to see what barriers to national climate adaptation policy are, it collected every factor that is identified as a barrier in the final 18 articles. Based on the identified barriers to national climate adaptation policy and related content in the final articles, it also investigated the barrier types and their origins and impacts at the national level to see the characteristics of the barriers. Identified barriers were classified into eight categories. Biesbroek et al. (2011) suggested seven clusters [4] of social barriers, and it considered that the clusters can provide useful insights about categories of barriers to national climate adaptation policy, including various aspects such as political, social, and institutional issues. Based on the clusters and the final articles, it develops eight categories of barriers to adaptation at the national level: conflicting time scales and priorities; uncertainty; institutional crowding and voids; fragmentation; lack of awareness and communication; resource; lack of authorities of the main department; and others. ‘Conflicting timescales and priorities’ are mainly about the priority of adaptation issues in the wider national policy agenda. Because the main government department responsible for adaptation policy generally suffers from a lack of authority (Park, 2013), it added the category of ‘lack of authorities of the main department’. This chapter also removed the motive and willingness to act cluster from Biesbroek et al. (2011) because related issues and barriers are addressed in the ‘conflicting timescales and priorities’ in terms of national-level policy issues. It also created space for barriers that cannot be clearly classified with the ‘others’ category. ‘Origin’ refers to a factor described or explained as causing the identified barriers in the final articles. ‘Impact’ refers to a factor (a result) influenced by the identified barriers, which shows national climate adaptation policy problems caused by the barriers. In addition, To see solutions for addressing the barriers, it analysed the final articles with two questions: is there any solution that was used to address the barriers? If yes, what are the results of the solution?; what solutions are suggested to address the barriers?

[4] Conflicting timescales; Substantive, strategic and institutional uncertainty; Institutional crowdedness and institutional voids; Fragmentation; Lack of awareness and communication; Motives and willingness to act; Resource

Table 4 Analysis criteria

Category	Description
General information of the article	– Reference – Relevance of the article – Year of publication – Research site (Country / Countries) – The name of the national policy – General aims of the article – Sector
Conceptualisation of barriers to adaptation	– The term as a synonym of barrier – Definition of barrier to adaptation – Definition of limit to adaptation – Additional information related to the concept of barrier to adaptation
Characteristics of identified barriers (types, origins, influences)	– Large categories of identified barriers (Biophysical, Social, or Both) – Direct relevance to climate change (climate change adaptation) – Detailed categories of identified barriers (Conflicting timescales and priorities / Substantive, Strategic, and institutional uncertainty / Institutional crowdedness or institutional voids / Fragmentation / Lack of awareness and communication / Resources / Power of the main department / etc) – Policy phases (process) and barriers – Origin of the barrier – Influence of the barrier
Solutions to the barriers to adaptation	– Solutions that have been used – Results of the solutions – Suggested solutions – Additional information related to solutions to the barriers to adaptation
The detailed categories of barriers are developed based on Biesbroek et al. (2011)'s seven clusters of barriers to adaptation.	

All processes and decisions are summarised in Figure 2.

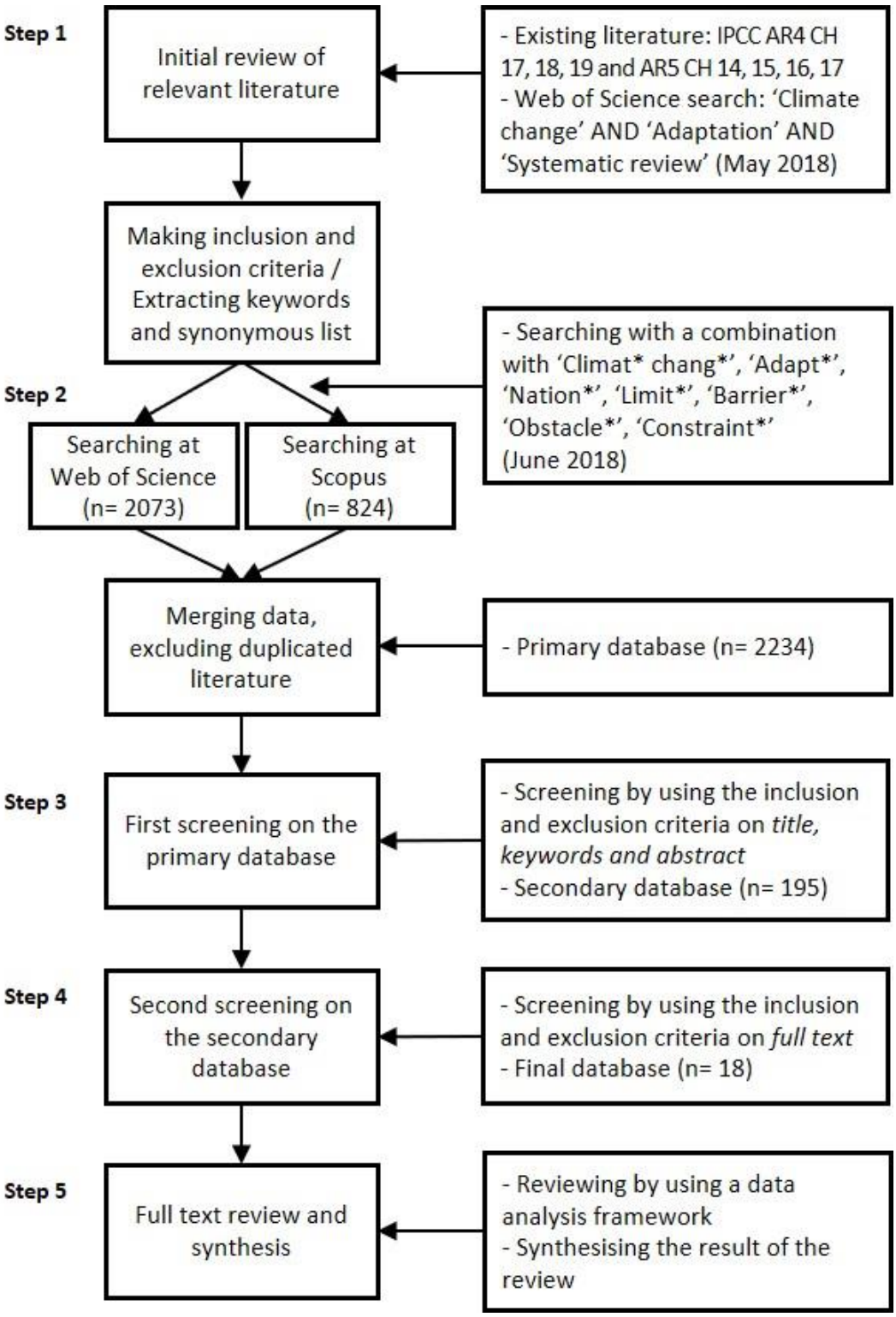

Figure 2 Systematic literature review process

4.3. Results

4.3.1. Background information of final data

An overwhelming majority of the articles (17 of 18) were published after 2010, and more than half of them (10 of 18) were published after 2015, indicating that research on barriers to national climate adaptation policy is of very recent vintage on the whole. All of the articles were inductive and qualitative case studies using policy documents, interviews and surveys as their primary data. A total of 11 articles analysed a single country case, the majority of them focusing on the Least Developed Countries (LDCs). The other seven articles focused on groups of countries such as those of the OECD, EU, LDC-SIDS, Central and Eastern Europe (CEE) and Commonwealth of Independent States (CIS), and Caribbean small island developing states. Most research focused on the Global North, and cases from the Global South are rarely mentioned. One-half of the articles examined barriers to comprehensive national climate adaptation policy, and the other half examined barriers to a specific sector of national climate adaptation policy (forest & ecosystem; land & coast; agriculture; industry; and water).

4.3.2. Concept of barriers to adaptation

The articles used a variety of terms to refer to a barrier to adaptation, including barrier, challenge, constraint, limit and problem. Some articles used the terms interchangeably, and three articles did not use any specific term. ‘Barrier’ was the most frequently used term, and the second most common term was 'challenge' (barrier: 8, challenge: 3, constraint: 3, limit: 1, problem: 1). Only two articles (Bauer et al., 2012; Kuruppu and Willie, 2015) explicitly defined a barrier to adaptation by referring to previous research, and only Bauer et al. (2012) explicitly distinguished between the terms “barrier” and “limit” to adaptation.

4.3.3. Characteristics of identified barriers

4.3.3.1. Type

Conflicting timescales and priorities

Eight articles identified a total of eleven barriers related to conflicting timescales and priorities. These barriers suggest that adaptation has a lower priority than other national policy issues in short-term policy cycles. For

example, economic development, poverty alleviation and the development of infrastructure can be more salient issues in the LDCs (Koch et al., 2007; Hickey and Weis, 2012; Hambira and Saarinen, 2015; Orru et al., 2018). Hickey and Weis (2012) suggest that investments in adaptation get trumped by the 'mountain' of other immediate social and economic priorities. Waters et al. (2014) and Vincent et al. (2017), in turn, highlight a mismatch between the time horizons of adaptation and the political and management practices of government departments as a barrier to national climate adaptation policy.

Uncertainty

Only two articles identified barriers related to uncertainty, specifically to uncertainties about the significance of environmental changes, policy change in the future, and their effects on society. Hambria and Saarinen (2015) refer to uncertainties of policymakers' perceptions and scales and Nalau et al. (2016) highlight uncertainties in the interaction between growing exposure and the means for climate change adaptation activities and agency practices.

Institutional crowding and voids

Nine articles brought up institutional crowding and voids as barriers. The articles suggest that lack of institutional capacity and weak institutions of a country are barriers to national climate adaptation policy. Examples include weak supporting legislation, absence of an integrated approach to adaptation and absence of clear rules and responsibilities for monitoring and evaluation (Massey et al., 2014; Waters et al., 2014; Nalau et al., 2016; Azhoni et al., 2017; Robinson, 2018; Pardoe et al., 2018; Orru et al., 2018; Ranabhat et al., 2018). Biesbroek et al. (2010) also suggest that unclear and overlapping responsibilities complicate the implementation of national adaptation policies. Only Nalau et al. (2016) observed that institutions for adaptation overlap with other policy responsibilities, which can complicate capacity building within Climate Change Adaptation and Disaster Risk Reduction sectors.

Fragmentation

Twelve articles identified fragmentation as a barrier in four different ways: 1) poor integration of adaptation policies across government departments (sectors); 2) poor integration of adaptation policies across jurisdictional levels; 3) poor integration of relevant knowledge; and 4) poor involvement of

stakeholders. Poor integration of adaptation policies across jurisdictional levels and poor involvement of stakeholders was highlighted most often. Kalame et al. (2011) suggest that although there are gaps between national level priorities and local or community priorities, national adaptation policies usually reflect only national level priorities. Bajec (2011) highlight in turn that local adaptation plans could not reflect national adaptation policies. Kuruppu and Willie (2015) call attention to limited engagement of communities and local authorities with national adaptation policies. In an analysis of EU member state policies, Biesbroek et al. (2010) found that most national adaptation policies focus on domestic issues and pay little attention to the role of the EU. Massey et al. (2014) consider the lack of transnational networks a barrier to national climate adaptation policy.

The articles also highlight that national climate adaptation policy processes often involve only a small number of stakeholders. Biesbroeck et al. (2010) and Kalame et al. (2011) found that only a small circle of experts and governmental and sectoral representatives are involved in the NAPA processes and the development of National Adaptation Strategies in EU countries. Kalame et al. (2011) found that the Ministry of Finance was not involved in the national climate adaptation policy process, while it has an important role in allocating budget to government departments: the lack of participation of such important actors in national climate adaptation policy may become a barrier. Lack of involvement of non-state actors is also commonly identified as a barrier to national climate adaptation policy (Koch et al., 2007; Bauer et al., 2012; Waters et al., 2014; Bizikova et al., 2015; Azhoni et al., 2017).

Lack of awareness and communication

Twelve articles identified two types of barriers related to lack of awareness and communication. First, lack of communication or information sharing between stakeholders is frequently observed, including limited communication or knowledge dissemination between experts and policymakers or among departments (Koch et al., 2007; Biesbroek et al., 2010; Kalame et al., 2011; Bizikova et al., 2015; Nalau et al., 2016; Ronabhat et al., 2018). Massey et al. (2014) consider that the language used in a national climate adaptation policy is sometimes a barrier. Second, low or no awareness among the public or politicians can be a barrier to national climate adaptation policy (Hickey and

Weis, 2012; Massey et al., 2014; Kuruppu and Willie, 2015; Robinson, 2018; Orru et al., 2018). Hambira and Saarinen (2015) suggest that there are denial and fatalism about climate change and that some actors believe that nature will manage itself at the end.

Resources

Almost all articles (16 of 18) identified resource barriers related to either information, finance or human resources. Lack of information about climate change and its effects was brought up in several articles (Hambira and Saarinen, 2015; Bizikova et al., 2015; Azhoni et al., 2017). Vincent et al. (2017) considered that existing information about future climate change is not appropriate for decision making, and Kuruppu and Willie (2015) and Robinson (2018) highlight the lack of baseline data and records as barriers to national climate adaptation policy processes. Lack of funding for national climate adaptation policy is an often-noted barrier (Kalame et al., 2011; Bajec, 2011; Massey et al., 2014; Robinson, 2018; Pardoe et al., 2018; Orru et al., 2018; Ranabhat et al., 2018). Kuruppu and Willie (2015) view that international funds for adaptation policy in LDCs are unpredictable and that the funds are often not appropriate for addressing the country's root vulnerabilities. Biesbroek et al. (2010) highlight that none of the national adaptation strategies of the EU member states considers how the implementation of the NAS should be financed. Lack of human resources (both qualitative and quantitative) was also frequently identified as a barrier (Koch et al., 2007; Massey et al., 2014; Robinson, 2018; Orru et al. 2018; Ranabhat et al., 2018). Koch et al. (2007) highlighted that staff turnover can be a critical barrier to national climate adaptation policy.

Lack of authorities of a main department

Three articles identified barriers related to the lack of authorities of the main department responsible for national climate adaptation policy. They can have little or no authority to ensure that adaptation policy is implemented as they do not have the means to force other agencies to focus or commit their resources on climate change adaptation (Koch et al., 2007; Orru et al., 2018). Azhoni et al. (2017) also indicate that giving additional responsibility without additional resources to organisations, such as Climate Change Cells of India, can render them ineffective.

Others

Additional barriers reported in the articles included a lack of high-level political commitment and national leadership (Bauer et al., 2012; Bizikova et al., 2015. Vincent et al., 2017). Dearth of multidisciplinary research on vulnerability was also considered a barrier in five articles (Biesbroek et al., 2010; Bajec, 2011; Hickey and Weis, 2012; Kuruppu and Willie, 2015; Orru et al., 2018). Kalame et al. (2011) and Massey et al. (2014) also consider that there is insufficient time to make adequate national climate adaptation policy.

4.3.3.2. Origin and impact of the barriers

This research analysed the interactions between barriers in the context of the articles, to better understand the characteristics of the barriers. There was some evidence of origins that cause barriers to adaptation, but none of the articles explicitly focused on them. Thirteen articles mentioned factors which create other barriers or aggravate them, although the causation was not considered in detail. Resource barriers (finance and human) are seen to cause barriers that hinder long-term policymaking and its implementation (Koch et al., 2007; Heckey and Weis, 2012; Bizikova et al., 2015; Azhoni et al., 2017; Orru et al., 2018). For example, an interviewee of Vincent et al. (2017)'s study said that "they do not have long-term plans based on long-term climate scenarios due to resource constraints." (Vincent et al., 2017 p.192). Lack of communication between stakeholders leads to a lack of participation of government departments and key stakeholders as well as to deficiency of information and knowledge (Koch et al., 2007; Bizikova et al., 2015; Azhoni et al., 2017). Kuruppu and Wille (2015) mentioned that "this (weak linkages and poor coordination between the tiers of government) gave rise to poor communication between communities and government, which often led to local or community needs being overlooked in adaptation efforts." (Kuruppu and Wille, 2015 p.77). Weak institutions, as well as uncertain methodology, for national climate change adaptation not only is the main reason for unclear roles and responsibilities of stakeholders, which results in weak participation, but it also makes it difficult to adopt an integrated approach for national climate adaptation policy (Kalame et al., 2010; Bajec, 2011; Azhoni et al., 2017). Koch et al. (2007) and Ranabhat et al. (2018) indicate that low priority of adaptation in a country gives rise to barriers that impede the establishment and implementation of a consistent and integrated policy. Culture of a country such as a lack of cooperative culture, a culture of dependency, or administrative culture can be reasons for horizontal and vertical fragmentation barriers

(Bizikova et al., 2015; Robinson, 2018;). For example, Orru et al. (2018) analysed as “The absence of an integrated approach to climate adaptation can be explained by the nature of the administrative culture of the institutions involved in the Estonian health system.” (Orru et al., 2018 p.7).

This chapter also examined the impact of barriers in the articles. Although causation was not given much attention, nine articles touched upon the consequences and impacts of the barriers. Unclear and overlapping (ambiguous) division of responsibilities was found to complicate roles and responsibilities of each sector or department in making and implementing adaptation policy (Biesbreok et al., 2010; Azhoni et al., 2017). Lack of coordination and lack of policy coherence between sectors (Pardoe et al., 2018) result in conflicts over resources and incentives between sectors or departments. Massey et al. (2014) and Orru et al. (2018) indicate that lack of political and public interest and awareness delays actions to make and implement adaptation policy and weaken motivation to act. Kuruppu and Willie (2015) note that financial barriers make developing countries more dependent on external funds and Nalau et al. (2016) suggest that greater external dependency makes policy progress slow, increases uncertainties for programmes and staff, and limits effective integration of adaptation policies. Koch et al. (2007) consider that staff turnover and low staff capacity increase the cost of education and training and Kuruppu and Willie (2015) view that cultural barriers create mistrust of climate information and low ownership of adaptation policy. Vincent et al. (2017) highlighted how short planning horizon and policy cycle results in difficulties for integrating adaptation policy with mid- and long-term climate projections. The relations between origins (or root barriers), barriers, and impacts above are presented in Figure 3.

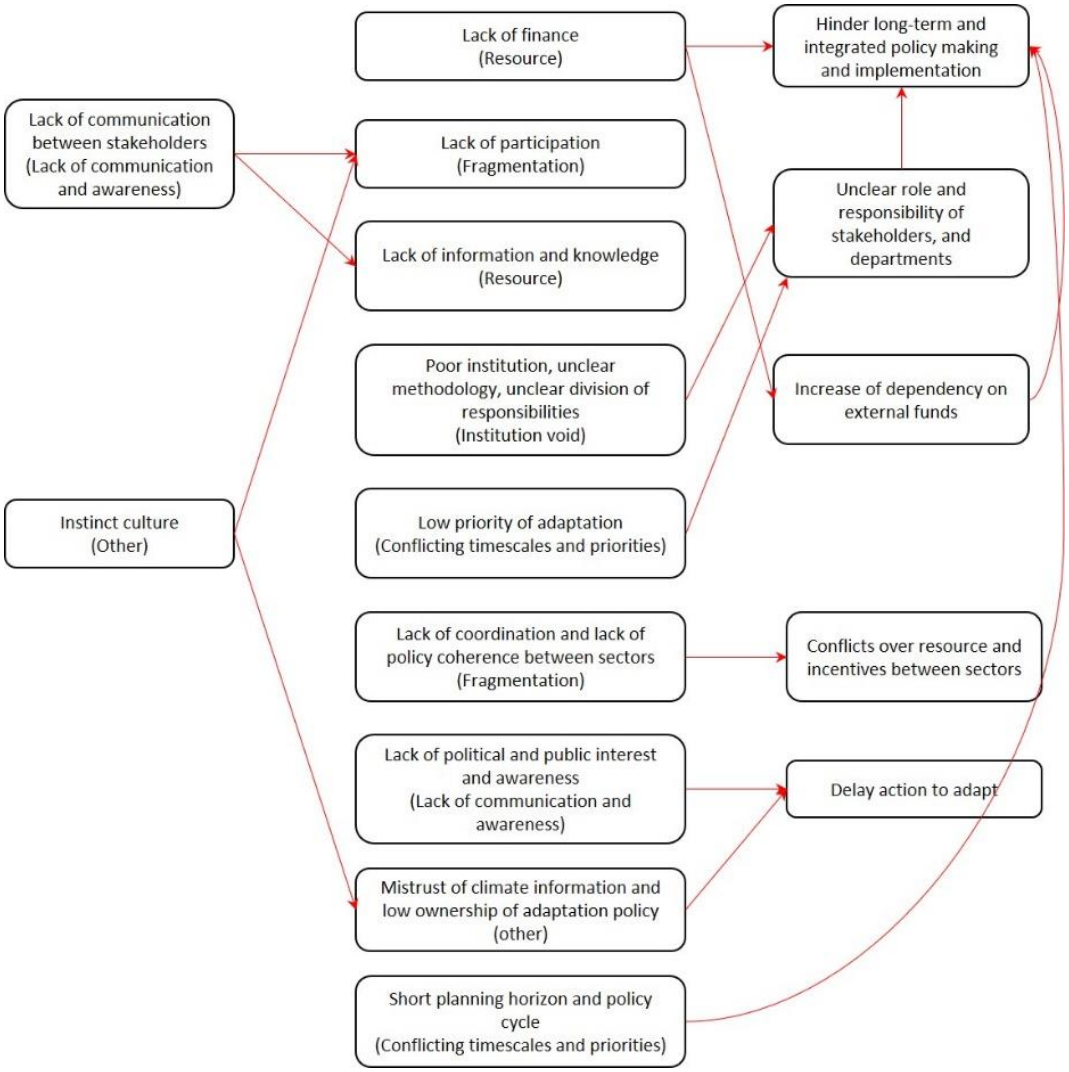

Figure 3 Relations between origins, barriers, and impacts

4.3.4. Solutions

4.3.4.1. Used solutions

There is little evidence in the articles about what nations have done to overcome the barriers they have encountered. Only Biesbroek et al. (2010) and Bauer et al. (2012) discuss solutions used to overcome barriers; they highlight the establishment of coordination bodies, temporary consultations and networks and partnerships to overcome fragmentation barriers in some countries (Bauer et al., 2012). To address communication barriers between scientists and policymakers, in particular, specialist organisations which can be described as ‘bridging’ or ‘boundary’ organisations have been established, and monitoring and evaluation schemes have been created (Biesbroek et al., 2010; Bauer et al., 2012). However, the two articles do not discuss whether these solutions were effective or not, nor on whether the nations overcame or could reduce the barriers.

4.3.4.2. Suggested solutions

Twelve of the eighteen articles suggested solutions for overcoming the barriers. Strengthening networks and coordination schemes are commonly suggested for overcoming poor integration and poor communication between stakeholders of national climate adaptation policy, both in the making and implementation of national climate adaptation policy (Koch et al., 2007; Bajec, 2011; Bizikova et al., 2015; Azhoni et al., 2017; Ranabhat et al., 2018). The establishment and roles of boundary organisations are also emphasised (Bajec, 2011; Vincent et al., 2017). Generating robust climate information and sharing it widely is also suggested as a solution (Hambira and Saarinen, 2015; Vincent et al., 2017; Azhoni et al., 2017). However, the suggested solutions are rather general and normative and little is said about how to deploy them, and there is no discussion of what outcomes they could produce.

4.4. Discussion

As adapting to climate change has become an urgent concern, barriers to adaptation have been given more attention. This SLR focused on the barriers to national climate adaptation policy in peer-reviewed journal articles published from January 1995 to July 2018, given that although the roles and function of national climate adaptation policy for overall adaptation, barriers to

national climate adaptation policy have been limitedly studied. After searching with keyword combinations and applying inclusion and exclusion criteria, the final data included 18 articles. This SLR scrutinised them to discern 1) what are the barriers to adaptation policy at the national level? 2) what are the characteristics of these barriers? 3) what are the limitations of current research on these barriers?

4.4.1. Background information on articles and concept of barrier

This SLR confirmed that research on barriers to national climate adaptation policy is much more limited than research on barriers to local or project level adaptation actions. Most studies on barriers to national climate adaptation policy have been published after 2015. In comparison, a large number of studies on barriers to adaptation actions have been published since the early 2000s. This is striking considering how significant the role of national policy for adaptation is considered to be (Adger et al., 2009; OECD, 2009; Biesbroek et al., 2010; Storbjork and Hedren, 2011; Eisenack et al., 2014; IPCC, 2014; Waters et al., 2014; Mullan et al., 2013). Also, most reviewed articles focus on national climate adaptation policy in the LDCs: there is surprisingly little evidence on barriers to national climate adaptation policy in developed countries and how they can be overcome. For example, barriers that Annex 1 countries have experienced are not discussed in their Seventh national communications (NC7s), whereas Non-Annex 1 countries report on the barriers they have encountered in their NCs. Developed countries may be aware of or consider barriers to their adaptation policy, but it is difficult to find an official effort to analyse and address them. This may reflect an assumption that lower vulnerability and greater adaptive capacity in developed countries make barriers less significant (O'Brien, K. et al., 2006; Moser and Ekstrom, 2010). However, in reality, most countries experience comparable barriers which hinder effective national-level adaptation and more research on them is needed.

This SLR also verified that there is still no consensus over the definition of the barriers to adaptation (Biesbroek et al., 2013; Eisenack et al., 2014). The reviewed articles use several synonyms of barriers to explain the same factor that impedes adaptation processes, and even IPCC AR4 and AR5 used different terms to refer to the same notion. However, clear and explicit definitions of key terms are needed to ensure a consistent approach and a

common understanding of barriers to adaptation. They will also play an essential role in understanding adaptation policy processes (Biesbroek et al., 2013) and implementing adaptation policy.

Most barriers mentioned in the eighteen articles are social barriers caused in the context or circumstances of adaptation policy (Adger et al., 2007; Barnett, 2010; Biesbroek, 2014). This SLR could thus affirm that most barriers to national climate adaptation policy we experience are related to social factors, not to physical aspects of climate change (Moser and Ekstrom, 2010; Biesbroek et al., 2013; Eisenack et al., 2014). This chapter suggested that barriers to adaptation at the national level fall into eight categories, drawing from the clusters suggested by Biesbroek et al. (2011).

4.4.2. Analysed data

4.4.2.1. What do we know?

This SLR generated important answers to the research questions it posed. First, the articles report on similar barriers to the national climate adaptation policy, most often on resource barriers (16 of 18), fragmentation barriers (12 of 18), and barriers related to lack of awareness and communication (12 of 18). Our results confirm that financial barriers are the most common form of resource barriers, frequently reported in the literature since the early 2000s (Adger et al., 2007, IPCC, 2007; 2014; Moser and Ekstrom, 2010; Australian Government, 2011; Biesborek, 2014; Waters et al., 2014). The articles highlight the lack of a specific fund for a national climate adaptation policy is highlighted. Biesbroek et al. (2010) suggested that institutionalised financial support is required for a consistent national climate adaptation policy, and nations need to consider how their national climate adaptation policy is financed from early on. Although this result arises from a small sample, it is significant as it is established by a robust SLR methodology and as the most common and highest priority barrier at the national level.

Secondly, our SLR uncovered interactions between the identified barriers by analysing the contexts of the articles, which has not been done in existing literature before. For example, informational barriers have several important sub-types and links to other barriers. The currently dominant form of climate information (climate projections) is not appropriate for decision-making

(information resource), which leads to communication gaps between stakeholders (lack of awareness and communication). The lack of communication between stakeholders, especially between information producers and users, results in information that is not practically useful for policymaking, and it is also associated with the poor integration of relevant knowledge from diverse stakeholders (fragmentation). The barriers related to poor integration of vertical and horizontal stakeholders (fragmentation) are linked to several other barriers, such as weak institutions for adaptation policy (institutional voids) and conflicts between different priorities of different stakeholders (conflicting timescales and priorities). Low or lacking awareness among the public and politicians (lack of awareness and communication) is in turn associated with a lack of high-level political commitment (others) and poor involvement of a broad range of stakeholders (fragmentation). Previous studies have stressed that barriers need to be addressed simultaneously (Spires and Shackletoon, 2018), without evidencing this claim. However, our SLR can evidence the interactions between barriers and thus provide the evidence base in support of simultaneous addressing of barriers. Figure 4 highlights that solutions addressing national-level fragmentation barriers have to consider the barriers of lack of awareness and communication at the same time.

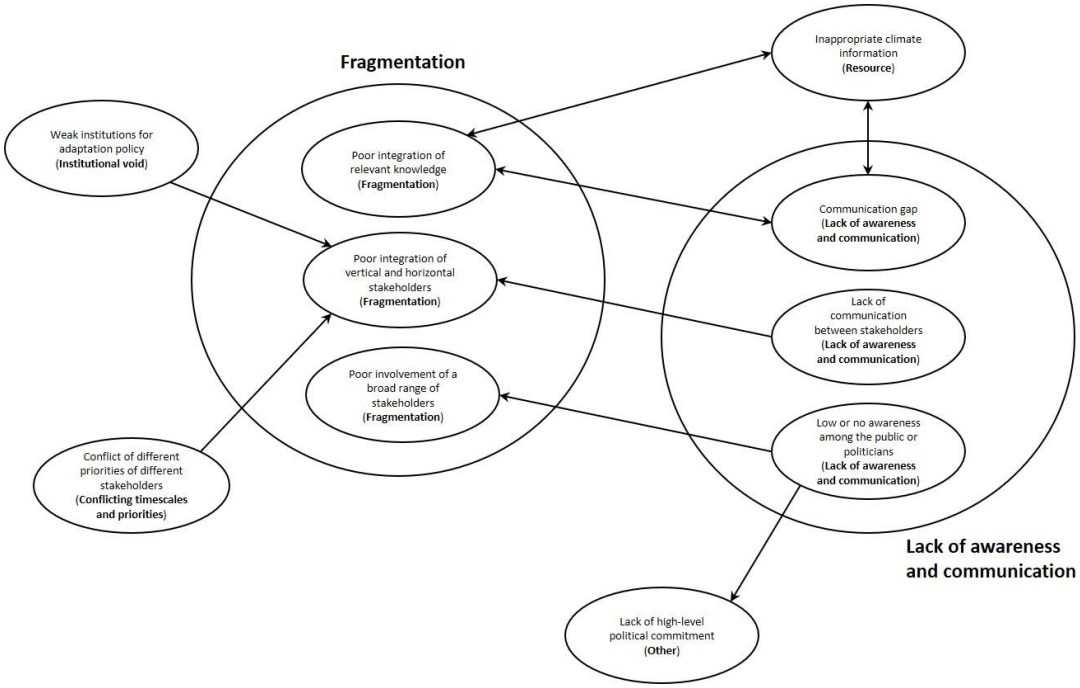

Figure 4 Interactions between barriers

Third, this SLR provided preliminary insights into the origins and impacts of the barriers to national climate adaptation policy. First, this chapter identified several root barriers that create or aggravate other barriers: these include resource barriers, lack of communication between stakeholders, weak institutions of national climate adaptation policy, low priority of adaptation in a country, and intrinsic culture of a country. Secondly, it identified the impacts of barriers to national climate adaptation policy. For example, barriers make the roles and responsibilities of sectors/departments complicated, cause conflicts over resources and impair coherence between sectors/departments, delay actions to make and implement adaptation policies, increase uncertainties to do with related programmes and staff, and weaken the integration and cooperation of adaptation policies. This does not mean that this article shows all origins and impacts of identified barriers to national climate adaptation policy, and the causation between them is still unclear. However, this approach could be a milestone to address the points discussed in the next section.

4.4.2.2. What do we not know?

Although this SLR could generate answers, many important questions remain unanswered. This chapter could determine the most frequent (or common) barriers to the national climate adaptation policy reported in the eighteen articles and identified financial barriers as a key. However, it remains an open question of what are the most common and significant barriers to national climate adaptation policy in practice, outside of our relatively small sample of articles. The amount of literature on barriers to national climate adaptation policy is still very limited, and the existing studies are very context-specific (Biesborek et al., 2011; 2013; Eisenack et al., 2014; Prabhakar et al., 2014). Moreover, most of them focus on developing countries. We still do not have enough evidence on barriers to adaptation in developed countries and mid-income countries. In addition, differences between barriers to local-level adaptation and barriers to national-level adaptation remain unanswered. Although a number of studies have been conducted on local-level adaptation, there is no SLR on barriers to local-level adaptation yet. Thus, a comparison of the barriers at the two levels is not yet possible.

Secondly, the causation between origins, barriers, and impacts at the national level remains unclear. The reviewed articles are rather descriptive and do not

explain the occurrence of barriers (Eisenack et al., 2014). They do not provide sufficient account of the underlying causes giving rise to the barriers, the relationships between them, and their consequences. That is, why barriers occur, how they influence national climate adaptation policy and how the barriers can be overcome remain unanswered questions (Biesbroek et al., 2011; Eisenack et al., 2013; Waters et al., 2014).

There are also notable limitations in the existing literature. The articles did not go beyond identifying the barriers. They gave limited attention to solutions for overcoming barriers and offered suggestions for solutions that are too general and normative to be useful. A few articles touched upon solutions such as establishing boundary organisations but did not provide evidence on their effectiveness or functioning. In other words, there is little evidence and guidance in the literature that practitioners and policy-maker could put to use in real-world adaptation policymaking and implementation. Moreover, none of the articles analyses how the identified barriers are dealt with by stakeholders and how they are changed in adaptation processes, after identifying them.

4.4.3. Research agenda

To solve the unanswered questions, a shift is needed in research focus from identifying barriers to understanding the circumstances where they occur and how they can be effectively addressed and overcome (Waters et al., 2014). This chapter identifies four key areas of future research in light of our systematic review. First, we need more case studies on national climate adaptation policy and barriers to it, in both developed and developing countries, to generate more robust evidence about what are the most common and significant barriers to national climate adaptation policy. Second, there is a need for research on the complex underlying web of reasons for the emergence and existence of barriers (Agrawala, 2005) which should analyse causation between origins, barriers, and impacts. This will be challenging because it is hard to uncover causation, and there are complex relationships between barriers and varied social factors. However, we need evidence of causation to map the origins, barriers, and impacts to obtain a deeper understanding of the barriers and to identify solutions for overcoming them. Third, there is a need for research tracking barriers in the whole process of national climate adaptation policymaking to identify how they occur, what impact they have and how, and how they change. This would help manage

identified barriers in real adaptation processes. Fourth, there is a need for research on what solutions are effective for overcoming or reducing barriers in real adaptation policy processes. Generation of evidence on practical solutions would not only deepen understanding of barriers but also play an important role in fostering the development of solutions.

National adaptation policies and plans have advanced substantially after IPCC AR4 (IPCC, 2014), but nations are struggling with similar barriers to their adaptation policy (Thomas and Twyman, 2005). Given the key roles of national governments in adaptation from steering society towards long-term outcomes to coordinating adaptation actions, sharing information, and supporting other levels' adaptation policy (Adger et al., 2009; OECD, 2009; Storbjork and Hedren, 2011; Mullan et al., 2013; Berrang-Ford et al., 2014; IPCC, 2014), paying more attention to barriers to national climate adaptation policy is essential.

4.5. Conclusion

As the effects of climate change become serious, the demand for adaptation has increased, and many countries progress concrete efforts for adaptation through their national adaptation policy or programme. However, the adaptation deficit is explicitly observable and getting wider, which is regarded as a wicked problem. Barriers to adaptation are pointed out as one of the major reasons for the adaptation deficit.

This systematic review uncovered critical limitations in the existing literature on barriers to national climate adaptation policy. First, the volume of research is very small, particularly considering the rapid progress with national adaptation policies and plans since IPCC AR4 (IPCC, 2014) and their recognised importance (Storbjork and Hedren, 2011; Mullan et al., 2013; Berrang-Ford et al., 2014). Because of the small volume of research, this chapter could not extract robust evidence of the barriers to national adaptation policies. Second, the literature does not go beyond identifying barriers to provide explanations for the origin and impacts of the barriers. There is a lack of progress in understanding the barriers, interrelations between origins, barriers and impacts as well as between barriers. Long lists of context-specific barriers have now been made for two decades. Third, the solutions presented

in the literature for overcoming barriers are not sufficiently grounded on evidence to be of use for guiding real adaptation policy processes.

This chapter concludes by outlining key future research needs. First, there is a need for more research on barriers to national climate adaptation policy that acknowledges their differing importance and priority for actors at different levels of governance and for different sectors, to identify the most common and significant barriers so as to address them more systematically. Second, explanatory research is needed on the barriers to mapping their origins, links and impacts, as well as how they change over the course of policymaking and implementation processes. Third, there is a need for in-depth research on solutions for overcoming barriers as well as evaluating their effectiveness.

Chapter 5
Deeper Understanding of the Barriers to National Climate Adaptation Policy Processes: The case of South Korea

Chapter 5
Deeper Understanding of the Barriers to National Climate Adaptation Policy Processes: The case of South Korea

5.1. Introduction

Climate change adaptation has become essential for the sustainable development of nations. Given the inevitable climate change impacts on ecosystems and economies caused by the already emitted greenhouse gases, the importance of adaptation is widely acknowledged (Adger et al., 2009a; IPCC, 2012, 2014; CCC, 2017). Nations are under international and domestic requirements to adapt to climate change, and the national government's roles in adaptation are stressed (Mullan et al., 2013; Biesbroek et al., 2013; Berrang-Ford et al., 2014; Eisenack et al., 2014; IPCC, 2014; Henstra, 2017). Since the Intergovernmental Panel on Climate Change (IPCC)'s fourth assessment report in 2007 (AR4), many countries have adopted and implemented official national adaptation policies that include national adaptation strategies and sectoral adaptation actions (IPCC, 2014). Examples include the National Adaptation Programme of the UK (2013, 2018), Deutsche Anpassungsstrategie an den Klimawandel of Germany (2008), Danish Strategy for Adaptation to a Climate Change of Denmark (2008), National Climate Resilience and Adaptation Strategy of Australia (2015), Wise Adaptation to Climate Change of Japan (2008), and China's National Strategy for Climate Change Adaptation (2016). However, despite the efforts, an 'adaptation deficit' persists and is getting wider: adaptation needs are not met by adaptation practices and policies (Burton, 2009; Eisenack et al., 2014; McClure and Baker, 2018; UNEP, 2018). Also, this situation includes all common features of wicked problems (see Section 2.5.1.).

Barriers to adaptation are considered a major reason for the adaptation deficit (Simoes et al., 2017; Clissold et al., 2020), and identifying and overcoming them is urgently required to reduce the adaptation deficit and enhance adaptative capacity (Eisenack et al., 2014; Simoes et al., 2017; Bednar et al., 2019; Clissold et al., 2020 Liu et al., 2020). Barriers are factors that impede adaptation processes, and they can be overcome with concerted effort, creative management, change of thinking, prioritisation, or change in resources, land uses, institutions and so forth. (Moser and Ekstrom 2010;

Biesbroek et al., 2011, Eisenack et al., 2014). Earlier studies have identified barriers to adaptation and classified them into various categories (Agrawala and van Aalst, 2005; IPCC, 2007; 2014; Adger et al., 2009a, 2009b; Berrang-Ford et al., 2011; Biesbroek et al., 2011; Wise et al., 2014; McNamara et al., 2017; Hurilimann et al., 2018), which offer a broad conceptual and empirical base of the barriers (Eisenack et al., 2014). However, previous studies' critical limitations have been repeatedly emphasised (see Section 2.4.4.). A shift in research that can provide a better understanding of barriers has been required (Burch, 2010; Eiesnack et al., 2014; Waters et al., 2014; Clissold et al., 2020). A better understanding should involve the explanations of barriers' origins, influences, and dynamics, which can produce practical insights into overcoming the barriers in actual adaptation processes.

This chapter aims to meet the demand for the research shift and provide a deeper understanding of barriers to adaptation through analysing barriers to national climate adaptation policy processes, including their origins, influences, and relationships between them. It also suggests a potential approach to address the barriers for policy-makers and policy practitioners. The questions guiding this chapter are: 1) what are the barriers to national climate adaptation policy and their origins and influences? 2) how do the barriers, origins and influences interact? 3) what can policy-makers and stakeholders do to address the barriers?

5.2. Case context

This chapter examines the national climate adaptation policy in the Republic of Korea (Korea). Based on an analysis of official documents related to the national climate adaptation policy from the Korean government and official supporting organisations (Appendix D) and climate change projection reports, the context of Korea's national climate adaptation policy can be briefly described below.

Climate change projections suggest that the mean temperature in the Korean peninsula will grow 1.3 times more than the projected global and East Asian mean annual temperatures by the end 21st century (KMA, 2017). To respond to the projections, the Korean government has implemented the National Climate Change Adaptation Plan (NCCAP) since 2011, under the Framework

Act on Low Carbon, Green Growth (2010) (the first 2011-2015 and the second 2016-2020). The Ministry of Environment (MoE) leads the policy process, and NCCAP involves a range of government departments and sectors; a total of 14 departments in the first plan and 20 departments in the second one (Korea Government, 2010, 2015). NCCAP involves only central government departments and their actions. Policy evaluation also focuses on government department tasks and projects. In 2017, the Korean government carried out an intermediate evaluation of the second NCCAP focused on the relevant departments' 285 tasks and 100 key projects and their implementation results: the results suggested that 96% of the tasks are implemented normally, and 4% of tasks are delayed or not implemented in terms of the criteria of implementation and goal achievement efforts (Sin et al., 2017).

The Korean government conducted climate change risk assessments in 2014 and 2019. The 2019 risk assessment identified 93 risks in eight sectors that the NACCAP needs to address. These include, for example, the increased drying up of streams due to droughts (water sector), decrease of manufacturing productivity due to heat waves, cold snaps and heavy rainfall events (industry and energy sector), increase in flooding in coastal areas due to heavy rain, tidal surges and sea-level rise (ocean, fishery and coastal sectors) and increase in mental health problems due to heat waves (health sector) (Song et al., 2019).

Korea Adaptation Centre for Climate Change (KACCC), an affiliated institute of MoE, provides services to the central government through formulating and implementing NCCAPs, evaluating the impacts of climate change and vulnerability, and developing and disseminating adaptation programmes and information.

Although NCCAPs have substantial experience from ten years of policy implementation, problems have been identified, and questions about the effectiveness of adaptation policies have been raised (Chae et al., 2014; Jang et al., 2019).

5.3. Methodology

5.3.1. Key terms

In order to overcome previous studies' limitations mentioned above and make this research more explanatory, it introduces new concepts hitherto missing from previous studies (Moser and Ekstrom, 2010; Dupuis and Knoepfel, 2013; Biesbroek 2014; Eisenack et al., 2014; Fayazi et al., 2020; Fatorić and Biesbroek, 2020). 'Barrier to adaptation' as a term refers to every factor that hinders national climate adaptation policy processes, which interviewees experienced or are experiencing in their work, which can be overcome with concreted effort, creative management, change in thinking, prioritisation, and related shifts in resource, land uses, institutions, etc. To highlight how barriers to adaptation occur, factors that give rise to the barriers are defined as 'origin'. To analyse how barriers affect adaptation processes, factors affected by the barriers are defined as 'influence', which refer to national climate adaptation policy problems caused by the barriers. 'Relationships' refer to connections between factors, indicating that a factor contributes to the occurrence of another: they include all relationships between barriers, origins, and influences.

5.3.2. Data collection

A case study is considered to investigate a contemporary phenomenon in depth and within its real-world context, focusing on answering how and why questions (Yin, 2003;2018; Baxter and Jack, 2008). Barriers to adaptation can be identified through the experiences of actors who participate in the adaptation process, and most barriers are related to the actors themselves (Eisenack et al., 2014). To identify barriers to adaptation, the interview method with key informants or stakeholders was broadly used across case scales, backgrounds, levels, etc. (Biesbroek et al., 2011; Jones and Boyd, 2011; Measham et al., 2011; Barnett et al., 2013; Azhoni et al., 2017; Wellstead et al., 2018). This research considered that conducting semi-structured interviews with core stakeholders of NCCAPs of Korea and qualitative content analysis of the interview results is the best method for the research purpose.

Interviewees were selected based on the list of participants of the first and second NCCAP, which includes four key stakeholder groups: (A) civil servants of the managing department (MoE); (B) civil servants of other government

departments; (C) experts of an official supporting institute (KACCC), and (D) experts of each sector or department. Also, (E) experts of local adaptation policy were interviewed for additional information. Potential interviewees were contacted and informed about interview details and personal information protection through emails and phone calls.

In total, 23 interviews with the core stakeholders of the NCCAPs were conducted. Interviews were conducted from 10th April to 19th July 2019 in Korea. Nineteen interviews were conducted through a face-to-face interview, and four interviews were conducted through a paper interview. Group D had the largest number of participants, and group B had the least (A=5, B=2, C=3, D=10, E=3). To anonymise interviewees and protect their personal information, they were codified based on their group and order of interviews. For example, a civil servant of the managing department (A) who was interviewed first is A1.

Based on the key terms, the main interview questions were drawn in three themes: 1) based on your experience, what were the barriers to national climate adaptation policy (barrier to adaptation)? 2) what problems were caused or what problems did you experience because of the barriers (influence)? 3) what do you think the reason for the barriers (origin)? Also, questions about used/suggested solutions for the barriers were made to understand the limitations of existing solutions and to analyse what stakeholders can do to address the barriers. The detailed Interview protocol is presented in appendix B. All answers from interviewees were recorded and transcribed. All interviews were conducted in Korean, and key answers were translated into English.

5.3.3. Analysis

The analysis method, codifying barriers based on factors that interviewees mentioned as barriers, was practically used in previous studies identifying barriers to adaptation through interviews with key informants or stakeholders (Barnett et al., 2013; Ekstrom and Moser, 2014). Ishtiaque et al. (2021) try to codify reasons for why the barriers occur as well as codify barriers to adaptation based on transcribed interview results.

This research identifies barriers to Korea's national climate adaptation policy based on the transcribed materials from the interviews. Every factor that the interviewees mentioned as a barrier to national climate adaptation policy is codified as a barrier. The codified barriers are classified into eight categories 1) conflicting timescales and priorities, 2) uncertainty, 3) institutional crowding and voids, 4) fragmentation, 5) lack of awareness and communication, 6) resources, 7) lack of authorities of a main department, and 8) other following Chapter 4, which suggests categories covering the characteristics of national-level policies as well as related problems through reviewing previous studies. This chapter considers that the categories are proper to address barriers to national climate adaptation policy in Korea. Next, this research concretely analyses each barrier's origins and influences based on interviewees' responses to main questions 2 and 3. For example, there is a response "this problem is caused because we do not have explicit indicators that show the effectiveness of adaptation policy, … It also means that we do not have clear directions of national climate adaptation policy" associated with an absence of effective monitoring and evaluation system. Then, an absence of explicit indicators for the effectiveness of adaptation policy is analysed as an origin of the barrier, and the unclear direction of national climate adaptation policy is an influence of the barrier.

Some recent studies have tried to analyse and explain the interrelationships between barriers to adaptation and between the barriers and related factors. Fayazi et al. (2020) develop the Model of progression of barriers to climate change adaptation to elucidate the process of barriers creation and their outcomes, based on a basic concept of the Pressure and Release model explaining that root causes lead societies to dynamic pressure that eventually materialise in unsafe conditions that put people and assets at risk. Mercado et al. (2020) use the Interpretive Structural Modelling (ISM) method that analysed the interrelationship of unclear and poorly articulated variables that define a problem or issue. Through a literature review, they identify the barriers to adaptation in Metro Manila, and interrelationships between the identified barriers are illustrated with the ISM model. Fatorić and Biesbroek (2020) analyse relationships or interdependencies among identified barriers by analysing the frequency of the relationship between two barriers and the direction of the relationship (i.e. negative influence) based on responses from semi-structured interviews.

This research elaborates on relationships between barriers and relationships between origins, barriers and influences by analysing responses about the relationship between factors (origin, barrier, influence) in transcribed interview results, as Fatorić and Biesbroek (2020) conducted. In order to map the relationships between factors, this research puts identified barriers in the middle first, then puts each barrier's origins and influences on the left and right side of the barrier, respectively. Then it draws connections between factors, and the direction of the relationships, with arrows. According to the analysed responses, some factors give and take multiple arrows with multiple factors across origins, barriers, and influences. Based on interviews in Korea, this chapter can map the relationships between barriers, origins and influences as well as between barriers with arrows, to arrive at a 'barrier map' of the NCCAP process that presents all of the relationships at once. Based on the mapped relationships, it explains what factors are related to the occurrence of a barrier, how the barriers influence adaptation policy, and how the barriers interact in a figure. It also identifies key barriers by analysing the number of sources, influences and interactions the barriers have. The key barriers have more than the average number of arrows coming in and out; they thus play a more significant role than the other barriers.

To come up with potential ways to address the barriers, first, this chapter identifies solutions that have been used for the barriers by the stakeholders and analyse the limitations of the used solutions. Secondly, it analyses the solutions that the interviewees suggested. Lots of solutions and approaches were suggested to address the barriers and adaptation policy problems, and it merges similar solutions and classify them into nine categories according to the solutions' purpose.

5.4. Results

5.4.1. Barriers to national climate adaptation policy

Conflicting timescale and priority

The low priority of adaptation, especially in government departments, is identified as a barrier to national climate adaptation policy. Politicians and high-ranking decision-makers have to demonstrate achievements within their four- or five-year term. They consider adaptation issues cannot generate tangible results within this timeframe. This leads to governmental indifference

towards adaptation and a low priority of adaptation among other national issues. D1 pointed out that governmental departments, even MoE, cannot give adaptation a high priority, because they cannot expect quick and tangible results from adaptation policies. C2 pointed that “civil servants think adaptation issues are the future things, not the current things which are pressing”. This low priority of adaptation undermines longer-term policies and securing resources for implementing adaptation policies. Interviewees considered that the origin of this barrier lies in the absence of explicit long-term directions of NCCAP and unclear achievements of adaptation policy.

Uncertainty

The uncertainty of outcomes of adaptation policy was identified as a barrier. Interviews indicate that this uncertainty leads to conservative responses by government departments. Because outcomes are uncertain, civil servants cannot attempt progressive or transformative policies with limited resources. D2 highlighted that it is hard for the departments to invest for 10 or 20 years for uncertain results of adaptation. Yet, the interviewees recognised that climate change projections cannot be perfect and that they need to make decisions on adaptation policies under uncertainty.

Institutional crowding and voids

Two key institutional barriers were identified: 1) the absence of effective monitoring & evaluation (M&E) system, 2) the lack of detail in the current Act. Half of the interviewees indicated that NCCAP does not have a formal system for M&E. They viewed that the current informal M&E system cannot establish the effectiveness of national adaptation policies. The M&E, focusing on individual projects, evaluates whether the projects are executed and if their budgets are used well, rather than establishing their contribution to adaptation. The evaluation is also conducted by government departments themselves. Interviewees highlighted that the current M&E system cannot establish the outcomes related to adaptation (C2, C3, E2), that it is impossible to conduct a comprehensive evaluation of the national climate adaptation policy (D2), that characteristics of regions or projects are not considered (D5), and those feedbacks from the system are pointless for next processes (D5, D9). C2 also pointed out that “this problem is caused because we do not have explicit indicators that show the effectiveness of adaptation policy, … It also means

that we do not have clear directions of national climate adaptation policy". D7 warned this problem would continue if the same M&E solution is retained.

A lack of detail about adaptation in the current Act is also considered a barrier. The Framework Act on Low Carbon, Green Growth has 64 Articles and focuses on the mitigation of greenhouse gas emissions. Only Article 48 of the Act and Article 38 of the Enforcement Decree provide a legal basis for the national climate adaptation policy. Interviewees viewed that the Articles are insufficient to support adaptation policy because they do not provide for formal procedures, e.g. there is no provision for risk assessments or M&E systems (D4). The hierarchical nature of the policy also causes conflicts with and overlaps with other policies, e.g. with mitigation policies. The Act does not specify the policy's form, range, and linkages with other adaptation policy levels which leads to inconsistencies between them. A4, A5, D8, D10 all suggested that the current Act does not provide for sufficient authority and resources for the MoE to operate a national-level policy, limiting its power.

Fragmentation

Both horizontal (between government departments) and vertical (between the central government and sub-national stakeholders) fragmentation barriers were identified. Interviewees from MoE and KACCC, in particular, had experienced the unwillingness of other departments to cooperate. From the early stages of the policy process, other departments participated inactively, and some even declined to participate, suggesting that they do not need adaptation policy. Although there is a cross-departmental consultative group consisting of high-ranking civil servants of participating departments, it has not functioned in the past decade. Interviewees described this as 'indifference of other governmental departments' which originated from a lack of understanding of adaptation. E1 mentioned that many departments consider that adaptation is not directly related to their agenda. D1 gave an example of policies for heatwaves in Korea:

Various departments make their policy to respond to heatwaves, but they don't think the policy is a kind of adaptation policy and don't want to implement it with other departments concerning losing their authority. … In a national view, heatwave policies do not have consistent directions, and it causes overlaps of similar policies and waste of resources.

Vertical fragmentation barriers are about cooperation between the national climate adaptation policy and local adaptation policies. In Korea, every local government and lower-level local government has to establish their adaptation policy, but the national-level adaptation and local-level adaptations are seldom linked, and policies are separately implemented. Interviewees said that the national climate adaptation policy did not consider local governments' roles and authorities, and there was no discussion on how to link various levels of policy from the outset. There is no linkage between climate change risk assessments at different levels either. Interviewees criticised that the current national policy and risk assessment do not capture the reality on the ground nor suggest common goals that all stakeholders would pursue, because of the vertical fragmentation (B1, C3, D8, E2). Furthermore, NCCAP does not involve private sectors and civil society organisations.

The interviews indicate that this vertical fragmentation barrier is caused by a perception gap between central government civil servants and sub-national stakeholders. In the interviews, central government civil servants recognise that the national climate adaptation policy is only about central government departments' goals and actions. In contrast, other stakeholders (experts, local government civil servants, private sectors) perceive that the national-level policy should address adaptation comprehensively at all levels. Because NCCAP is made up of a small number of central government civil servants and experts, their perceptions inform the national climate adaptation policy.

Lack of awareness and communication

Barriers related to lack of awareness and communication are most frequently mentioned by interviewees. These barriers are of three subtypes: 1) the lack of understanding; 2) the lack of awareness and; 3) the absence of a comprehensive and continuous communication system. Interviewees suggested that a lack of understanding of adaptation by stakeholders, especially government departments, is a significant barrier, which affects horizontal fragmentation barriers. They said that although NCCAP has been implemented for a decade, the participating departments still question what they can do for adaptation and whether adaptation needs specific, dedicated policies. Government departments find it difficult to link adaptation and their core agenda (B1). Even MoE civil servants talked about the difficulty of understanding the concept of adaptation. For example, A5 said that "the range

of climate change impacts is too broad, and many departments are involved … the concept of adaptation is difficult and complex compared to the concept of mitigation". It is still hard to distinguish adaptation policy from existing policies, especially disaster risk reduction policy, and to explain to other departments how adaptation is deeply related to their work (A2, A4). C1 thought that "civil servants have an awareness of adaptation, and they know we need adaptation policies. However, they hardly understand what adaptation is and what we can do now". Moreover, interviewees suggested that unclear definition and different interpretation of key adaptation terms makes them hard to understand. This lack of understanding leads to the result that the current national climate adaptation policy mainly consists of policies which are government departments want to do, rather than considering effectiveness for adaptation.

A lack of awareness of adaptation by the public also hinders national climate adaptation policy. The public does not link climate change issues that they are experiencing and the concept of adaptation. D2 said "the public feels inconvenience caused by climate events such as heatwaves, and they think something should be changed. However, this thought is not linked with adaptation policy". D7 considered that people usually think about mitigation when they face climate change issues; adaptation is not widely known among people. Interviewees identified two key origins of this barrier: 1) over-emphasis by the government in its response to climate change on mitigation, 2) adaptation issues are only dealt with by a small number of experts. A lack of awareness by the public leads to political apathy of politicians and high-ranking decision-makers regarding adaptation.

Interviewees also identified an absence of a comprehensive and continuous communication system as a barrier. The NCCAP does not have a formal communication platform that involves various stakeholders in a continuous manner. Interviewees highlighted that there are communication problems between scientists who generate scientific data and policy-makers who use the data. D5 said the functions of climate research and adaptation policy are separated, and it is hard to link them because of different views of timescales. Also, there is a lack of communication between the central government and sub-national stakeholders. In Korea's current national adaptation scheme, there is no way for local governments or private sectors to participate in or

local realities to be incorporated into the national-level policy. This barrier influences policy acceptance and its effectiveness on the ground.

Human and Financial Resources

Interviewees frequently mentioned three aspects of a human resource barrier: frequent rotation of civil servants, human resources shortage of the NCCAP, and lack of adaptation experts. Frequent rotation of civil servants from one position to another impede national policy implementation. Civil servants in charge of the NCCAP change at least three times in any five-year period because civil servants are rotated every two years. Interviewees said that civil servants have different understandings of adaptation, some needing further training, and NCCAP is significantly influenced by their different understandings. Experts from outside of the government departments viewed that the rotation system negatively affects expertise, continuity, and policy experience for national climate adaptation policy. However, civil servants consider it a systemic limit, not a barrier because the rotation system is part of the civil service regulations. We need to accept the limit and find solutions on the limit, like other policies do (A2, A4, A5).

Although NCCAP involves many departments and projects, it is led by a small group of only four civil servants who have high workloads. In contrast, mitigation policies are implemented by several teams or a full department. Interviewees considered that it is almost impossible to lead the implementation of the policy effectively with this small group of civil servants. Interviewees also felt they do not have enough experts specifically in adaptation who could give consistent and clear policy advice. Adaptation is a secondary area of expertise for most of the experts who currently provide policy advice to the NCCAP: they have different understandings of adaptation and? interpret key terms and concepts in light of their primary areas of expertise which often leads to confusion (A4, A5).

Almost every interviewee identified the lack of financial resources as a barrier. No department has a specific budget for adaptation policy, and MoE does not have financial resources to support other departments' adaptation policy. Because of this, departments want to implement existing policies that secured enough budget as their adaptation policy, being reluctant to get a new budget to implement new and progressive adaptation policy (D2). Interviewees also

highlighted that the legal basis of the current national climate adaptation policy is such that it leads to insufficient funds for the policy. D10 mentioned that NCCAP does not have enough power to lead departments unless the policy has a sufficient budget to do so.

Lack of authority of a main department

The limited authority of MoE is a barrier; the interviewees considered that MoE does not have sufficient budget and procedures to oversee and coordinate all departments' adaptation actions. Although limited authority is a smaller problem in the policy adoption stage, it is a substantial issue for policy implementation. MoE cannot force other departments to make more effort or to dedicate resources or to change their course of action. D2 also asked: "although MoE manages NCCAP, essential projects are implemented by other departments. … For adaptation, what is MoE doing on the ground?". With limited authority, MoE cannot require other departments to participate actively, which undermines the working of the cross-departmental consultative group (A4, A5). The limited authority of MoE entails limited authority of the KACCC as well. Interviewees traced the origin of the barrier to the current Act, which does not provide for authority and budget to MoE.

Others

The interviewees identified two further barriers. First, climate change risk assessment does not play a sufficient role in NCCAP. Stakeholders did not see a link between the findings of the assessment and their activities. They pursue the activities they want regardless of the identified risks, which are addressed only superficially by the policy. As a result, NCCAP does not have well-established priorities for adaptation policies (A2, A4, A5, D1, D2, E2, D7, D8, D10). Secondly, NCCAP is not sufficiently supported by relevant research. Notably, research on the effectiveness of adaptation policy was considered insufficient. Civil servants said that existing research does not provide support for the design of adaptation policies and or establish their outcomes and performance. D1 highlighted the lack of studies justifying adaptation policy which typically involve substantial uncertainty regarding outcomes. In particular, the dearth of research on the economic feasibility of adaptation policies affects their acceptance. Interviewees stressed that more research is needed on the cost of climate change impacts and the benefits of adaptation policy to provide a strong rationale for why adaptation is needed now.

5.4.2. Relationships between factors and key barriers

By drawing the effects between barriers and their origins and influences as arrows, This chapter maps the relationships between them in Figure 5. The barriers occur and intertwine with various factors in a complex way: barriers are related to several origins, influences, and other barriers across categories. Although the relationships are complex, Figure 5 highlights why the barriers and national climate adaptation policy problems occur and which factors are related to each other. In what follows, it analyses the key barriers that are more influential than others for barriers to Korean national climate adaptation policy.

On average, barriers have three arrows coming in and out. This chapter defined key barriers to have at least four arrows and found seven of them. Barriers related to institutions are most notable among them. Although they are themselves directly considered barriers, they are also direct or indirect origins of other factors. For example, ‘Lack of detail in the current Act (insufficient legal basis)’ directly relates to three other barriers and two influences: it gives rise to one origin, two more barriers, and five influences. Although the barrier has multiple effects, only one factor is pointed out as its origin: ‘national climate change response focus on mitigation’. ‘Absence of effective M&E system’ is also a key factor, which has three direct origins. It affects ‘Unclear achievement of adaptation policy’ and causes four further barriers and three influences. Resource barriers, particularly ‘Frequent rotation of civil servants’ are also key factors. It is an administrative factor not directly related to climate change, but it has four problematic influences for adaptation policies. It originates from ‘Civil servant regulation’ that is also an administrative factor. ‘Lack of financial resources’ leads to two influences related to conservative policies which result in less progressive adaptation actions. The barrier has complex origins in institutions, indifference, and understanding issues. ‘Difficulty of securing resource for adaptation policy’ arises from the origins and barriers related to low understanding and attention issues. Horizontal and vertical fragmentation barriers are all key factors with different origins. Horizontal fragmentation is caused by government departments’ lack of understanding of and indifference toward adaptation. Vertical fragmentation is caused by weak institutions and a perception gap about the range of national climate adaptation policy between central and local government civil servants. ‘Low priority of adaptation’ is also a key factor that

arises from a combination of origins to do with timeframe gaps, unclear achievement and lack of explicit directions of adaptation policy, indifference and understanding of adaptation.

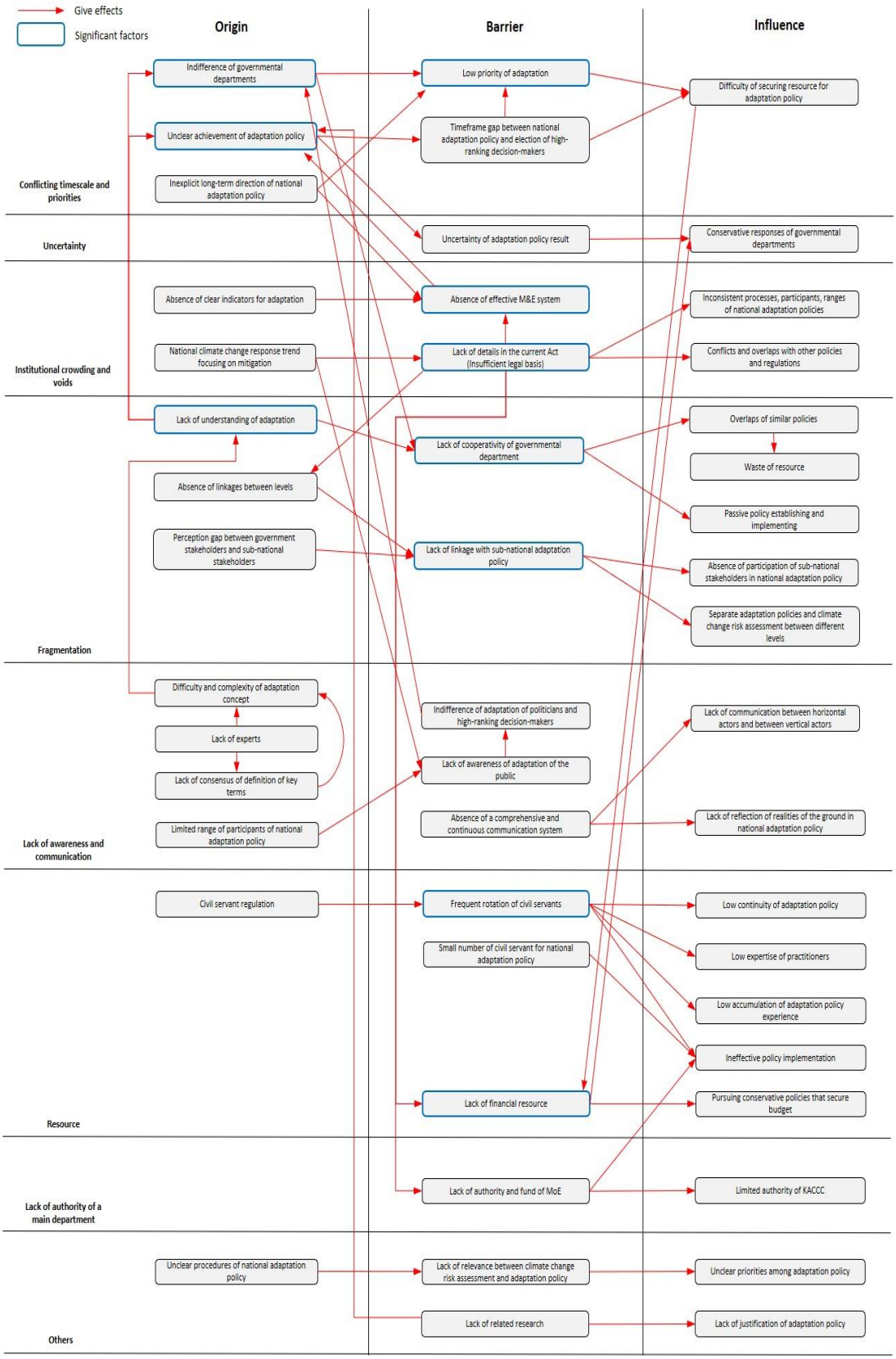

Figure 5 Relationships between barriers, origins, influences in Korea's national climate adaptation policy process

5.4.3. Solutions for the barriers

5.4.3.1. Used solution

Interviewees from groups A and C mentioned three types of solutions that had been used. First, there were solutions to increase communication. From the early stage of establishing the policy, the managing department had held several general and sectoral workshops to gather the views of the experts and key stakeholders and to explain the concept of climate change adaptation to them. Through the workshops, participants from government departments could get feedback on their department's adaptation policy and help make the policies more practical (A2, A3). By holding a public hearing, the managing department also tried to gather views from the public and to communicate with them (A3, C2). Secondly, successful adaptation examples were used as a solution. In the implementation stage, the managing department and the official supporting institute searched for successful examples among policies in NCCAPs. They incentivised departments by highlighting successful examples and tried to increase the interest in adaptation policies more generally (A1, A4, A5, C1). The interviewees had also tried to improve the current legislative system for adaptation. The MoE and KACCC conducted research to help legislate a Climate Change Adaptation Act and submitted a draft to the National Assembly. They also tried to legislate regular M&E of NCCAPs (A4, A5, C2, D6). However, attempts at changing the current legislation have not passed the National Assembly yet. While the interviewees identified the above three types of used solutions, none of them could tell whether the solutions had been effective in overcoming the barriers or not.

Interviewees outside of groups A and C said that there were no solutions for overcoming barriers. They saw no specific action to help reduce or overcome the barriers, although they said they had given a lot of thought to such solutions. D5 said, "unfortunately, as far as I am concerned, no solution has not yet been applied. … It is the reality that we have covered up and ignored the barriers, although we have experienced them". There was no concept or awareness of barriers in the process of the policy, so that, the used solutions were not barrier-specific (D1, D2, D9).

5.4.3.2. Suggested solution

Interviewees suggested a variety of solutions which it groups into nine categories (see Table 5). Interviewees emphasised that improving civil

servants' understanding of and expertise in adaptation is important to overcome barriers. Because national climate adaptation policy should involve multiple sectors, education for an understanding of and expertise in adaptation is needed for civil servants in relevant departments, not only in the environment department. Education for high-ranked civil servants and leaders was seen as particularly important. To supplement the problems caused by the civil servants' rotating system, interviewees suggested introducing an expert committee supporting the policy continuously. Supporting research on climate change impacts and policy research was also suggested to reduce policy uncertainty and increase public awareness. Interviewees also suggested better prioritisation of adaptation policies. They highlighted that the current national climate adaptation policy focuses on very detailed projects without priorities. They suggested selecting and focusing on core policies based on risk assessment results and establishing a clear long-term vision for the national-level policy. The current risk assessment practice was also seen to need improvements by also focusing on other than key risks. The interviewees considered that the national climate change risk assessment should be linked with local-level risk assessments to have comprehensive spatial coverage. Better linking of adaptation research results, risk assessment results and departmental activities was also emphasised as a solution. It was also seen necessary to legislate the M&E scheme and to establish clear and measurable indicators. Communicating the M&E between implementing civil servants was also considered important. Finally, it was seen as important to expand the range of participants in the policy process, as the current policy is implemented by a small number of experts and civil servants.

Table 5 Suggested solutions given by interviewees by category

Category	Solutions	Interviewee
Improving civil servants' understanding and expertise of adaptation	• Including climate change content in the education curriculum for civil servants above a certain level and high-ranked leaders • Conducting regular education for civil servants of governmental departments • Introducing an expert committee with special civil servants or experts, which	A2, A3, C1, C2, C3, D1, D5, D8, E1,

Category	Solutions	Interviewee
	can supplement the rotating system of civil servants.	
Reducing uncertainty	• Continuous investment in climate change impact research • Expansion of government support for research on the difference between adaptation policy and other policies	B1, D1
Finding concrete results of adaptation policy / good examples	• Presentation and publication of specific results of adaptation policy to the public • Finding and sharing good examples of adaptation policy	C1, D1, D2, D5
Prioritising among adaptation policies	• Selecting and focusing core policies, projects, or issues • Establishing clear goals based on the risk assessments • Focusing on establishing a clear and long-term vision, not focusing on detailed short-term projects	A2, C2, D2, D3, D4, D9, E2, E3,
Improving the current risk assessment	• Prioritising less but core risks through a systematic process of risk assessments • Including a spatial concept in risk assessment by linking with local level risk assessments	B1, D2
Improving communication between stakeholders	• Establishment and practical operation of an official adaptation consultative group • Making clear adaptation governance with related departments • Holding regular meetings for civil servants who participate in the policy	D3, D5. D10
Making linkage between	• Analysis of linkage and making evidence between climate adaptation	B1, C2, E1

Category	Solutions	Interviewee
adaptation and practical tasks	research results and the current tasks of governmental departments • Making linkages between risk assessment results and departments' current tasks	
Improving the M&E system	• Making a clear and regular M&E system with a legal basis • Research supporting for practical indicators • Clear presentation of policy achievements and failures • Conducting hands-on regular meetings for M&E with civil servants.	A3, D5, D7, E2
Expanding the range of participants of the policy	• Establishing the policy with a bottom-up way from local and private level adaptation • Including roles of local authorities for adaptation in the policy • Expanding the current participant range from risk assessment stage	D5, D6, D7, E3

5.5. Discussion and conclusion

This chapter have examined the barriers to the Korean national climate adaptation policy and their origins, influences and relationships to provide a deeper understanding of barriers to national climate adaptation policy. This research draws conceptual, methodological, and empirical contributions beyond the literature's limitations in this research field.

First, by introducing the concepts of origin and influence of barriers to adaptation, this chapter provides a theoretical contribution to answering questions that were a long-standing limitation of previous studies in this research field; why the barriers occur and how barriers affect adaptation processes (Biesbroek et al., 2013; Eisenack et al., 2014; Waters et al. 2014; Clissode et al., 2020). It identified 16 barriers, 14 origins, and 19 influences.

Among 16 barriers, some are similar to the barriers identified in previous studies, which were identified in Chapter 4.

However, it identified national level barriers that are new or more concrete, such as ‘absence of a comprehensive and continuous communication system’, ‘frequent rotation of civil servants’, ‘small number of civil servants for national climate adaptation policy’, and ‘lack of relevance between climate change risk assessment and adaptation policy’. These barriers cannot be identified through official document analysis, and it is a result that can be identified only through this research method.

The existing literature has given limited attention to the influence of the barriers, for example, impeding progress from one stage to another or resulting in unintended consequences in adaptation policy processes (Moser and Ekstrom, 2010); it showed 19 concrete influences of the barriers to national climate adaptation policy, problems that practitioners and policy-makers are experiencing in real-world policy processes. Our results also help understand why the problems have occurred and what barriers are related to the problems. Interviewees discussed some barriers in detail with their origins and influences but some barriers very briefly, as elaborated in the result section. It reflects how often and deeply the interviewees were confronted with the barriers in the process of making and implementing the policy.

Secondly, this chapter provides a methodological contribution to understanding an underlying ‘dynamic web of barriers’, which has been conceptually suggested in the literature (Agrawala and van Aalst, 2005; Eisenack et al., 2014) by mapping the relationships. It has demonstrated how barriers interact and mapped these interactions visually. Lack of understanding of why barriers occur and what are the interdependencies and dynamics between the barriers have been considered key knowledge gaps in the existing literature (Biesbroek et al., 2013; Eisenack et al., 2014; Clissold et al., 2020). It presented all factors in Figure 5 and explained how the complex interactions cause challenges for the national climate adaptation policy in Korea. The results highlight the overlaps and interactions between barrier categories (Shackleton et al., 2015) and that barriers need to be addressed simultaneously, not individually (Spires and Shackleton, 2018). It also demonstrates how administrative factors that are not directly related to climate

change can cause serious problems to the policy (Storbjörk and Hedrén, 2011), for example, ‘frequent rotation of civil servants’.

Third, this chapter identified key barriers. The literature on barriers to adaptation has usually dealt with barriers on the same footing. But it analysed what barriers are more influential than others: this can contribute to providing preliminary insights into where solutions need to start to overcome the barriers (Eisenack et al., 2014; Clissold et al., 2020; Esteve et al., 2018) and prioritising between barriers. In Korea, barriers related to institutions, resources, and fragmentation are clearly central.

Fourth, this chapter addressed the used and suggested solutions for the barriers. It found that only interviewees who directly manage the policy from MoE and KACCC brought up solutions that had actually been tried. Although there were three groups of used solutions, the outcomes of them were unclear. For example, an attempt to improve the current legislation has not yet been successful. It also found that the solutions in the process of national climate adaptation policy do not give any explicit attention to barriers. As Biesbroek (2014) has said, the concept of barriers to adaptation remains isolated from the real adaptation processes. It argue that the absence of consideration of barriers in the policy process leads to an absence of practical solutions to overcome the barriers, at least in our Korean case study. The suggested solutions that are in nine categories are clearer and more specific about what needs to be done now than the solutions discussed in the existing literature (Jones, 2010; Storbjörk and Hedrén, 2011; Clar et al., 2013; Waters et al., 2014; Spires and Shackleton, 2018).

Based on the results, it concludes this study by providing practical insights into national climate adaptation policy. This chapter suggests a methodology that can diagnose national climate adaptation policy problems, understand related barriers and origins and devise concrete solutions, which can be practically used in adaptation policy processes in any other countries beyond the Korean case. The procedure of the method is 1) identifying factors of barriers, origins, influences and relationships between them, 2) checking current problems among the influence factors, 3) identifying related barriers and origins through tracing relationships backwards, 4) making an entry point or taking insights to address the barriers with an analysis of relationships

between factors and used/suggested solutions. For example, in the Korean case, there are problems of the NCCAPs, such as ‘overlaps of similar policies’, ‘waste of resource’ and ‘inactive policy establishing and implementing’. Policy-makers and stakeholders can identify that ‘lack of cooperativity of government departments’ barrier and ‘indifference of government departments’, ‘lack of understanding of adaptation’ origins are related to the problems through tracing relationships in Figure 5. Based on the relationships and suggested solutions, it can devise potential solutions. For example, the Korean government can include climate change contents in the education curriculum for civil servants and conduct regular education for participants of the policy to improve an understanding of the adaptation of civil servants in departments. MoE and KACCC can provide connections between adaptation issues and departments’ priorities by analysing evidence between adaptation research results and the departments' current tasks, making linkages between risk assessment results and department’s priority tasks, and finding and sharing good examples of adaptation actions. The Korean government can also make clear the national adaptation governance range, set an official adaptation consultative group, and operate practically through regular meetings with high-ranked civil servants of participating departments and political leaders for continuous cooperation.

This research acknowledges that this research does not show every factor or aspect related to barriers to Korea's national climate adaptation policy. If policy-makers and stakeholders develop Figure 5 with their experiences and updated evidence, it would show more and become more practical for the policy. In addition, as it focused on a single in-depth case study, the question remains as to whether the research findings can be generalisable more widely. Thus, comparative research with multiple country cases based on the methodology used in this research is required for a generalised understanding of barriers to national climate adaptation policy and approaches for overcoming them.

Chapter 6
Beyond Conceptual Understanding of Barriers to National Climate Adaptation Policy Processes: A comparative analysis of South Korea and the UK

Chapter 6
Beyond Conceptual Understanding of Barriers to National Climate Adaptation Policy Processes: A comparative analysis of South Korea and the UK

6.1. Introduction

Adaptation is getting more attention, given the inevitable climate change caused by the already emitted greenhouse gases (Adger et al., 2009a; Ford and Berrang-Ford, 2011; IPCC, 2012, 2014; Berrang-Ford et al., 2014; Klein et al., 2017), and the role of national climate adaptation policy is increasingly emphasised (OECD, 2009; Biesbroek, 2014; Russel et al., 2020; Mullan et al., 2013). Despite the substantial progress with the development of national adaptation policies or programmes, adaptation policies are not keeping up with the increasing need, which has led to an 'adaptation deficit'. (Eisenack et al., 2014; Lonsdale et al., 2017; McClure and Baker, 2018). The literature to date has not specifically addressed the reasons for the adaptation deficit (Dupuis and Knoepfel, 2013), and there is a demand for practical solutions to reduce it.

This chapter aims to improve the current understanding of barriers to national adaptation policy processes through a comparative analysis of national climate adaptation policy in two cases. Chapter 5 suggested a research approach that can show barriers' origins, potential causal mechanisms, influences, and interrelationships, which makes it possible to explain the characteristics of barriers to national climate adaptation policy processes. By applying the research approach to national climate adaptation policy in South Korea (Korea) and the UK to compare them, it purposes to offer a better understanding of common barriers to national climate adaptation policy and to generate general and practical insights into overcoming the common barriers. The research questions it seeks to answer are: 1) what are the common barriers to national climate adaptation policy processes in Korea and the UK? 2) what are the characteristics of the common barriers and their influence and origin? 3) how can we approach to reduce and overcome the barriers at the national level?

Based on the criteria in Section 3.2.3.1., this thesis chooses Korean and UK cases to provide more generalised insights into the barriers to national adaptation policy processes, across economic, political, cultural and climatic backgrounds, beyond the limitations of previous studies. Looking at common barriers between the two countries will draw generally useful knowledge about what barriers to national adaptation policy processes are and how we can address and overcome them.

6.2. Climate Adaptation Policy in Korea and the UK

Based on the official document analysis, it was found that climate adaptation policies in Korea and the UK have several similarities. They are policies with a five-year rolling plan based on specific legislation and involve climate change risk assessments. Both countries have multi-ministerial policies led by an environmental ministry, and both have a top-down political structure. However, there are also clear differences between them. Korea has a multi-party system and centralised government, with the President as the head of state (Park, 2013; Yang, 2019). In turn, the UK has a decentralised political system with parliaments in Scotland, Wales, and Northern Ireland (Tangney and Howes, 2016). Although the policies in the two countries have a specific legal foundation, the content and form of their respective Acts are considerably different. The organisation that supports the making and implementing of national climate adaptation policy has different status and authority in the two countries. The sub-national stakeholders are differently involved in national climate adaptation policy. These similarities and differences, this research argues, help shed light on the nature of barriers to national climate adaptation policy and common problems that countries experience in adaptation processes and improve our understanding of how to overcome the barriers.

National adaptation policy contexts in Korea and the UK are described below based on an analysis of official documents from government and national organisations.

6.2.1. Korea

The ‘National Climate Change Adaptation Plan (NCCAP)’ of Korea is based on the ‘Framework Act on Low Carbon, Green Growth (2010)’. The Article 48 of the Act and the Article 38 of the enforcement decree provide that the government shall assess climate change impacts and vulnerability and that the Minister of Environment shall establish and implement the NCCAP every five years, based on consultation with the heads of the central administrative agencies concerned. According to NCCAP, the heads of the central administrative agencies concerned and Mayors and sub-level Governors shall establish and implement detailed action plans. The Articles identify the sectors and subjects that should be included in the assessment and the NCCAP, but they do not define the range of participants or stakeholders to be involved clearly.

Korea has implemented NCCAPs since 2010. The Ministry of Environment (MoE) established the first NCCAP (2011-2015) in October 2010 and revised in 2013 it as NCCAP (2013-2015) to incorporate the results of a new impact assessment based on the IPCC’s climate change scenarios (Representative Concentration Pathways, RCP). The first NCCAP included nine sectors (health, agriculture and fisheries, water management, natural disasters, forests and ecosystem land and coast, industry, infrastructure and international cooperation, and monitoring and forecasting), 67 projects, and 13 governmental departments participated. The first official climate change risk assessment was conducted in 2014: it identified 87 priority risks for seven sectors in Korea (Park et al., 2014). Based on the risk assessment, the NCCAP2 (2016-2020) was released in December 2015. Now 20 governmental departments participate in it. The NCCAP2 set five adaptation principles and consisted of five areas[5] and 20 major projects. To prepare the NCCAP3 (2021-2025), the second climate change risk assessment was conducted in 2019, and 93 priority risks by eight sectors of Korea were covered (Song et al., 2019). Risk priorities were selected only in each sector,

[5] 1) Lay foundation for scientific climate change risk management system, 2) Build a society safe from climate change, 3) Strengthen industrial competitiveness by turning climate change risk into opportunity, 4) Sustainably manage natural resources, 5) Work to ensure successful execution and effectiveness of adaptation measures at national and internati onal level.

and priorities between risks in different sectors were not presented: there is no national top priority risk which is across-sectors in the risk assessment.

The Korean government founded the Korea Adaptation Centre for Climate Change (KACCC) to support NCCAPs. It is an affiliated institute of MoE. It plays the role of supporting the formulation and implementation of the NCCAPs, developing and disseminating adaptation programmes and information, and cooperating on climate change adaptation with international and domestic stakeholders.[6]

6.2.2. The UK

Although every nation in the UK has established and implemented their own national adaptation programmes, this chapter mainly focuses on England. The 'Climate Change Act 2008' is the legal foundation for adaptation in the UK. The sections 56-63 of the part 4 of the Act direct the government to report on the climate change risks every five years (Climate Change Risk Assessment (CCRA)) and to publish a programme outlining how the identified risks will be addressed (National Adaptation Programme (NAP)). The Act asks for an assessment of the progress made towards implementing the objectives, proposals and policies set out in the NAPs every two years after a NAP is released. The Act also introduces powers for the government to require public sectors and statutory undertakers to carry out their own risk assessment, make plans to address identified risks and report to the Government (Adaptation Report Power (ARP)). The Act does not identify sectors or subjects or the participants or stakeholders which have to be included in the NAPs. Outside of England, other governments of the UK have established their own laws and regulations to supplement based on their conditions and status - an example is the Climate Change (Scotland) Act 2009.

Under the Climate Change Act 2008, the Committee on Climate Change (CCC) and Adaptation Sub-Committee (ASC), which changed to Adaptation Committee (AC) in 2018, were established. They are supporting the implementation of CCRAs, preparation of NAPs, and the independent assessment of NAP. In January 2012, the Department for Environment, Food and Rural Affairs (Defra) published the CCRA 2012, which set out the main

[6] kaccc.kei.re.kr

priorities for adaptation in the UK for the themes of agriculture and forests; business; health and wellbeing; buildings and infrastructure, and; natural environment. Based on nine opportunities and 38 priority risks identified in CCRA 2012, the UK government published the first NAP in July 2013. It had seven main themes: built environment, infrastructure, healthy and resilient communities, agriculture and forestry, natural environment, business, and local government. More than 370 actions were included in the programme; the majority of these actions were owned by central Government departments and their agencies (CCC, 2017). Two progress reports on the first NAP were published by the CCC in 2015 and 2017. The CCRA 2017 was published in January 2017, and it divided the 56 identified priority risks into four categories7. It set the top six areas of inter-related climate change risks for the UK: flooding and coastal change risks to communities, businesses and infrastructure; risks to health, well-being and productivity from high temperatures; risk of shortages in the public water supply, and for agriculture, energy generation and industry; risks to natural capital, including terrestrial, coastal, marine, and freshwater ecosystems, soils and biodiversity; risks to domestic and international food production and trade; new and emerging pests and diseases, and invasive non-native species, affecting people, plants, and animals. To respond to CCRA 2017, Defra published the second NAP in July 2018. It encompassed the five themes of natural environment, infrastructure, people and built environment, business and industry, and local government and included 21 main activities. The CCC published a progress report on the second NAP in 2019, suggesting that the government had failed to increase the ambition of the adaptation policy and its implementation after the NAP (CCC, 2019).

6.3. Methodology and Materials

Comparative and actor-centred methods are well-suited for advancing our understanding of the barriers and for generating findings that help overcome them (Eisenack et al., 2014). In this regard, this research applies the methodology used in chapter 5 to two cases. Chapter 5 introduced concepts of origins, influences, and relationships of barriers to adaptation and used the concepts to explain the barriers beyond identifying and describing them.

[7] More action needed, Research priority, Sustain current action, and Watching brief

‘Origin’ is a factor that gives rise to barriers, ‘influence’ is a factor affected by barriers and also refers to national climate adaptation policy problems caused by barriers. ‘Relationship’ refers to connections between all barriers, origins, and influences. The chapter identified barrier, origin, and influence factors through semi-structured interviews and visually mapped the relationships to show potential causal mechanisms of barriers and problems of the national climate adaptation policy. By applying the same concepts and methodology to Korea and the UK cases, this research focuses on the experience of actors who participate in the national climate adaptation policy processes in Korea and the UK, to compare common barriers and their characteristics.

To identify actors to recruit for interviews, this research used the participant lists of the first and second NCCAP (Korea) and the second CCRA (the UK). Based on the lists, it contacted 95 key stakeholders of the national climate adaptation policy in Korea and the UK via emails and phone calls during the first quarter of 2019. Also, some potential interviewees were contacted with a snowballing method through stakeholders in the lists. Information about the main questions of the interview and personal data projection was explained in an information sheet. The voluntary intention of the interviewees to participate was confirmed by filling out a consent form (Appendix C).

A total of forty-one semi-structured interviews were undertaken: 23 in Korea and 18 in the UK between 10th April and 25th October 2019. Thirty-two interviews were conducted face-to-face in Korea and the UK, five were paper interviews, and four interviews were conducted over telephone calls. Interviewees included (A) civil servants of the managing departments (MoE, Defra); (B) civil servants of other government departments; (C) experts of official supporting institutes (KACCC, CCC), and (D) sectoral experts. Also, (E) experts of local-level adaptation policy were interviewed. The interviewees were codified for personal information projection. Korean interviewees’ code starts with ‘K’, UK interviewees’ code starts with ‘U’. After K and U, interviewees’ codes indicated their group and the order of the interview. The largest number of interviewees came from the sectoral expert group (19), and the smallest one was from the expert of local-level adaptation policy group. The interviewee group sizes were as follows: Korea (KA=5, KB=2, KC=3, KD=10, KE=3); the UK (UA=4, UB=4, UC=1, UD=9).

The interviews covered three key areas: 1) identifying barriers to national climate adaptation policy, 2) identifying influences of the barriers, and 3) identifying origins of the barriers. Interviewees were asked about their experiences and opinions of working in the national climate adaptation policy process, from risk assessment to monitoring and evaluation (M&E). The main questions were:

1) Based on your experience, what are the barriers to national climate adaptation policy?

2) What problems are caused because of the barriers?

3) What do you think are the reasons for the barriers?

All interviews were recorded and transcribed. To compare barriers to national adaptation policy processes in Korea and the UK, important parts of the interviews in Korea were translated into English. Through a quantitative content analysis of transcribed and translated interview results, this research first identifies each country's factors related to barriers to national adaptation policy processes (barriers, origins, influences) and maps relationships based on the connections between them. Like chapter 5, all factors that interviewees mentioned as a barrier are codified as a barrier. Origins and influences of each barrier are analysed based on transcribed interview responses to questions 2 and 3. The relationships between origins, barriers, and influences are analysed, and the connections between the factors (the direction of the relationship) is drawn with arrows in barrier maps. Then, it draws common barriers and related origins and influences between Korea and the UK national adaptation policy processes by comparing the analysis results. Based on drawn common factors, this research presents a common barrier map underlying the national climate adaptation policy processes of Korea and the UK.

6.4. Results

The interviews indicated that Korea and the UK have experienced context-specific barriers to their national climate adaptation policy. For example, in Korea, an absence of a comprehensive and continuous communication system is identified as a barrier. Although the NCCAP has a cross-departmental consultative group, it has not functioned. Only an ad-hoc working group to establish the NCAAPs was organised early in each policy period. This barrier causes awareness gaps between the managing

department and other departments, as well as underappreciation at the national level of the needs at the local level and in the private sector (KA4, KA5, KD1, KD3). The Korean interviewees also identified the unclear hierarchical status of the national climate adaptation policy as a barrier. Its relationships with other policies and regulations are not explicit. Hierarchical relationships with local-level adaptation policies are also unclear. This causes overlaps between similar policies and the difficulty of adopting common long-term visions or goals between national- and local-level adaptation policies (KC2, KD8). In the UK, an ambitious national target of CO2 mitigation is considered a barrier to national climate adaptation policy, as the majority of resources and efforts for climate change are committed to mitigation, and adaptation receives less attention. Thus, adaptation is a lower priority and securing financial and human resources for adaptation policy is difficult (UA1, UA4). An unsystematic timeframe between CCRA, NAP, ARP and local-level adaptation is also pointed out as a barrier. Only the timeframes for CCRA and NAP work well. As UB2 said, “as time goes, all adaptation schemes are becoming complicated and fragmented now”.

However, interviewees in the two countries identified many more common barriers than different, context-specific barriers. Although various categories or clusters of barriers to adaptation have been suggested in previous studies (IPCC, 2007; 2014; Biesbroek et al., 2011; Lindsey and Emily. 2011; Mullan et al., 2013; Wise et al., 2014; Waters et al., 2014), this research categorised the common barriers into four types: 1) national political and administrative system, 2) resources, 3) laws and regulations, and 4) nature of adaptation. In addition to identifying barriers, this research indicates the barriers’ influences and origins that are common in both countries.

6.4.1. Common barriers and their origins and influences

6.4.1.1. National political and administrative system

There are six common barriers to national climate adaptation policy related to the national political and administrative system in Korea and the UK. Interviewees identified conflicts between governmental departments as a barrier to their national climate adaptation policy. There was an inter-sectoral competition, and it was challenging to convince the departments to engage in the process (KA3, KA4, KD10). There were tensions between Defra and other departments about regulations, and although Defra made sense for them to

think about adaptation, there were many competing goals and sectoral objectives (UC1, UD9). The interviewees considered that this barrier is caused by four factors: unclear provisions in regulations about the range of participants in national climate adaptation policy, absence of regulations about the accountability of each department for adaptation, indifference of departments, and limited authority and role of the managing department. Interviewees from managing departments and institutes suggested that they do not have authority based on law or regulations to force other departments to participate in the policy (KA3, KA4, KA5, UA1, UB4, UC1). This horizontal fragmentation barrier leads to two problems: lack of responsibility of each department for adaptation, and inability of dealing with cross-cutting issues. Departments' adaptation policies usually consist of soft measures focusing on picking the low-hanging fruit with unclear responsibility for adaptation (KA3, UD9). UB4 also said, "this barrier makes things disjointed. … the current policies are not connected up to issues and departments".

Lack of connection between national- and sub-national-level adaptation policy was another common barrier. The national climate adaptation policy consisted only of central government departments' actions, and local authorities did not participate in the policy process. It is not clear how much the national-level policy is being used in sub-national adaptation. For example, KD8 emphasised that "in policy processes of both levels, there is no concept of how we link national climate adaptation policy and local adaptation policy". This barrier has its origin in two factors: unsystematic schemes (timeframes) of different levels of adaptation policy, and unclear range of participants in national climate adaptation policy. There are no provisions for involvement of local authorities in national climate adaptation policy (KD2), and local and national level policies follow different timeframes (KD8, UB1). This vertical fragmentation barrier leads to two problems: no linkage between different levels of adaptation and omission of realities on the ground. As a result, national and local adaptation policies have been implemented separately, without common vision or goal for adaptation, and national climate adaptation policy is not grounded on and does not reflect adaptation actions at the ground. (KE1, KE2, KE3, UB1, UB2).

Lack of linkage between different levels of climate change risk assessments was also identified as a barrier. National and local risk assessments have been conducted separately, and there is no linkage between them. In the UK,

although the current CCRA contains risks for England and the devolved governments, the level of detail is not enough for each devolved government. They have had to conduct additional risk assessments, and there is no linkage between different governments' risk assessments (UA2, UA3, UB4). KD8 also stressed that "there is no spatial concept in the current risk assessment. … Risks need to be connected both spatially and contextually between different levels, but national risk assessments don't contain local level risks and vice versa". Two factors originate from this barrier: lack of communication between different levels for adaptation and the unclear range of participants in national climate adaptation policy.

Limited authority and role of the managing department was raised as an administrative system barrier. The national climate adaptation policy is managed by the department of the environment in the two countries (MoE, Defra). The interviewees considered that the department does not have enough authority and resources to influence other departments. The managing department is one of the least powerful departments in both countries, so it is hard to lead an adaptation that involves multiple departments (KD2, UC1, UD1). Also, because there are no regulations about responsibility and accountability for adaptation, the managing department cannot require other departments to make efforts or dedicate resources for adaptation (KA2, KA4, KA5, KC3, UA1, UA2, UD3). The origin of this barrier is the limited support in the current institution. There is no legal basis for authority and resources for the managing department; thus, it is a challenge to mobilise other departments (UD6). The influences of this barrier include conflicts between government departments, lack of overarching policy and direction and high dependence on other departments' action and budget. UA2 said, "It could not be overarching policy or direction, it is just a collection of policies because of our limited power". The managing department cannot be involved in the implementation of other departments' adaptation policy, and it only collected the results that other departments sent with high dependence (KC3, UA3).

Frequent rotating of responsible civil servants was also identified as a barrier to national climate adaptation policy. Civil servants responsible for national climate adaptation policy are rotated two to three times within one policy period. Rotating civil servants' varying understanding of adaptation introduces variation into the national climate adaptation policy and its implementation

(KC2, KD8, UC1). Civil servant regulation was considered the origin of the barrier. The barrier has four key influences: additional time needed to educate new civil servants, low continuity and connectivity of adaptation policies, low expertise of practitioners and limited accumulation of adaption policy experience. Because adaptation is a relatively new concept, new civil servants have different levels of and sometimes limited understanding of it. Thus, additional time is needed to educate them and because of it the continuity and connectivity of adaptation policies could not be guaranteed (KA3, KD7, KE2, UC1). KD5 emphasised that “expert knowledge and experience of adaptation have accumulated but that adaptation is always a new topic for civil servants in departments who lead on adaptation policy”.

Interviewees indicated that lack of interest and support from the government (political will) is a barrier. In both Korea and the UK, the national interest and support have decreased for the second national climate adaptation policy cycle. UC1 said, “We have seen a lot of adaptation issues falling away because of political interest. … Climate change has fallen off the agenda. So, all that institutional arrangement has fallen way over previous years”. KA2 said that “It was hard to have a national momentum for adaptation policy in the process of establishing the second NCCAP”. Interviewees identified three origins for this barrier: low political salience of adaptation and resulting unimportance for winning votes, short time-horizon of politicians and high-level leaders and the difference between adaptation timescales and electoral cycles. This barrier had two key influences: lack of specific funds for adaptation and continuing low priority of adaptation. It was very difficult to secure funds for adaptation because of the low interest of the government, although the managing department had to spend time and effort to highlight the importance of adaptation policy and the funds needed for it (KA2, KA3, KA4, KA5, KC1, UA1, UC1).

6.4.1.2. Resources

Two resource barriers were identified. First, interviewees said that no specific funds for adaptation is a barrier to national climate adaptation policy. National climate adaptation policy in the two countries does not provide funds for adaptation policy to other departments, and the majority of provided funds come from other departments based on the departments’ actions, not the managing department. Also, the government and departments in Korea and

the UK do not have specific ‘adaptation funds’, and there is no adaptation funding scheme at a national or local level or at the private sector. UD9 stressed that “Departments are aware of adaptation and the reason why they need to do. However, because of a small budget, it is like anyone who is operating adaptation, at the moment, hand tights behind backs”. This barrier has three factors of origin: absence of institutions for adaptation funds, lack of interest and support from the government and continuous low priority of adaptation. It is difficult to make a case for funding for adaptation to departments because it is seen as a future issue that can be attended later, financial resources are first allocated to emergency or high priority issues (KA2, KC1, UA1, UA2, UB1, UC1).

Lack of human resources in the managing department was the other resource barrier. Just 4-7 people in the managing department operate the whole process of national climate adaptation policy, and it is too few to handle the policy effectively and to monitor every relevant part of the policy. KA2 said, “tasks related to GHG mitigation are carried out by several teams or departmental units, but only four people manage all climate change adaptation tasks”.

Although interviewees in both countries considered this barrier is significant, no one clearly said about the origin of the barrier. One influence of the barrier was identified: difficulty of handling and monitoring the policy. UA4, e.g. mentioned that “more people of our division are needed to check everything and to make sure things are progressing”.

6.4.1.3. Laws and regulations

In this category, two barriers were identified. Interviewees found that unclear range of participants of national climate adaptation policy in the current regulations is a barrier. The current adaptation Acts and regulations in the two countries do not clearly indicate the range of horizontal and vertical participants of national climate adaptation policy. In other words, under the current legislation, it is not clear who should be involved in the policy process and what the involved stakeholders’ accountability is. Interviewees considered that it was difficult to engage stakeholders and that some departments were reluctant to interact (KA2, KE3, UA4. UD6). Secondly, national climate adaptation policy does not involve all relevant stakeholders as it is

implemented by a small number of central government civil servants and experts in a top-down way (KD5, KD6, KD7, UC1, UD7). The barrier has one origin: complicated governance arrangements of the national climate adaptation policy. The complicated governance arises from the nature of adaptation, which has unclear audiences, and because the responsibility for adaptation is not sufficiently defined. Thus, the range of participants in the policy process is also unclear (KD6, KE2, UB2, UB3, UA4, UC1, UD9). This barrier has five influences: conflicts between governmental departments, lack of connection between national and sub-national levels of adaptation policy, lack of linkage between different levels of climate change risk assessment, inability to deal with cross-cutting adaptation issues and inconsistent range of participants (horizontal and vertical). The first and second policy cycles involved different stakeholders. In Korea, although the range of stakeholders engaged with was extended, there are still questions about who should be involved – e.g. what should be the role of local authorities and private sector. In the UK, as adaptation issues have lower priority and adaptation team was trimmed down, the engagement in the second policy cycle was weaker than in the first one.

Unclear or absent monitoring and evaluation (M&E) provisions are identified as a barrier to national climate adaptation policy. Although both countries have a M&E system for adaptation policy, interviewees saw problems in it. The current system only evaluates administrative attainment, such as whether the planned projects have been executed, or the planned budgets used, rather than evaluating the effect on adaptation. In other words, we do not know whether the policy is effective for national adaptation (KD2, KD5, KD7, KD10 UA1). Also, interviewees said that feedback from the current system is not helpful for improving the policy going forward (KD9, UA4). Absence of a clear indicator for adaptation was considered an origin of this barrier. KC2 said ”because there is no proper indicator, NCCAP cannot have a clear direction of monitoring and evaluation”, and UC1 also said, ”We have 180 indicators that we used. … but it is not saying risks are coming down with our indicators”. This barrier originates from and influences the uncertainty on effectiveness of adaptation policy. For example, UD9 emphasised that “lack of legal measures means nothing is happening at the end”.

6.4.1.4. Nature of adaptation

This category involves seven barriers. Interviewees indicated that continuously low priority of adaptation is a barrier. Adaptation is never a priority issue that governmental departments invest effort and money in: it is an additional or future task on top of their existing responsibilities. UB4 stressed that “Adaptation has not been something at the front of people thinking. … I think adaptation just has not had focus”, and UB2 said “it (adaptation) is always just seen as kind of an added work”. There are seven origins for this barrier: adaptation does not help winning votes, short time-horizon of politicians and high-level leaders, competing priorities and interests of departments, lack of immediate and visible results of adaptation, lack of interest and support from the government, the difference between adaptation timescales and electoral cycles and lack of economic approaches and research on adaptation. KD1 said, “The reason is that there is no immediate visible result. Civil servants and leaders cannot show the achievements of the policy; thus, they do not prioritise adaptation”, KE3 viewed that “Climate change adaptation measures are a mid- to long-term plan, but leaders are changed every four or five years. So, it is important that leaders can show achievements right away and get votes”. UD8 said “It is not about vote winning. I think it is something that needs to be done, but actually, it does not make into the higher levels of priority compared to education, health service, security etc. … Other priorities are coming first, and adaptation can get left out”. It influences one factor in both countries: lack of specific funds for adaptation.

Interviewees identified uncertainty of effectiveness of adaptation policy as a barrier. It is difficult to demonstrate that we are making the right adaptation decisions. KD2 said “There is a key question concerning the effect of doing adaptation projects, but we cannot find answers within a short time”, UA2 and UA3 said that we don’t know adaptation policy is working or not. UB1 emphasised that “something we have to bear in mind when we work in this field is that we are not going to get those exact figures on impacts of the adaptation measures”. There is one origin that interviewees mentioned: absence of clear indicators for adaptation. It is difficult to find suitable indicators; the national climate adaptation policy has some indicators in both countries, but we still don’t know those are good to show the effectiveness of the policy (UA1, UA2, UC1). Three factors are influenced by this barrier: unclear results of national climate adaptation policy, difficulty in setting clear

targets for adaptation and assumptions that have not been proved. UB2 mentioned that “You can read the national adaptation plan, but it can be quite vague of what it is asking people to do. So, what is asking government departments, for example, to do. It is not easily measured”, also UC1 said “We would love to be able to measure things (policy results) but we are not able to measure”. UA4 stressed that “We had to accept some assumptions of policies from other sectors. We worked with some assumptions that have not been proved and have not enough scientific evidence”. In addition, as mentioned above, this barrier gives and takes an influence with unclear or absence of monitoring and evaluation regulation.

Next, difference between adaptation timescales and electoral cycles is identified as a barrier. Climate change impacts and adaptation are long-term issues requiring long-term processes. However, time horizons of politicians and leaders are short. Politicians and leaders don’t want or need to plan very far into the future, and they want to achieve something within the election cycle (KE3, UA2, UB3). UB2 said, “The government is working on election timescale … but adaptation is the much longer time period over the election periods”. This barrier influences and is influenced by short time-horizon of politicians and leaders. It also influences three other factors: lack of interest and support from the government, continuous low priority of adaptation and difficulty of establishing long-term goals for adaptation. Interviewees emphasised that it is hard to set long-term goals for adaptation in the current governmental system which changes every five years (KA2, KD9, KE3). Also, because of the barrier, asking politicians to sign up to adaptation actions is difficult (UC1), and adaptation is never really treated as a priority area. It never had many people working on it. It never had visibility or popularity. It was never something that government departments put much money on (UB2).

Interviewees pointed out that there is a lack of understanding of adaptation. The awareness of adaptation has increased, but the understanding of adaptation is still limited. Differences between adaptation and mitigation as well as between adaptation and Disaster Risk Reduction are not well understood yet. Interviewees suggested that there are still three poorly answered questions: what is adaptation? what do we need to do for adaptation? what can we do for adaptation? Even practitioners and civil servants who lead the policy cannot answer the questions and have different levels of understanding (KA2, KC2, KD7). UB4 also said, “Even now, we don’t

know what to do for adaptation. … I think we are still developing our understanding to answer what we need to try to deal with it". This barrier originates from three factors: lack of examples of adaptation, limited range of participants in national climate adaptation policy process and lack of adaptation experts. There is a lack of examples of adaptation which could demonstrate what adaptation is and what each department can do (UA4, UD7). KC1 said, "Although departments secure budgets, they don't know what projects they can do. We don't have good and clear examples of adaptation projects". Climate change adaptation is still an agenda for selected few people (KD6, UA1, UA2), so only a small number of people share the understanding of it. This barrier's influences include indifference of departments, terminology gaps between stakeholders, lack of relevance for current issues and weak linkage between adaptation policy and climate change risk assessments. A few departments did think adaptation is not their job and did not link adaptation with their current work. In other words, with the current understanding of adaptation, national climate adaptation policy does not appear relevant for the current issues, especially for other departments.

Also, there is a terminology gap between stakeholders. The definitions and concepts of key terms of adaptation are not mutually agreed or clear: these include the terms adaptation, risk, vulnerability and adaptive capacity. Experts and civil servants who participate in the policy process differently interpret and use the terms based on their understanding, training and expertise (KA4, KD10, UC1). This barrier is influenced by lack of adaptation experts and lack of understanding of adaptation. Its influence includes misunderstanding or confusion between stakeholders.

Insufficient economic approaches and research on adaptation is identified as a barrier. Interviewees mentioned that we do not know the cost of taking adaptation actions as well as the cost of not taking the actions. So the costs and benefits of adaptation remain unclear. UD9 said, "We have a quite clear climate science, but there is big uncertainty of climate policy and cost of adaptation, cost of not doing adaptation". This influence of this barrier includes continuous low priority of adaptation and low awareness of the urgency of adaptation. The national climate adaptation policy does not make financial implication; thus, it cannot attract attention from the public and politicians (KD5, UB2).

Lastly, a lack of linkage between climate change risk assessment and current issues and ongoing tasks is considered a barrier. We are looking at the climate change risks in isolation, not making implication in departments' work context, although the risk assessments are very systematic (KD1, UD7). The government cannot demonstrate the importance of adaptation based on risk assessments, and civil servants of the departments cannot link their tasks with the results of the risk assessments (KA4, KA5, UD9). There is one origin for this barrier: lack of consideration of climate change risks by policy-makers. KD2 said, "Although adaptation policy should be based on climate change risks, there was no consideration of them. The current policy is a set of similar policies which were going on in departments". UD3 said, "They (civil servants) just put those things we are going to do; actually it is not a plan: it is a wish-list, not consideration of risks". This barrier weakens the linkage between adaptation policy and climate change risk assessments.

6.4.2. Characteristics of the common barrier map

This research presents a map that indicates the relationships between barriers, origins, and influences as well as between barriers – the research calls it 'the common barrier map of national climate adaptation policy' (Figure 6). In the map, it identifies 54 factors common for the two countries: 17 origins, 17 barriers, 20 influences. Seven barriers relate to the nature of adaptation, six are to the national political and administrative system, and resources and laws & regulations categories include two barriers each. As the nature of adaptation category has the largest number of barriers, it also has the largest number of origins (14) and influences (17). The national political and administrative system category has 13 origins and 13 influences. The arrows from the categories of nature of adaptation and laws and regulations head to influences, other barriers, and origins in a complex way. The majority of arrows from national political and administrative system and resources point towards influences. Ten influences are related to the national political and administrative system barriers, eight are related to the nature of adaptation categories, three influence factors are linked with the laws and regulations barriers, and one is linked with the resources barrier.

6.4.3. key barriers

Each barrier has a mean of 4.2 arrows: 1.9 input and 2.2 output, and there are eight barriers which have more arrows than the average, these are shown as key barriers in Figure 6. Although the number of arrows does not indicate the importance of the barriers, the eight barriers play a more prominent role than the other barriers. The key barriers can be classified into three types.

In the first type, four barriers are originated by one or two factors but give influences on four or five factors. In the map, frequent rotating of civil servants is a barrier that is caused by only civil servant regulation, but it leads to four problems in national climate adaptation policy. Also, unclear range of participants of national climate adaptation policy in the current regulations is derived from one origin, complicated governance of national climate adaptation policy, but it affects to not only two problems of the policy but also three other barriers. Uncertainty of effectiveness of adaptation policy has one origin, absence of clear indicators for adaptation, and it influences on three problems. This barrier also inter-influences with the unclear or absence of M&E regulation barrier. Timescale difference between adaptation issues and election periods causes a problem and gives effects on two other barriers. The origin, short time-horizon of politicians and high-level leaders, inter-influences with this barrier.

In contrast, two barriers in the second type have only one or two influences but many origins. These barriers are a result of a complex set of origins and barriers. Continuous low priority of adaptation has seven origins and one influence. Four origins and three barriers cause this barrier, but it influences only on specific fund for adaptation barrier. Conflict between governmental departments is also derived from four factors: two origins and two barriers, and it affects two influences.

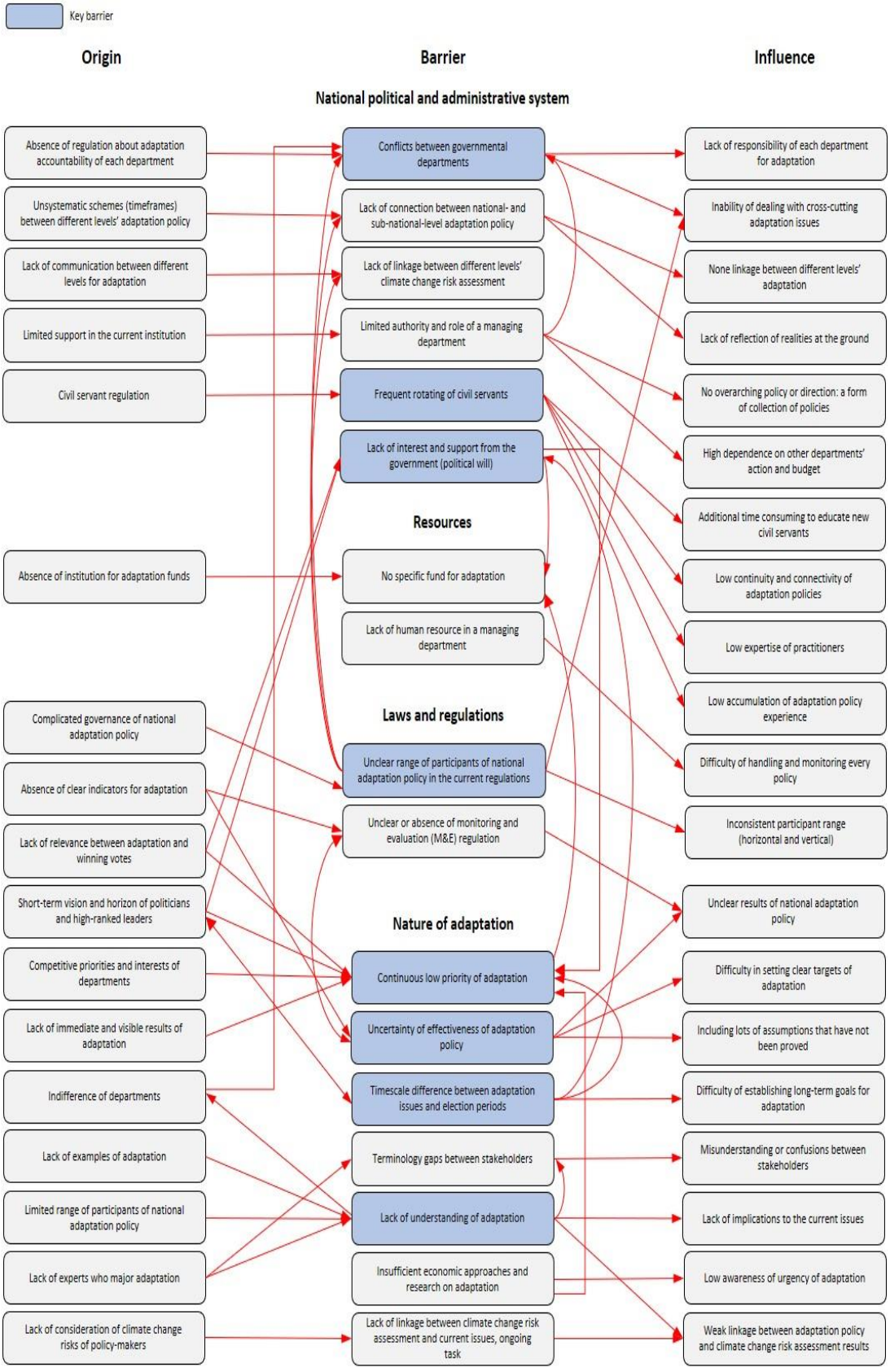

Figure 6 Common barrier map underlying national climate adaptation policy of Korea and the UK

Lastly, two barriers in the third type have similar numbers of origins and barriers. Lack of interest and support from the government (political will) is influenced by two origins and one barrier, and it also influences on two other barriers. Lack of understanding of adaptation is derived from three origins, and interestingly, it gives influence to every type of factors (two influences, one barrier, one origin).

Based on the characteristics, this research also can see that each type needs different approaches to overcome the barriers. It is relatively easy to address the barriers of the first type with a small number of origins, and the responses should help reduce the adaptation deficit somewhat. For example, lack of economic evaluations of adaptation could be addressed by funding a programme of research to generate an improved evidence base, as well as to improve the understanding of adaptation. However, more comprehensive measures are required to overcome the second and third types of barriers. For example, uncertainties related to the effectiveness of adaptation may need research efforts but may also need communication strategies, case examples of successful adaptation and new processes and solutions to enhance understanding of adaptation among key stakeholders. The approaches should cover multiple origins and barriers simultaneously and consider the relations between the barriers to clarify which barriers need to be handled first.

6.5. Discussion and Conclusion

This chapter applied the research approach suggested by Chapter 5, to compare Korea and the UK in-depth to overcome the limitations of previous studies on barriers to adaptation and to provide a better understanding of common barriers to national climate adaptation policy. Based on the official document analysis, it could find that there are similarities and differences between national adaptation policies in Korea and the UK. However, there was no research comparing barriers to national adaptation policy processes in both countries. This research confirmed that there are clear commonalities in barriers to national climate adaptation policy processes between Korea and the UK through a comparative analysis. By focusing on them, it analysed what common barriers to national climate adaptation policy are, how they affect policy (influence), and why they occur (origin). An underlying ‘dynamic web of

barriers', which has been suggested only conceptually (Agrawala, 2005; Eisenack et al., 2014), was also uncovered empirically by mapping the relationships between factors. Based on it, this research could identify the common relationships and dynamics of the barriers, which has been recognised as an 'unopened black box' (Biesbroek et al., 2015; Eiseneack et al., 2015; Biesbroek and Candel, 2019).

Seventeen common barriers to national climate adaptation policy in Korea and the UK in four categories were identified. Based on previous studies (Swart et al., 2009; Eisenack et al., 2014; Kato and Ellis, 2016; Lonsdale et al., 2017; UNEP, 2018), this research argues that four barriers to national climate adaptation policy commonly occur across contexts: 'low priority of adaptation', 'conflict between government departments', 'lack of political interest', and 'unclear related regulations'. This chapter also identified seven barriers which are specific to national climate adaptation policy: 'frequent rotating of civil servants', 'unclear range of participants of national climate adaptation policy in the current regulations', 'lack of linkage between climate change risk assessment and current issues, and ongoing task'. In addition, 'lack of linkage between different level's climate change risk assessment', 'lack of human resource in a managing department', 'uncertainty of effectiveness of adaptation policy', 'timescale difference between adaptation issues and election periods' offer more detail than identified barriers in previous studies. In terms of a practical understanding, although a financial resource barrier has frequently been reported as an influential barrier (Agrawala, 2005; IPCC, 2007, 2014; OECD, 2009; Biesbroek et al., 2013; Waters et al., 2014), it was not influential in the cases. KC1 commented that "Even if the budget was secured, there were many cases where they don't know what to do for adaptation". Therefore, it emphasises that it is necessary to reconsider the barriers that were taken for granted before for a practical understanding of them. Like mentioned in the previous chapter, these barriers were not explicitly mentioned in official documents related to national adaptation policies in both countries, although stakeholders have experienced them repeatedly in their policy process.

Origins and interdependencies between barriers were analysed, and it observed potential common causal mechanisms in the national climate adaptation policy of Korea and the UK. An empirical understanding of social mechanisms has been emphasised to understand the nature of causality and

explain connections between causes and effects (Hedström and Swedberg, 1998; Gerring, 2008; Mason et al., 2013), and the understanding of mechanisms is important to open up the ‘black boxes’ of barriers and to practically use the results of research on barriers in the actual adaptation process (Wellstead et al., 2018; Biesbroek and Candel, 2019). Also, understanding the mechanisms enables researchers and practitioners to collect diagnostic evidence, theorise variables and empirical examples, and test hypotheses (Kay and Baker, 2015; Wellstead et al., 2018). In this respect, this research identified potential causal mechanisms of common barriers to national climate adaptation policy. By following the arrows in the common barrier map (Figure 6), factors are related to the occurrence of a barrier and connections between the factors are revealed. In addition, as it focused on commonalities, the research results can play a critical role as a milestone to theorise common causal mechanisms of barriers to national climate adaptation policy.

This chapter also indicated the common barriers’ influences in detail and identified their policy implications. this research identified 20 influences caused by barriers, which are common problems of national climate adaptation policy in the UK and Korea. Previous studies on barriers to adaptation focused only on a barrier itself or relationships between barriers without considering the actual impacts on adaptation policy establishment and implementation (Clissold et al., 2020; Fatorić and Biesbroek, 2020; Ghasemzadeh and Sharifi, 2020), and it led to a separation of the barriers from real policy processes (Biesbroek, 2014; Fayazi et al., 2020). However, this research indicated how barriers are influencing the national adaptation policies in Korea and the UK by highlighting concrete influences so that barriers could be better considered within the adaptation policy process. Adaptation policy stakeholders and practitioners can diagnose policy problems that they are experiencing among the influence factors, analyse what barriers and origins are related to the problems and to decide what should be addressed first to solve the problems.

To effectively address overall barriers and reduce the adaptation deficit, this research argues that focusing on overcoming barriers that have simple and a small number of sources first would be practical. It classified the key barriers into three types according to the number of their origins and influence, and this is a new approach to understanding the characteristics of barriers to

adaptation beyond only identifying and describing them. Also, it can be useful for the actual adaptation process; stakeholders can use this approach to devise concrete solutions. For example, in Figure 6, several problems caused by the ‘frequent rotating of civil servants’ barrier can be addressed with solutions that supplement the current civil servant regulation, for example, establishing a ‘boundary organisation (Biesbroek et al., 2010; Bauer et al., 2011)’ that can continuously participate in the whole policy process from outside the civil servant system. By doing so, it could retain continuity and connectivity of adaptation policies as well as expertise and accumulated experiences of the policy. By legally specifying both horizontal and vertical participants of the governance of national climate adaptation policy, it would help to reduce conflicts between government departments, to improve not only connections between national- and subnational-level adaptation schemes but also the inability of dealing with cross-cutting issues. ‘Uncertainty of effectiveness of adaptation policy’ could be overcome through setting a clear M&E regulation and making appropriate indicators for adaptation. If making appropriate indicators is difficult now, governments could set clearly measurable goals for the policy to make sure of the effectiveness of the policy. By availing funds for research programmes, ‘insufficient economic approaches and research on adaptation’ could be addressed. It will help improve low awareness of the urgency of adaptation and continuous low priority of adaptation problems through strengthening the evidence base on adaptation and providing examples of successful adaptation. In addition, these approaches will provide a basis for overcoming more complex barriers.

This research has limitations. First, this research focused on common factors related to national-level barriers, but it cannot deny that context-specific factors can have a great influence on the occurrence of the barriers too. This issue should be dealt with in each case study. Secondly, still, the cases are insufficient to generalise the results of this research. To identify general barriers to national climate adaptation policy and theorise the causal mechanisms, more national-level case studies with the same methodology are required.

Our results have implications for how to go about reducing the adaptation deficit in national climate adaptation policy in Korea and the UK. First, civil servants and stakeholders should examine the problems that they have encountered in establishing and implementing the policy by focusing on the

influence factors. Next, they should identify what barriers cause the influences and determine what are their origins by tracing the causal mechanisms backwards. Then, based on the characteristics of the barriers and the prevailing adaptive/policy capacity, they should prioritise barriers and find out an entry point to overcome the barriers. Doing so would help make adaptation to climate change more effective and efficient and reduce the adaptation deficit.

Chapter 7
A Theoretical Approach for Overcoming Barriers to Adaptation Based on Social Learning Theory

Chapter 7
A Theoretical Approach for Overcoming Barriers to Adaptation Based on Social Learning Theory

7.1. Introduction

It is considered that the barriers to adaptation can explain the current adaptation deficits (Valente and Veloso-Gomes, 2020), as the barriers prevent adaptation plans from linking to the implementation of practical measures and make adaptation actions slow and, often, unsustainable (McNamara, 2013; Wise et al., 2014). Simoes et al. (2017) emphasise that overcoming the barriers is pivotal to reducing adaptation deficits. However, discussions on how we can address the barriers to adaptation and what concrete solutions are required are limited in previous studies (Waters et al., 2014; Wise et al., 2014; Liu et al., 2020). Although existing literature suggests diverse solutions (Waters et al., 2014; McClure and Baker, 2018; Spires and Shackleton, 2018; Fatorić and Biesbroek, 2020), most of them are too normative and general to apply to the actual adaptation processes or too context-specific for a unique case (Clar et al. 2013; Eisenack et al., 2014). In addition, because research on barriers to adaptation is a relatively new research field, there are few theoretical approaches based on the social and policy sciences. It leads to a lack of generally applicable knowledge in this research field (Dupuis and Knoepfel, 2013).

Meanwhile, there are clear and deep connections between barriers to adaptation and common features of wicked problems. Wicked problems have common features: complexity, uncertainty, interdependency, difficulty, a lack of knowledge, complex engagements, controversy, and so forth (Lazarus, 2009; Carlile et al., 2013; Brown, 2015; Perry, 2015; van Epp and Garside, 2019). There is no single root cause of wickedness and no single best approach to address such problems (Head and Alford, 2012), and non-traditional approaches are required to deal with them. Adaptation issues include all the features of wicked problems and have higher wickedness than other issues because of inherent uncertainty, time-taking benefits, and low priority (Perry, 2015; Termeer, 2016; Mudombi et al., 2017; Brown et al., 2018; Russel et al., 2020); thus, adaptation issues are considered super wicked problems (Lazarus, 2009; Jones and Preston, 2011; Fisher and Dodman, 2019).

With cross-sectoral adaptation policy natures, inherent uncertainties and a wide range of stakeholders, national climate adaptation policy explicitly presents the common features of wicked problems. Wicked problems are generally associated with social pluralism (multiple interests and values of stakeholders), institutional complexity (inter-organisational cooperation and multi-level governance), and scientific uncertainty (fragmentation and gaps in related knowledge) (Head and Alford, 2015). Barriers to national climate adaptation policy processes identified in Chapters 5 and 6 show clear and deep connections with the three aspects. For example, the ‘unclear range of participants of national climate adaptation policy in the current regulation’ is associated with the ‘institutional complexity’, the ‘uncertainty of effectiveness of adaptation policy’ is related to the ‘scientific uncertainty’, and ‘continuous low priority of adaptation’ is associated with the ‘lack of knowledge’.

Based on the connections, this chapter asserts that analysing and understanding barriers to adaptation help understand the wickedness of climate change adaptation and provide practical insights into devising approaches to address the wicked problem. Therefore, this chapter aims to apply a theoretical approach to real cases to understand the current state of a national climate adaptation policy (a super wicked problem) and provide practical insights into addressing the current adaptation problems through dealing with barriers to national adaptation policy processes. In order to do this, first, based on the social learning theory that has been suggested to address wicked problems, it adopts and re-defines a theoretical framework that can diagnose social learning levels of adaptation actions. Secondly, with the identified barriers and related data from Chapter 6, it applies the framework to the UK and Korean cases and diagnoses the social learning levels of their national climate adaptation policy. Lastly, it suggests directions for overcoming barriers to national climate adaptation policy processes that aim to move towards higher levels of social learning.

7.2. Developing a Theoretical Framework for Adaptation Contexts

7.2.1. Multi-loop learning approach

In Section 2.5., the thesis justified why social learning theory is appropriate to address wicked problems. In short, social learning theory and its approaches include the key factors for better addressing wicked problems (governance,

communication, coordination, and learning) and policy study themes (policy design, policy deliberation, policy reform, effective implementation, policy evaluation, policy legitimation, etc.) and provide practical help to public policy fields.

Various approaches have been suggested and used in previous research on social learning for adaptation. For example, based on characteristics of social learning outcomes, Fisher and Dodman (2019) analyse three domains: cognitive (factual information), normative (norms, values, and beliefs), and relation (trust, networks, and relationships). van Epp and Garside (2019) analyse four major elements of social learning to see social learning approaches in the context of climate change and food security: engagement, iterative learning, capacity development, and challenging institutions. Mudombi et al. (2017), in terms of transformations, suggest three forms of transformations (cognitive, relational, and technical) to diagnose social learning in climate change adaptation initiatives in South Africa. Although previous approaches have provided valuable results, this chapter considers that 'multi-loop learning' is the best approach that can include the key factors and policy study themes mentioned above, with concrete theoretical foundations in previous studies.

Although learning is not linear, it is an iterative process with multiple feedbacks or learning loops (Henly-Shepard et al., 2015). Argyris and Schon (1974) first introduced single- and double-loop learning in the organisational theory area. Following this theoretical scheme, the term triple-loop learning has been developed by many authors from various research fields, which describes metaphorically a higher and deeper level of learning than single- and double-loop learning (Swieringa and Wierdsma, 1992; Isaacs, 1993; Flood and Romm, 1996; Peschl, 2007; Pahl-Worstl, 2009; Nicolaides and McCallum, 2013; Kwon and Nicolades, 2017). Three learning loops play an important role in detecting and correcting errors or problems that actors face (Argyris and Schon, 1996).

Single-loop learning solves problems with incremental improvements of established routines, existing methods and actions without questioning underlying assumptions (Argyris and Schon, 1974; Pahl-Worstl, 2009; Tran et al., 2020). Learners focus on the best means to achieve their defined goals, by asking "Are we doing things right?" (Flood and Romm, 2018), rather than asking why the problems occur (Kwon and Nicolades, 2017).

Double-loop learning inquires into the assumptions that govern the established routines, existing methods and actions. Means and goals are recognised as problematic, asking “Are we doing the right things?” (Argyris and Schon, 1974; Flood and Romm, 2018). It leads to a reframing of our cognitive schema, goals and problem framing, and assumptions on how goals can be met. Improvement is achieved with innovative approaches, new kinds of measures, and fundamental changes in our behaviour (Pahl-Worstl, 2009; Kwon and Nicolades, 2017). In this process, learners encounter structural constraints that stabilise dominant frames (Pahl-Worstl, 2009).

Beyond single- and double-loop learning processes, triple-loop learning is directly associated with the transformation of existing structural context and shifts in norms, values, and paradigms (Pahl-Wostl, 2008; Medema et al., 2014). It refers to inquiry into values, norms, and beliefs that determine the dominant frames, existing assumptions and actions (Keen and Dyball, 2005; Tran et al., 2020), addressing the question “How do we decide what is right?” (Johannessen et al., 2019). As the basis for processes of the most fundamental and profound change (Peschl, 2007), triple-loop learning leads to radical innovations and transformation of structural context as well as governance regime. Pahl-Worstl (2009) notes that the structural change through triple-loop learning will lead to a transition of actor-networks where new actor groups come into play, boundaries and power structures are changed, and new regulatory frameworks are introduced.

Also, given that the multi-loop learning approach emphasises its role in detecting and overcoming errors and barriers that actors face (Argyris and Schon, 1996; Pahl-Wostl, 2009), it was expected that the approach could provide proper theoretical insights into addressing barriers to adaptation processes.

7.2.2. Developing a theoretical framework

This chapter adopts and re-defines a theoretical framework to apply the concepts of social learning and multi-loop learning to an adaptation context from Pahl-Wostl's (2009) conceptual framework. Pahl-Wostl (2009) suggests a conceptual framework to analyse adaptive capacity and multi-loop learning process in governance regimes. Assuming that multi-level governance regimes and multi-loop learning

processes improve adaptive capacity and sustainability beyond traditional policy regimes and processes, it emphasises that we need a systematic framework to diagnose and analyse the dynamics of multi-level and complex governance systems and social learning processes. To deal with the complexity of governance systems more systematically, Pahl-Wostl (2009)'s framework introduces four dimensions of governance regimes (institutions, actor networks, multi-level interactions, and governance modes) and uncertainty as important aspects of governance regimes.

Institutions denote rules governing the behaviour of actions, which are classified into three types: regulative, normative, cultural-cognitive. Pahl-Wostl (2009) defines three types of institutions as below.

Regulative institutions can be identified with formal legal structures, regulatory frameworks, formalised professional rules of good practice as typically codified in professional handbooks. The introduction of new regulative institutions is associated with high transaction costs. Hence a broader interpretation of existing institutions will most likely be the first approach for widening the scope of existing regulatory frameworks. Normative institutions can be identified with informal societal norms, shared but not codified rules of good practice. Normative institutions reflect value structures. Contrary to regulative institutions, change is not based on negotiations and formal agreements but is more gradual and emergent. Cultural-cognitive institutions can be identified with paradigms, mental models that strongly influence system understanding, how boundaries are delineated, the search space for problems and solutions are determined. Similar to normative institutions, change is not negotiated but enacted in shared practices (Pahl-Wostl, 2009, p.356).

Actor networks are also emphasised as governance includes a broader set of stakeholders than the traditional form of governmental authority and control. Actor networks are mainly about the participation of diverse actors in governance for policy or institution development and implementation. State and non-state actors are involved in designing the institutions that govern their behaviour, which is expected to increase the compliance and effectiveness of the institutions (Pahl-Wostl, 2009). In addition, the participation of actors in the policy can reduce uncertainties in the policy implementation process with increased compliance and reduced likelihood of unexpected resistance (Newing et al., 2005; Pahl-Wostl, 2009).

Multi-level interaction focuses on two aspects: dispersion of authority and vertical and horizontal interplay between actors. Based on the concept of a polycentric political system which is a system of many centres of decision-making that are formally independent of each other (Ostrom et al., 1961), multi-level governance should refer to a polycentric governance system. The decision-making authority is distributed in a nested hierarchy and does not reside at one single level, such as a national or local government, and many degrees of freedom at different levels are guaranteed. Also, polycentric systems are presumed to have a high adaptative capacity for sudden changes or failures of the systems and environment (Ostrom, 2001; Pahl-Wostl 1995, 2009). In addition, effective interplay and coordination between horizontal and vertical actors are essential for environmental governance. Fragmentation between different levels is proved to be a barrier (Pahl-Wostl, 2009).

There are three modes of governance: bureaucratic hierarchies, markets, and networks. These modes differ along the dimensions of the formality of institutions and the role (or power) of state and non-state actors in governance. Bureaucratic hierarchy mode is based on highly formal institutions and governmental actors who have dominant roles. In market processes, a combination of formal and informal institutions governs the processes, and non-state actors dominate them. In network governance, both state and non-state actors participate in an informal institution that largely govern the governance (Pahl-Wostl, 2009).

Given the importance of handling uncertainty for adaptive governance approaches, the conceptual framework includes uncertainty as its own category with other governance regime categories (Pahl-Wostl, 2009).

This research adds ‘resources’ as a category that needs to be considered in the analysis of adaptation policy to the framework. Adaptive capacity refers to available resources and the ability to utilise resources appropriately (Nelson et al., 2007). Proper distribution of resources is regarded as a core of adaptation (Kelly and Adger, 2000). In addition, resources have been identified as a major barrier to adaptation (see Agrawala, 2005; IPCC, 2007, 2014; OECD, 2009; Biesbroek et al., 2013; Waters et al., 2014).

Based on the categories suggested by Pahl-Wostl (2009), this research re-defines the categories for adaptation contexts. The term institutions refer to the rules that govern adaptation actions. Regulative institutions involve formally codified regulations associated with national climate adaptation policy and its policy process, such as Acts, regulations, formal adaptation policy development and implementation processes and monitoring and evaluation. Normative institutions include non-codified norms, expectations, policy systems and the relationship between stakeholders. Cultural-cognitive institutions include, for example, awareness and understanding of adaptation, climate change and adaptation scepticism and lack of interest in and inattention to adaptation. Actor-networks are about the range of participants and their roles in the policy process. Multi-level interactions involve horizontal interaction between governmental departments and vertical interaction between the national government and the supra- or sub-national stakeholders. There are three broad modes of governance: bureaucratic hierarchies, markets, and networks, which differ in terms of the formality of institutions and the role and power of involved actors (see Pahl-Wostl, 2009). Uncertainty encompasses both uncertainties of climate change projections and adaptation policy results and how adaptation policy and its policy process address them. Resources focus on the amount of and distribution of financial and human resources for meeting the goal of the policy.

Thus, a framework, Table 6, summarising a series of changes expected at different levels of social learning in each category is suggested.

Table 6 Characterisation of changes expected for multi-loop learning (adopted and re-defined from Phal-Wostl, 2009)

	Single-loop	Double-loop	Triple-loop
Institution-general	No calling into question of established institutions, signs of unilateral reinterpretation	Reinterpretation of established institutions by many parties	Established institutions changed and/or new institutions implemented
Regulative institutions	Existing regulations are strictly followed and used to justify established routines	Regulatory frameworks identified as major constraints for innovation	Formal substantial changes in regulatory frameworks, new policies implemented
	New by-laws and interpretation of existing law to accommodate exceptions	More juridical conflicts about rule interpretation	Institutional change towards more flexible regulations that leave room for context-specific implementation. More process regulations
		Exemptions allowing innovative approaches and experimentation	
Normative institutions	Established norms are used to justify prevailing system Relying on codes of good practice	Established norms and routines are called into question	Change which can be identified in public discourse and new
Cultural-cognitive institutions	Discourse remains in established paradigms that are refined	New ideas emerge beyond isolated groups	Discourse dominated by new paradigm (media, political debate, public hearings, scientific conferences)
	Radical alternatives clearly dismissed	Strong arguments about alternative views – "ideological" debates	Powerful representatives of "mainstream" argue in a new paradigm

	Single-loop	Double-loop	Triple-loop
Uncertainty	Uncertainty used to justify non-action	Uncertainty accepted and perceived as opportunity in processes of negotiations and reframing	Uncertainty discourse emphasises different perspectives and world views
	Activities to reduce uncertainties. Reliance on science to find the truth/a solution	Existence of different perspectives and world views explicitly acknowledged	New approaches to manage uncertainty (e.g. participatory scenario development) and risk (e.g. risk dialogues, robust action) are implemented with corresponding efforts to change structural constraints
	Discourse focuses on technical approaches to dealing with uncertainty with a goal to improve predictive capabilities	Established approaches to managing uncertainty and risks are called into question	Conscious decision-making under (irreducible) uncertainty with the prospect of adapting the measures when necessary
Actor network	Actors remain mainly within their networks – communities of practice	Explicit search for advice/opinion from actors outside of established network (e.g. invitation to meetings)	Changes in network boundaries and connections
	Established roles and identities are not called into question	New roles emerge – e.g. facilitators in participatory processes	New actor groups and roles have become established
		Arguments about identifying frames – e.g. what does it mean to be an "engineer"	Changes in power structure (formal power, centrality – new actors in centre)
		Boundary spanners of increasing importance that start to connect different networks-communities of practice	Identify frames/roles get blurred/less important, rather joint approaches than isolated performance according to one's role

	Single-loop	Double-loop	Triple-loop
Multi-level interactions	Vertical coordination in established patterns – e.g. increased regulation from the top level	Increased informal knowledge exchange between levels	Formalised participation of actors of different levels
	Pattern of flow of authority (by an institution does not change, Mainly uni-directional	Informal coordination groups to improve exchange in planning processes established	Established practices of knowledge exchange across levels More polycentric structures and balance between bottom-up and top-down approaches
Resource	Established resource system is not questioned	Changes in established resource systems are asked	New resource system is established with flexible regulations
	Effective use within distributed resources is required, Purpose of distributed resources can not be changed	Flexibility of distribution of resources is emphasised, Flexible utilisation of resources is required	Total resources and their utilisations can be changed when necessary
	Resource distribution is decided by a small number of restricted members	Involving various voices is required for making decisions for resource distribution	Various stakeholders participate in decision-making processes
Governance mode	No change in the relative dominance of governance types	Other than dominant governance types start to become more visible and dominant governance type called into question (e.g. discussion of market- based instruments if absent before, introduction of participatory approaches, emergence of bottom-up participatory processes, argument about dominance of one type)	New governance types implemented established governance types substantially changed

	Single-loop	Double-loop	Triple-loop
	Improvement of performance within established governance modes	Informal networks shaping discourse and supporting experimental innovations become more prominent	More diverse governance structures-less dominance of one type Learning networks challenging dominating structural assumption become effectively connected to and influence established policy arenas

7.3. Applying to Real Cases

This research applies the re-defined theoretical social learning frameworks to real cases, national climate adaptation policy and policy processes in Korea and the UK. By interpreting identified barriers to national climate adaptation policy processes and related origins and influences with the criteria in the framework, it diagnoses social learning levels of each country's national climate adaptation policy and suggests directions for overcoming the barriers that aim to go towards higher levels of social learning.

7.3.1. Data

As mentioned above, barriers to adaptation have connections with common features of wicked problems as well as they are associated with all categories of the developed theoretical framework in Section 7.3 (institutions, uncertainties, actor networks, multi-level interactions, resources, and governance mode). Also, this is important that higher levels of social learning can be attained only when lower-level barriers are encountered and overcome (Pahl-Wostl, 2009). Thus, focusing on the barriers to adaptation can be the best way to diagnose the current social-learning level of adaptation, to understand the currently related adaptation policy problems, and to move towards a higher social learning level of adaptation than the current one. Thereby, theoretically, a society can have higher adaptive capacities to climate change.

Therefore, this research considered that the identified barriers to national climate adaptation policy processes in Korea and the UK and analysis results on the barriers' origins, influences, and relationships in Chapter 6 are the most proper data. Based on the lists of participants of National Climate Change Adaptation Plans (NCCAPs) of Korea and Climate Change Risk Assessments (CCRAs), research in Chapter 6 conducted 41 semi-structured interviews with key stakeholders (23 in Korea and 18 in the UK) between 10th April and 25th October 2019. The interviewee groups included (A) civil servants of the managing departments (MoE, Defra); (B) civil servants of other government departments; (C) experts of official supporting institutes (KACCC, CCC), and (D) sectoral experts. Also, (E) experts of local-level adaptation policy were interviewed. The interviewees were codified according to their country (K or U), group (one of A to E), and interview order (number). The interviewees were

asked mainly three questions: 1) based on your experience, what are the barriers to national climate adaptation policy? 2) what problems are caused because of the barriers? 3) what are the reasons for the barriers? All interviews were recorded and transcribed.

Focusing on commons between two countries, Chapter 6 elaborated on the barriers to national climate adaptation policy processes in Korea and the UK in detail with the transcribed interview responses. It included an analysis of the barriers' origins, influences and relationships between them. By mapping the relationships, it presented a barrier map of national climate adaptation policy processes in Korea and the UK and showed potential causal mechanisms of the barriers. It also provided concrete information about the current state of the Korean and the UK national adaptation policies.

7.3.2. Analysis

In this chapter, the research results from Chapter 6 and the transcribed interview responses are interpreted through criteria in the theoretical framework in Section 7.3. By doing so, it diagnoses the current social learning levels of national climate adaptation policy in Korea and the UK and suggests directions for overcoming barriers to national climate adaptation policy processes. The diagnosis process consists of three steps. It first checks which identified barriers are associated with each category in the framework (institutions, uncertainties, actor networks, multi-level interactions, resources, and governance mode). Second, it analyses interview responses related to each barrier based on the criteria of the framework and determines the social learning level of each category of the country's national climate adaptation policy. Lastly, it presents the general social learning level of the national climate adaptation policy of Korea and the UK by summing all social learning levels of each category. Based on the analysed social learning levels of each category, directions for overcoming the identified barriers in each category are suggested aiming at moving to higher social learning levels. The diagnosed social learning levels of national climate adaptation policy in Korea and the UK are described in the next section, and the suggested directions for overcoming the identified barriers are explained in the discussion section.

7.4. Results

7.4.1. Social learning levels of Korea national climate adaptation policy

The results of analysis through the re-defined framework show that the national climate adaptation policy of Korea is generally in single-loop learning. In other words, the Korean adaptation policy system is pursuing solutions for its problems mainly through incremental improvements based on established routines and existing methods/actions. It also focuses on the best means to achieve pre-defined goals within the established system. Only regulative institutions and resources categories are in double-loop learning, questioning the established systems, routines, and actions. The social learning levels of each category are described in detail next.

Regulative institutions are seen to move towards double-loop learning. Stakeholders questioned the established regulatory frameworks and singled them out as barriers to national climate adaptation policy. The current Act, Framework Act on Low Carbon, Green Growth (2010), is required systematic revisions and amendments for adaptation by adding more details to support the National Climate Change Adaptation Plans (NCCAPs) legally. KD6 said, “The importance of adaptation is not sufficiently reflected in the current Act; most of the Articles are about mitigation. … It has been about ten years with the Act, and it is time to amend it to emphasise the importance of adaptation legally”. KA1, KA3, KA5 emphasised that because the range of the participating actors is not legally clear, other departments are not actively participating in the policy, and some even refuse to participate. Interviewees also pointed out that the absence of regulations for monitoring and evaluation of the policy is a clear barrier to national climate adaptation policy (KC3, KD2, KD5, KD10, KE1). KC2 said, “There are no legally established evaluation systems and indicators for national climate adaptation policy”. Cultural-cognitive institutions are in single-loop learning. Low awareness and indifference of adaptation, especially in government departments, are repeatedly mentioned. The current adaptation discourse does not have explicit implications for other sectors’ current issues or works. Adaptation is always considered an issue for the future or added works. Thus, adaptation has a low priority among government works (KC2, KD1, KD2). KC1 stressed that many participants, even some of the policy practitioners, don’t know what they need (or can) do for adaptation under the current adaptation discourse

and understanding. In relation to normative institutions, the Korean national climate adaptation policy is in single-loop learning. The 2nd NCCAP established ‘Principles of climate change adaptation for sustainable development to guide adaptation policies and actions, and the current adaptation policy system is justified by the principle. None of the principles is called into question.

The uncertainty of climate change projections and impacts is in double-loop learning. Stakeholders accept the uncertainty and recognise that it cannot be eliminated. They also acknowledge that they need to make decisions and implement their adaptation policy under the uncertainty (KA3, KD3, KD8). NCCAPs also invest enough resources into climate change science and projections to reduce the uncertainty (KD5). Nevertheless, there is no effort to change structural constraints related to the uncertainty and make alternative measures to address the irreducible uncertainty. Thus, this category is in double-loop learning. In contrast, it is in single-loop learning in terms of the uncertainty of adaptation policy results. This uncertainty is used for the reason for inactive attitudes of participants and lack of adaptation actions. KD2 said that departments don’t want to implement adaptation policies because it is hard to show clear achievements of the policy, which leads to a lack of justification of their participation in the national climate adaptation policy. Interviewees also said that civil servants and decision-makers are reluctant to invest in long-term policies that have uncertain outcomes (KB1, KD10, KE3).

The actor networks of NCCAPs is in single-loop learning. Not all stakeholders are involved in the national policy processes. Only a few experts and civil servants engage in the policy as part of their established roles and identities. Also, there is no continuous communication system that includes various stakeholders (KA1, KA5, KD1). Interviewees said, “It remains at the expert level as to what adaptation is and what we can do, the public does not take the issue seriously (KD6)”. “Even there is no clear way for the public to participate in adaptation issues (KD5)”. The roles of other stakeholders (e.g. local authority, business, NGOs) remain undefined in NCCAPs as well as the current regulations.

NCCAPs are in single-loop learning on multi-level interactions. Horizontal and vertical interactions are addressed in a top-down way based on established

regulations, and coordinated adaptation actions across levels are absent. There were only a few formal horizontal coordination events, such as formal across-department meetings, and the government departments' indifference and inactive attitudes are pointed out as barriers to national climate adaptation policy (KA1, KA3, KA5, KD10). Vertical interaction and coordination have received even less attention. There is seldom coordination between the national climate adaptation policy and local level adaptation policies. They have different timeframes and are implemented in isolation, and there is little evidence of knowledge exchange through vertical interactions. KD8 emphasised that "There is no concept of linkage between national climate adaptation policy and local adaptation policies, and there is no discussion on it too.". KC3 said, "In the process of national climate adaptation policy, a bottom-up way to make adaptation measure or assess climate change risks was never considered. Processes of national climate adaptation policy and local adaptation policies are separated.".

The national climate adaptation policy of Korea is in double-loop learning in terms of resources. Financial and human resources are allocated under an established resource system that includes a small number of people for decision-making, and flexible changes of the allocated resource are not possible. Interviewees highlighted problems with the current system, such as lack of budget for adaptation and too frequent rotation of civil servants. KE2 suggested that "expertise and continuity are needed in adapting to climate change, but it is difficult to maintain the two things with the current civil servant institutions". Interviewees call for the improvement of the current system by amending the related regulations, in tune with the views of other stakeholders. Also, interviewees emphasised that adaptation policy should have its own resources in the adaptation budget (KC1, KC2, KD10).

NCCAP has a bureaucratic hierarchical governance mode which is in single-loop learning. It is based on a formal Act, and there are no related informal institutions about adapting to climate change. Governmental actors play dominant roles in the process of the policy. There is no role for local governments, private sectors or civil society. During the implementation of the first and second NCCAPs, the mode of governance has remained unchanged. Performance improvements have been sought by changing the structure of the NCCAP and extending the list of participating departments within the existing bureaucratic hierarchical governance mode.

7.4.2. Social learning levels of the UK national climate adaptation policy

Generally, the social learning levels of the national climate adaptation policy of the UK are in between single-loop learning and double-loop learning. Similar to the Korean case, cultural-cognitive institutions, actor network, multi-level interactions, and governance mode are in single-loop learning, focusing on incremental improvements and the best means to achieve pre-defined goals within the established system. However, regulative institutions, uncertainty, and resource are in double-loop learning. In the double-loop learning level, the assumptions that govern the established routines, existing methods and actions are called into question, and existing means and goals are recognised as problematic and are required to be changed.

Regulative institutions are in double-loop learning. The UK interviewees raised questions about the established regulatory frameworks, mainly the Climate Change Act 2008 and pointed them out as barriers to the national climate adaptation policy of the UK. The current Act and regulations are required to add concrete provisions, especially about accountabilities of stakeholders and amend for systematic operations of major components (Climate Change Risk Assessment (CCRA), National Adaptation Programme (NAP), Adaptation Reporting Power (ARP), and subnational level adaptations) in the adaptation scheme of the UK. Although the Climate Change Act 2008 sets several schemes for adaptation, only CCRA and NAP are organised systematically (UB2, UD1). There are mismatches between cycles of CCRAs, NAPs, APR and subnational level adaptation. UD9 also said, “It is a legal question, who is accountable for adaptation? The NAPs set to do things, but no one is accountable … Lack of legal measures means nothing happening”. Cultural-cognitive institutions are in single-loop learning; in other words, the adaptation discourse remains in the current paradigm, and no radical alternatives are embraced. First, interviewees responded that climate change is badged as an environmental issue, and it does tend to be mitigation, although climate change adaptation has come up as an agenda (UA4, UB4). As climate change adaptation is regarded as an environmental issue, it is not given the importance that economic and social issues are given, and there is no clear answer to convincing the public and the Cabinet Office (UD9). Interviewees stressed that adaptation needs to be recognised as an economic and social issue. UA4 mentioned, “(in the current adaptation discourse) our

challenge entirely is to get over the message that climate adaptation is for everyone and every part". Secondly, in the current adaptation discourse, adaptation is considered an issue in the future, and actions for adaptation are add-on works. Adaptation is regarded as a long-term issue where people need to do things now to get benefits 50 or 100 years later (UA2, UA3, UC1). With short-term political cycles and election periods, adaptation always does not have a top priority against other economic and social issues. Also, UB2 mentioned, "it (adaptation) was never something that government departments put much money. I think it was always kind of add-on works on the side of the engine". In terms of normative institutions, the UK national climate adaptation policy is in no learning. Stakeholders do not have official norms shared in the policy process. An expert pointed out that there are no strong institutional norms to apply to the UK national climate adaptation policy, and it is a barrier to the national climate adaptation policy of the UK.

The uncertainty of climate change projections and impacts is in double-loop learning. Stakeholders of the national climate adaptation policy of the UK accepted the uncertainty and recognised that they have to make decisions with uncertain measured values about climate change projections. Also, the uncertainty of climate change projections and impacts is not used to justify non-action for adaptation. UD3 said, "it is not 100% certain, so, we should be able to say that under this condition, this is the risk that we need to focus. … But we also need to have very transparent ways of making assumptions and evidence, not being relaxed about climate change evidence". Similar to Korea, there is no effort to change structural constraints related to the uncertainty and to make alternative measures to address the uncertainty of climate change projection. In terms of the uncertainty of policy results, it moves toward double-loop learning beyond single-loop learning. There is clearly the uncertainty about adaptation policy results in the UK, and stakeholders have difficulties in finding suitable indicators for evaluating the effectiveness of adaptation policies (UA2, UA3, UA4, UD9). However, the UK national climate adaptation policy has a system to monitor and evaluate the policy results. Through regular reports of progress in preparing for climate change published by the Adaptation Committee, the national climate adaptation policy of the UK is officially evaluated, and the stakeholders are working on making better strategies for monitoring and evaluation to supplement the uncertainty of adaptation policy results (UA1, UC1). Also, unclear policy results do not justify non-actions for adaptation (UA4).

The actor networks of the national climate adaptation policy of the UK is in single-loop learning. Various actors from various levels are not engaged in the process of the policy. Only a few civil servants and experts engage in the policy, focusing on their established roles and identities. Advice and opinion from actors outside of the established national level actor network are not actively considered. Interviewees said that climate change adaptation is addressed by high-level people in the government and it misses out a lot of important people to engage in. UC1 said, “The second NAP is even worse than the first programme in terms of engagement. … There has been a lot less engagement because of shrinking financial and human resources. They were not able to do that engagement. … So, outside government as well as inside government but it is not very well jointed together”. UD9 also stressed that actors of the national climate adaptation policy want to concentrate only on national level actions and network.

In terms of Multi-level interactions, the national climate adaptation policy of the UK is in single-loop learning. The policy has top-down ways to interact with horizontal and vertical stakeholders based on established regulations, and there are no multidirectional interactions. Although stakeholders recognise that cross-cutting coordination and work are needed for national adaptation, a lack of connection and coordination between government departments is repeatedly pointed out as a barrier (UA4, UB3). UC1 said that although the national climate adaptation policy is a cross-government policy, there is no cross-government adaptation measure. Also, there is no interaction between different governments of the UK; each government has established and implemented its policy separately. In terms of vertical interactions, there is no knowledge exchange between national-level adaptation and subnational level adaptation, and national level stakeholders do not know how much information of their national-level policy is used in subnational level adaptation. UB2 emphasised that ARP schemes and local adaptation policies are getting more isolated from the national-level adaptation actions.

The resource aspect of the national climate adaptation policy in the UK is in double-loop learning. The current systems related to financial and human resources are required to be changed. Most of all, there is no specific fund for adaptation, and financial resource for adaptation mainly depends on other

departments' budget, not Defra or CCC. UC1 said, "It is difficult to make a case for funding to make adaptation to the department like Treasury because it is always seen as an issue in the future that we can do in the future". Also, flexible use of distributed funds is required. There are only a few people in the department for adaptation policy. Compared to mitigation, the number of human resources is very small. Civil servants who take charge of the policy require more people in their department to address all aspects of the national climate adaptation policy properly. In addition, the current frequent turnover system of civil servants is pointed out as a barrier, and measures that can supplement the system are required.

The UK national climate adaptation policy has a bureaucratic hierarchical governance mode and it is in single-loop learning. The current governance for national climate adaptation policy is based on highly formal institutions (mainly the Climate Change Act 2008), and there are no informal institutions for national adaptation. Also, actors from government departments play dominant roles in the process of the policy. There was no change in the governance mode during the first and second policy periods, and stakeholders have tried to improve the performance of the policy within the established governance mode. Still, there is no attempt to involve other governance modes or informal networks in the process of the national climate adaptation policy.

The social learning levels of national climate adaptation policy in Korea and the UK are summarised in Table 7.

This diagnosis provides evidence for critical reviews of national climate adaptation policy and its process in Korea and the UK, and it can be a foundation of social learning cycles (Kolb, 1984; Johannessen et al., 2019).

Table 7 Social learning levels of national climate adaptation policy in Korea and the UK

Category	Social learning levels of Korea	Social learning levels of the UK
Institution		
Regulative institutions	Double-loop	Double-loop
Cultural-cognitive institutions	Single-loop	Single-loop
Normative institutions	Single-loop	Zero-loop
Uncertainty		
Uncertainty of climate change projection and impact	Double-loop	Double-loop
Uncertainty of adaptation policy result	Single-loop	Double-loop
Actor network	Single-loop	Single-loop
Multi-level interaction	Single-loop	Single-loop
Resources	Double-loop	Double-loop
Governance mode	Single-loop	Single-loop

7.5. Discussion

Given that climate change adaptation is an iterative learning process for changing environments (Collins and Ison, 2009; Reed et al., 2010; Johannessen et al., 2019; Orsato et al., 2019), approaches based on social learning have been considered to address adaptation issues and to build adaptive capacities (Pelling et al., 2008; Pahl-Wostl, 2009; Albert et al., 2012; Mudombi et al., 2017; Tran et al., 2020). The social learning approach's potentials are more emphasised with the nature of adaptation as a super wicked problem (Levin et al., 2007; Gupta, 2016; Fisher and Dodman, 2019) as it can deal with the key factors for better addressing wicked problems. However, it has been rarely discussed how the approaches can be applied to real adaptation processes and how the wickedness of adaptation can be addressed (Ensor and Harvey, 2015), and social learning literature has

pointed out that evidence to support the theoretical argument is insufficient (Lebel et al., 2010; van Epp and Garside, 2019). In this regard, this chapter provides important contributions in terms of academic and practical adaptation policy aspects by 1) connecting the concept of social learning and wicked problems with barriers to adaptation, 2) adopting and re-defining a theoretical framework for adaptation contexts, and 3) operationalising the framework to Korean and the UK national climate adaptation policy cases.

When a group's perspective is inconsistent with their experience, a social learning cycle starts, and it leads to a critical review of an issue (Kolb, 1984; Johannessen et al., 2019). In terms of climate change adaptation, this research argues that barriers to adaptation explain reasons for the inconsistency between adaptation needs and adaptation actions, and we can critically review the current adaptation policy by analysing identified barriers to the policy processes, thus, identifying and addressing barriers to adaptation can be a proper way for social learning in climate change adaptation policy. The application of social learning to adaptation contexts is also justified by connecting the common features of wicked problems and barriers to adaptation in this research (Fisher and Dodman, 2019). In addition, panaceas for overcoming barriers suggested by previous studies have weak explanatory power and are not useful for practice policy processes (Pahl-Wostl, 2009), but this research reinforces the explanatory power of suggestions for overcoming barriers to adaptation through the social learning theory, especially the multi-loop learning approach.

Secondly, by redefining a theoretical framework for adaptation contexts and operationalising it for the real adaptation cases, it showed how the social learning theory approach can practically inform adaptation policy processes. There are uncertainties that hinder applying social learning approaches to realities, such as how social learning is done, how it is measured, and what outcomes it can achieve (Ensor and Harvey, 2015), and an analytical framework has been required to justify what is needed for higher-levels of social learning (Fisher and Dodman, 2019). Based on identified barriers and their contexts, it allowed us to understand the current social learning levels of national climate adaptation policy in the UK and Korea. In other words, through the theoretical analysis, adaptation policy stakeholders can see where their key elements of adaptation governance are (institutions, uncertainty, actor network, multi-level interactions, resource, and governance

mode) and what they can do for better adaptive capacity aiming to move towards higher levels of social learning (Pahl-Wostl, 2009). Also, by applying the same framework to multiple cases, it made it possible to compare the current levels of adaptation in two countries, which can contribute to producing generalised knowledge and theorisation of approaches to understand barriers to adaptation with theoretical grounds (Dupuis and Knoepfel, 2013; Eisenack et al., 2014).

Lastly, it provided practical insights into overcoming barriers to adaptation policy processes, which leads to the current adaptation moving to higher learning levels. Learning is an iterative process with learning loops through integrating cooperation structures and advancing information management (Pahl-Wostl, 2009; Henly-Shepard et al., 2015). However, it remains unanswered that how to overcome the state of single-loop learning of climate change adaptation, which is so-called “lock-in” situation that blocks changes toward higher levels of social learning (Pahl-Wostl, 2002; Pahl-Wostl et al., 2008; Johannessen et al., 2019). Given that the multi-loop learning approach emphasises its role in detecting errors and gaps that actors face and higher learning levels can be achieved through overcoming them (Argyris and Schon, 1996; Pahl-Wostl, 2009; Johannessen et al., 2019), directions for potential solutions to escape the “lock-in” situation can be suggested through addressing identified barriers that are related to the current social learning level. Theoretically, solutions for the barriers related to single-loop learning categories should question previously held beliefs, assumptions, information or shared understanding (Argyris, 2005; van der Wal et al., 2014), and the current means and goals also need to be recognised as problematic (Argyris and Schon, 1974; Flood and Romm, 2018). The solutions lead to reframing the current cognitive schema, problem framing and approach for how goals can be met, which should transform the current strategies (Pahl-Worstl, 2009; Kwon and Nicolades, 2017). Solutions for the barriers in double-loop learning categories should be directly related to transformations and changes in regulatory frameworks, practice and governance structures and produce shifts in norms and values as well (Medema et al., 2014; Johannessen et al., 2019). Solutions should lead to new structures reflecting on lessons learned, which are widely informed through the various voice of participants (McClory et al., 2017). Through the solutions, actions and reflection to overcome the barriers need to be taken place simultaneously (Kwon and Nicolades, 2017). Therefore, directions for potential solutions for overcoming barriers in each

country can be suggested below (concrete suggestions for each country are written in italics). The suggestions are presented based on the current social levels of each category, and they include some different directions for the same barrier according to the social learning levels of each country.

Regulative institutions

Both countries' national adaptation policies are in double-loop learning in terms of regulative institutions. In order to move towards triple-loop learning, substantial changes in formal regulatory frameworks and new policy implementations are required, and institutional changes need to involve more flexible regulations that leave room for context-specific implementation. Thus, identified barriers and origins related to regulation institutions should be overcome in the direction of officially revising the current regulations and applying the revised regulations to actual policy implementations. *Concretely, the Acts related to adaptation in both countries need to be revised, adding more details about a clear range of stakeholders of the policy and the stakeholders' accountabilities, emphasising the importance of climate change adaptation. Adding regulations for monitoring and evaluation of the policy (in Korea) and setting a systematic operating system including CCRA, NAP, APR, and subnational level adaptation (in the UK) should be considered in amending the current regulations.*

Cultural-cognitive institutions

Cultural-cognitive institutions of national climate adaptation policy in Korea and the UK are in single-loop learning. To move towards double-loop learning, the current adaptation discourse needs a shift with new ideas beyond isolated groups and strong arguments about alternative views. Thus, barriers and origins such as 'low awareness or indifference of adaptation' and 'lack of understanding of adaptation' could be handled with a shift of the current adaptation discourse. *In both countries, adaptation needs to be reconsidered as an issue that is closely related to everyday life and the ongoing tasks of government departments. Beyond the current discourse regarding adaptation is a future issue, adaptation needs to become an issue for the present related to economic and social problems, and it is important to make the public and decision-makers think that adaptation actions lead to benefits from now to the future.*

Normative institutions

Korea and the UK have different levels of social learning in relation to normative institutions. In Korea, with ‘Principles of climate change adaptation for sustainable development’, the national climate adaptation policy is in single-loop learning. To move to double-loop learning, the established norms and routines need to be called into question. *Accordingly, barriers and origins related to normative institutions in Korea could be addressed by asking whether the principles have played enough role in the policy as shared norms and the principles need to be changed for more effective adaptation.*

For the UK case, first, it is necessary to establish social and policy norms related to adaptation that can be shared with stakeholders of national climate adaptation policy and widely with the society. This could be formal principles like the Korean case or strong messages from the government. The shared norms will play an important role in guiding the UK's adaptation policies from national-level adaptation to subnational-level adaptation.

Uncertainty of climate change projection and impact

The uncertainty of climate change projection and impact is in double-loop learning in both countries. There was no identified barrier related to this uncertainty, as both countries’ stakeholders accept that they should make decisions under the uncertainty of climate change projection and impact. However, *to deal with this uncertainty at a higher social learning level, both countries, first, new approaches to manage the uncertainty and climate change risk need to be introduced with corresponding efforts to change structural constraints. Secondly, alternative measures for the uncertainty are necessary to consider for the case where concrete and precise results of climate change projections are essentially needed.*

Uncertainty of adaptation policy result

The national climate adaptation policy of Korea is in single-loop learning in terms of this uncertainty. Double-loop learning requires accepting the uncertainty and questioning established approaches to managing it. Thus, to overcome barriers and origins related to the uncertainty of adaptation policy results, such as ‘absence of clear indicators for adaptation’ and ‘uncertainty of effectiveness of adaptation policy’, *first, stakeholders need to accept the*

current uncertainty and do not use it for justification of their non-action for adaptation. Also, it is necessary that the current approach focusing on technical approaches to managing the uncertainty is called into question, and stakeholders should start discussing alternatives to manage it together.

Although the UK has similar barriers and origins related to the uncertainty of adaptation policy results of the Korean case, the directions of overcoming them are different as the NAP is in double-loop learning with respect to this uncertainty. To move towards triple-loop learning, *new approaches to manage the uncertainty need to be implemented with corresponding efforts to change structural constraints and conscious decision-making with alternative measures when necessary. Because the current approaches to evaluate the effectiveness of the policy have structural constraints and strongly depend on technical approaches, stakeholders need to devise alternative measures beyond the current indicator-based approaches and a new evaluation structure that involves multi-directional communications and feedback systems and various stakeholders.*

Actor network

In terms of actor network, the national adaptation policies of Korea and the UK are in single-loop learning. To attain double-loop learning, it is required to search for advice and opinion from actors outside of the established network, raise questions about the current network frames, emerge new roles of participants, and start to connect different networks or communities of practice. Based on it, the directions of overcoming the barriers and origins such as ‘complicated governance of national climate adaptation policy’ and ‘limited range of participants of national climate adaptation policy’ can be suggested. *In both countries, first, it is necessary to expand the policy network, which makes it possible for various actors outside of the current national-level network can engage. Second, various opportunities for multi-level actors can suggest their advice and opinion need to be provided, and policy-makers need more opportunities to access the advice and opinion during the whole process of the policy. Lastly, with a big landscape of national climate adaptation policy, roles and authorities of subnational-level adaptation actors need to be officially presented with a robust legal basis.*

Multi-level interactions

Both countries are in single-loop learning with respect to multi-level interactions of national climate adaptation policy. Double-loop learning of multi-level interactions needs increased informal knowledge exchange between policy levels and informal coordination between stakeholders in various policy levels. Hence, to address barriers and origins related to multi-level interactions, for example, ‘lack of connection between national and subnational level adaptation policy’, most of all, *both national adaptation policies need multidirectional interactions with horizontal and vertical stakeholders. Beyond the current top-down way of interaction based on regulations, more knowledge exchange opportunities should be arranged. Also, national climate adaptation policy needs to make issues that are horizontally and vertically cross-cutting for active multi-level coordination.*

Resource

In relation to the resource of national climate adaptation policy, both countries are in double-loop learning. Triple-loop learning of resources requires a new resource system with flexible regulations, utilisations and decision-making processes, including various stakeholders. *Thus, in both countries, barriers and origins related to the financial and human resources of national climate adaptation policy need to be overcome in mainly two directions. First, it is necessary to establish a specific adaptation resource system, including financial and human resources. The systems should be flexible for the use of distributed resources. Secondly, the current decision-making process of resources in which only a few numbers of people participate needs to be open to various stakeholders. Also, the decisions should reflect the voices of the stakeholders.*

Governance mode

Both countries have a bureaucratic hierarchical governance mode, which is in single-loop learning. To move towards double-loop learning, the dominant governance mode needs to be called into questions, and informal networks shaping discourse and supporting experimental innovations need to become more prominent. *Thus, in both countries, beyond the current governance mode, it is necessary that policy-makers and stakeholders consider other instruments for more effective adaptation, such as a bottom-up participatory process that is used in other governance modes. In other words, advantages*

of markets and networks governance modes can be brought in the current governance mode for better adaptation policy-making and implementation.

7.6. Conclusion

Based on connections between barriers to adaptation and common features of wicked problems, this research applied social learning theory to barriers to the adaptation research field. This research adopted and re-defined a theoretical framework for adaptation contexts based on multi-loop learning, which consists of mainly six categories of climate adaptation governance. It can diagnose the current social learning levels of adaptation policies or actions and suggest what stakeholders need to do for higher levels of social learning by overcoming identified barriers to the current adaptation policy processes. This research also showed how the framework could be applied to real national climate adaptation policy cases with the UK and Korean cases and provided practical suggestions for decision-making to improve the current social learning levels of national adaptation.

Previous studies provide a clear warning against the one-sided preference for higher levels of learning that underestimates the importance of lower levels of learning or loops in the multi-loop learning approach; significant improvements or transforming in performance cannot be gained without enough learning experience and efforts to overcome constraints at a lower level (Pahl-Wostl, 2009; Tosey et al., 2012). However, the importance of this research is that it suggests a direction for what is ideal and practical to improve the current adaptation situation, rather than the one-sided pursuit of higher levels of learning or loops.

This research provides examples of operationalising social learning theory to practical adaptation cases and generalised directions for solutions to address barriers to adaptation through a theoretical approach, which have been pointed out as limitations of each study field. Therefore, it is expected that the contributions of this research will be of great help for future research and practical adaptation policy and its process as well as social learning in practice.

Chapter 8
Discussion

Chapter 8
Discussion

8.1. Overview of the Research

Adapting to a changing climate is one of the major concerns across the world (Moss et al., 2013; IPCC, 2014), and it has become essential for the sustainable development of nations (Massey and Huitema, 2013). Consequently, there has been substantial progress in the development of national climate change adaptation policies, and the importance of their roles for overall adapting to climate change has gotten more attention (Mullan et al., 2013; IPCC, 2014; Henstra, 2017). However, despite the advance of national climate adaptation policy in many countries, the adaptation deficit has been observed and getting wider (Dupuis and Knoepfel, 2013; Eisenack et al., 2014; Lonsdale et al., 2017). This situation is also considered a super wicked problem (Levin et al., 2009; Lazarus, 2008; Jones and Preston, 2011; Fisher and Dodman, 2019). In order to improve the current adaptation deficit situation, understanding and overcoming barriers to adaptation is critical (McNamara, 2013; Wise et al., 2014; Simoes et al., 2017; Valente and Veloso-Gomes, 2020). However, our understanding of barriers to adaptation is limited, and previous studies on the barriers have rarely provided practical help to the real-world adaptation processes (Biesbroek et al., 2015; Eisenack et al., 2015; Wellstaead et al., 2018). Beyond the limitations of previous research on barriers to adaptation, this thesis has investigated barriers to national climate adaptation policy processes, their origins, potential causal mechanisms, influence, relationships, and solutions. In its undertaking, it has set out to progress knowledge in this research area as well as has contributed methodological approaches to diagnose problems of national climate adaptation policy and its process and devise practical solutions to address barriers to national adaptation policy processes.

Based on pragmatism research philosophy, this research has taken a multimethod approach. Firstly, through a systematic literature review, it scrutinised the characteristics of barriers to national climate adaptation policy and its process in the peer-reviewed research articles (Chapter 4). This review clarified the limitations of previous studies on barriers to national climate adaptation policy and its process and knowledge gaps that need to be filled

and provided preliminary insights into studying barriers' origins, influences and relationships. Chapter 5 analysed empirical barriers to the national climate adaptation policy process in Korea, including their origins, influences and potential solutions, through an in-depth case study. In Chapter 6, this thesis examined common barriers to national climate adaptation policy processes through a comparative analysis of Korean and the UK cases and presented potential common causal mechanisms of the barriers by mapping the relationships between barriers, origins and influences. General and practical insights into approaches to address the barriers to national-level adaptation policy processes were suggested in the chapter. Based on the wicked problem and social learning theoretical background, Chapter 7 adopted and re-defined a theoretical framework for adaptation contexts and operationalised it to the national climate adaptation policy of Korea and the UK. With the data from Chapter 6, it diagnosed social learning levels of national climate adaptation policy and suggested directions for potential solutions to overcome the barriers, which aim to move toward higher social learning levels. Also, it provides practical insights into addressing wicked problems broadly.

This thesis has focused on comparative and actor-centred methods to advance our understanding of barriers to national climate adaptation policy processes (Patwardhan et al., 2009; Eisenack et al., 2014). Whilst the data collected and analysed in the research is specific to the cases, Korea and the UK, wider insights can be drawn that contribute to providing a deeper understanding of barriers to adaptation for an academic aspect and improving the current adaptation deficit through addressing the current barriers for a practical policy aspect.

This thesis has responded to the demand for addressing the limitations of previous research on barriers to adaptation that are called 'unopened black boxes' and providing practical help for the adaptation policy processes in reality (Biesbroek et al., 2015; Eisenack et al., 2015; Wellstaead et al., 2018). It has endeavoured to go beyond the conceptual understanding of barriers to adaptation which has been made in previous research, and to understand and interpret identified barriers within real national adaptation policy process cases. By identifying barriers' origins and influences and presenting potential causal mechanisms, this thesis provides a more pragmatic understanding of

barriers to national climate adaptation policy, not dealing with a barrier to adaptation as an isolated entity.

Sections 8.2.1. to 8.2.4. revisit each of the research objectives to draw out the key findings from each chapter and discuss contributions of this thesis to advance our understanding of barriers to national climate adaptation policy and its process and practical approaches to address them. Section 8.3. highlights the implication of the research findings for national climate adaptation policy and its process. The research limitations of this thesis are discussed in Section 8.4. In the same section, it outlines research priorities and research agendas for further research.

8.2. Revisiting Research Objectives

Chapters 4 to 7 have focused on research objectives 1 to 4. The main research findings and key progress in knowledge of the chapters are summarised below.

8.2.1. Research objective 1

This thesis scrutinises the characteristics of barriers to national climate adaptation policy and its process in previous studies and clarifies their limitations using a systematic literature review.

Systematic Literature Review (SLR) is a valuable research methodology when some research has been conducted on an issue, but key questions remain unanswered (Petticrew and Roberts, 2006). Many studies on barriers to adaptation have been published over the last 20 years, and they report that nations are experiencing a variety of barriers to their adaptation policy (Agrawala, 2005; OECD, 2009; Bauer et al., 2011; Mullan et al., 2013; Biesbroek, 2014), but what barriers to national climate adaptation policy and its process exist, what the origins and influence of the barriers are, and how they can be overcome remain unanswered (Biesbroek et al., 2011; Eisenack et al., 2014; Waters et al., 2014). Indeed, several SLRs have been conducted focusing on climate change adaptation (Berrang-Ford et al., 2011; 2015; Ford et al., 2011; Biesbroek et al., 2013; Lorenz et al., 2014; Spires et al., 2014;

Sud et al., 2015; Sherman et al., 2016). However, there was no SLR that focused on barriers to adaptation at the national level specifically.

Chapter 4 conducted an SLR to scrutinise barriers to national climate adaptation policy and its policy process with peer-reviewed articles published between January 1995 to July 2018. This SLR comprehensively collected and analysed data of barriers to national climate adaptation policy and its policy process, clarified what we know and what we do not know about the barriers through previous studies, and suggested research agendas for further research. It confirmed that research on barriers to national climate adaptation policy and its policy process is much more limited than research on barriers to local or project level adaptation actions. Although a large number of studies on barriers to adaptation have been published since the early 2000s, most studies on barriers to national climate adaptation policy and its policy process have been published after 2015. Also, the majority of reviewed articles focus on national climate adaptation policy and its policy process in the Least Developed Countries (LDCs), reflecting the assumption that lower vulnerability and greater adaptive capacity in developed countries make barriers less significant (O'Brien et al., 2006; Moser and Ekstrom, 2010). The SLR also verified that there is still no consensus over the definition of barriers to adaptation (Biesbroek et al., 2013; Eisenack et al., 2014). There are several synonyms of barriers to explain the factor that impedes adaptation processes, for example, challenges, constraints, and limits. In addition, it could affirm that most barriers to national climate adaptation policy and its policy process are related to social factors, not to physical aspects of climate change (Moser and Ekstrom, 2010; Biesbroek et al., 2013; Eisenack et al., 2014).

Chapter 4 generated important answers to the questions that remain unanswered in previous studies. Firstly, the reviewed articles report similar or common barriers to national climate adaptation policy and its policy process, most often on resource barriers, fragmentation barriers, and barriers related to lack of awareness and communication. Among them, financial barriers are the most common and highest priority barrier at the national level. Secondly, the SLR uncovered interactions between the identified barriers by analysing the content and contexts of the reviewed articles. By mapping the interactions between the barriers, it provided evidence for the argument that barriers should be addressed simultaneously, not treating each one separately (Spires and Shackletoon, 2018). Third, preliminary insights into the origins and

impacts of the barriers to national climate adaptation policy were provided, although their causation was still unclear. Through analysing the content and contexts in the reviewed articles, several origins that create or aggravate other barriers were identified, and some problems that are caused by the identified barriers were also identified.

The results from the SLR also highlighted the critical limitations of previous studies. There is an open question of what are the most common and significant barriers to national climate adaptation policy and its policy process in practice, outside of the sample articles of the SLR. Because the amount of literature on barriers to national climate adaptation policy and its policy process is still small, we do not have enough evidence on the barriers. The causation between origins, barriers and impacts remains unclear. The reviewed articles focus on describing barriers themselves and do not provide sufficient account of underlying causes giving rise to the barriers, the relationship between the barriers and their consequences. Lastly, previous studies gave limited attention to solutions for overcoming the barriers and offered suggestions that are too general and normative to be useful. Still, there is little evidence and guidance in the literature that practitioners and policy-makers can use in real-world adaptation policy establishment and implementation processes.

Therefore, based on the results, Chapter 4 drew research agendas for further research. A shift is needed in the research focus from identifying and describing barriers (thin description) to understanding the circumstances where they occur and how they can be effectively dealt with and overcome (think description) (Waters et al., 2014). For the shift, first, more case studies on barriers to national climate adaptation policy are needed in both developed and developing countries. It is necessary to collect sufficient evidence of barriers to national level adaptation through comparative analysis of a large number of cases (Swart et al., 2014). Secondly, there is a need for research on the complex underlying web of reasons for the emergence and consequences of barriers (Agrawala, 2005) that can analyse causation or relations between origins, barriers, and impacts (Eisenack et al., 2015; Wellstaead et al., 2018). Lastly, there is a need for research on what solutions are effective for overcoming barriers in real-world adaptation policy processes and how the solutions can be devised and justified. Generation of evidence on practical solutions would not only deepen our understanding of barriers to

adaptation but also play an important role in fostering the development of solutions.

8.2.2. Research objective 2

This thesis analyses empirical barriers to the national climate adaptation policy process of Korea, including their origin, influence, and dynamics. It also suggests a potential approach to overcome the barriers.

Despite a decade of national climate adaptation policy efforts, an adaptation deficit persists and is getting wider (Burton, 2009; Eisenack et al., 2014; McClure and Baker, 2018; UNEP, 2018), and this situation is observed in both developed and developing countries. Barriers to adaptation are considered one of the major reasons for the adaptation deficit (Simoes et al., 2017; Clissold et al., 2020), and earlier studies have established a broad conceptual understanding of barriers to adaptation. However, there are still gaps in our understanding of the barriers as described in the above sections, and there has been a lack of empirical evidence of barriers to adaptation at the national level.

Chapter 5 collected empirical data through interviews with key stakeholders of the national climate adaptation policy of Korea. It found 16 barriers, 14 origins and 19 influences: barriers are every factor that the interviewees mentioned as a barrier, origins are factors that give rise to barriers, and influences are factors that are affected by barriers that create challenges for the national climate adaptation policy process of Korea. By mapping the relationships between factors with arrows, it explained what factors are related to the occurrence of a barrier, how the barriers influence adaptation policy processes, and how the barriers interact. In the process of analysis, key barriers that have more arrows than the average (4, including in and out) were identified: low priority of adaptation, absence of effective M&E system, lack of details in the current act, lack of collaboration of government departments, lack of linkage with subnational climate adaptation policy, frequent rotation of civil servants, lack of financial resource. Used and suggested solutions were also analysed to come up with a potential approach to address the identified barriers.

Chapter 5 drew conceptual, methodological and empirical contributions beyond the limitations of previous studies on barriers to adaptation. It identified barriers to national climate adaptation policy processes. Some are similar to the barriers identified in previous studies (Biesbroek et al., 2011; Wise et al., 2014; McNamara et al., 2017), but some are new or more specific for national-level adaptation. For example, 'lack of relevance between climate change risk assessment and adaptation policy', 'absence of comprehensive and continuous communication system', and 'frequent rotation of civil servants'. Although the literature has given limited attention to the consequences of the barriers, this chapter identified 19 concrete influences of the identified barriers, which are problems that practitioners and policy-makers experience in actual policy processes. By linking barriers to actual issues in adaptation policy processes, this study enabled barriers to be considered within the policy process. By introducing the concepts of origin and influence of barriers to adaptation, Chapter 5 provided a conceptual contribution to answering the why and how questions that remained unanswered in previous studies (Waters et al., 2014; Wise et al., 2014; Clissold et al., 2020; Fatorić and Biesbroek, 2020): the question, why the barriers have occurred, can find its answer through analysing the relationships between origins and barriers, and answers to how the barriers affect adaptation processes can be found through analysing relationships between barriers and influences.

Chapter 5 also provided a methodological contribution to understanding an underlying 'dynamic web of barriers' by mapping the relationships between barriers, origins and influences (Agrawala, 2005; Eisenack et al., 2014). It has visually demonstrated how barriers, origins, and influences interact with a barrier map. The results highlighted the overlaps and interactions across barrier categories (Shackleton et al., 2015) and that barriers need to be addressed simultaneously, not individually (Spires and Shackleton, 2018). It also showed how policy-administrative factors that are not directly related to climate change could cause serious problems to the adaptation policy and its process (Storbjörk and Hedrén, 2011). The research results contributed to providing preliminary insights into where solutions need to start to overcome the barriers by analysing relationships between barriers and origins. In other words, it showed what should be addressed first to overcome a barrier with visualised mechanisms.

Through addressing used solutions for the barriers in Korea, Chapter 5 found limitations of the solutions that were used by adaptation stakeholders in actual policy processes; 1) only stakeholders who directly manage the policy brought up solutions that had actually been tried, 2) the outcomes of the solutions were unclear, 3) the solutions in the process of national climate adaptation policy did not give any explicit attention to barriers (not barrier-specific). The chapter also addressed suggested solutions that are clearer and more specific about what national-level actors need to do now to overcome the barriers than the solutions discussed in the existing literature (McClure and Baker, 2018; Spires and Shackleton, 2018).

Based on the research results, Chapter 5 provided practical insights into addressing barriers to national climate adaptation policy process, suggesting a methodology that can diagnose national climate adaptation policy process problems, understand related barriers and origins, and devise concrete solutions. It includes four steps: 1) identifying factors of barriers, origins, influences, and relationships between them, 2) checking current problems among the influence factors, 3) identifying related barriers and origins through tracing relationships backwards, 4) making an entry point or taking insights to address the barriers with an analysis of the relationships and used/suggested solutions. This methodology can be practically used in diverse adaptation contexts in other countries beyond the Korean case.

8.2.3. Research objective 3

This thesis examines common barriers to national climate adaptation policy processes and potential common causal mechanisms of the barriers through a comparative analysis of Korean and UK cases. It also provides general and practical insights into addressing the barriers.

It is important to focus on common barriers and factors occurring across national adaptation policy processes to bridge the conceptual understanding of barriers to adaptation and real-world national-level adaptation policy processes, although the occurrence of context-specific barriers in different countries is inevitable (OECD, 2012; Mullan et al., 2013; Russel et al., 2020). The literature has reported that countries experience similar or common barriers to adaptation (OECD, 2009; Biesbroek et al., 2010; Bauer et al., 2011; OECD, 2012; Mullan et al., 2013; Prabhakar et al., 2014; Russel et al., 2020).

Biesbroek (2014) demonstrates that there is a set of barriers to adaptation that is shared across institutional contexts, and Eisenack et al. emphasise that "Identifying common causal patterns, interdependency and the dynamics of adaptation will significantly advance our ability to explain the occurrence of barriers and find promising ways to overcome them" (Eisenack et al., 2014: p.870). In addition, fragmented research results based on different research methods and theoretical backgrounds are pointed out as a limitation of the barrier research field as it has made it difficult to compare or generalise the research findings (Biesbroek et al., 2011; Biesbroek et al., 2013; Valente and Veloso-Gomes, 2020).

In this regard, Chapter 6 applied the same methodology from Chapter 5 to multiple cases. Based on the concept of origin, influence, and relationship of barriers to national climate adaptation policy processes that was introduced in Chapter 5, Chapter 6 analysed common barriers to national climate adaptation policy processes in Korea and the UK. It collected research data through semi-structured interviews in the countries, considering that a comparative and actor-centred method is well suited for advancing our understanding of the barriers and generating meaningful findings (Eisenack et al., 2014). It also mapped relationships between identified common barriers, origins and influences to highlight the interactions between them.

Chapter 6 demonstrated that there are explicit commonalities in terms of barriers to national climate adaptation policy processes between Korea and the UK. It also introduced four categories of barriers that are appropriate to address national-level adaptation barriers: 1) national political and administrative system, 2) resources, 3) laws and regulations 4) nature of adaptation. There were explicit common barriers to national climate adaptation policy processes in Korea and the UK in the four categories. Compared to previous studies, the chapter found that there are four common key barriers to national climate adaptation policy processes across contexts: 'low priority of adaptation', 'conflict between government departments', 'lack of political interest', and 'unclear related regulations' (OECD, 2012; Mullan et al., 2013). It also identified seven barriers which are practically more concrete to national-level adaptation: 'frequent rotating of civil servants', 'unclear range of participants of national climate adaptation policy in the current regulations', 'lack of linkage between climate change risk assessment and current issues, and ongoing task', 'lack of linkage between different level's climate change

risk assessment', 'lack of human resource in a managing department', 'uncertainty of effectiveness of adaptation policy', 'timescale difference between adaptation issues and election periods'. In addition, the chapter contributed to understanding the identified barriers more practically through their influences. It indicated how the common barriers are influencing the policy process by revealing 20 concrete influences, and in this way, barriers could practically be considered within the adaptation policy process, not as isolated entities.

The research results showed common relationships and dynamics of the barriers, which have been recognised as an 'unopened black box' (Biesbroek et al., 2015; Eiseneack et al., 2015; Biesbroek and Candel, 2019). An empirical understanding of social mechanisms has been emphasised to understand the nature of causality and explain connections between causes and effects (Hedström and Swedberg, 1998; Gerring, 2008; Mason et al., 2013), and the understanding of mechanisms is important to open up the 'black boxes' of barriers and to practically use the results of research on barriers in adaptation processes (Wellstead et al., 2018; Biesbroek and Candel, 2019). By analysing relationships between factors, this research made it possible to observe potential common causal mechanisms of the barriers and national climate adaptation policy process problems of Korea and the UK. Also, the research results focusing on the commonalities can play a critical role as a milestone to theorise causal mechanisms of barriers to national climate adaptation policy processes (Dupuis and Knoepfel, 2013; Wellstead et al., 2018).

Chapter 6 classified the key barriers into three types according to their origins and influence, which is a new approach to understanding the characteristics of barriers to adaptation beyond only identifying and describing them. Three types include 1) simple origins but multiple influences, 2) multiple origins but simple influences, and 3) multiple origins and multiple influences. Based on the classification, the chapter highlighted that focusing on overcoming barriers that have relatively simple and a small number of sources first would be practical to address overall barriers and reduce the adaptation deficit effectively. It also suggested examples of potential solutions for the common barriers, which can be used in both Korean and UK contexts focusing on identified barriers with relatively simple and few sources.

8.2.4. Research objective 4

This study defined the current climate change adaptation problem as a wicked problem and explored a theoretical approach to deal with it through social learning theory. Based on social learning theory, this thesis adopts and re-defines a theoretical analysis framework that diagnoses social learning levels of national climate adaptation policy, considering the current barriers to the policy process. It also suggests directions for potential solutions to address the barriers based on the framework.

It is demanded that a generalised approach to address and overcome barriers to adaptation, although the barriers occur context-specifically (Biesbroek et al., 2011; Eisenack et al., 2014). With the reoccurrence of barriers to adaptation, the adaptation deficits are apparently observable and are getting wider across sectors and scales (Burton and May, 2004; Burton, 2009; Dupuis and Knoepfel, 2013; Ashwill and Heltbrg, 2013; Markus and Savini; 2016; Lonsdale et al., 2017; Clissold et al., 2020; Liu et al., 2020; Marcus and Hanna, 2020). This situation is regarded as a wicked problem (Levin et al., 2009; Collins and Ison, 2009; Lazarus, 2009; Jones and Preston, 2011; Fisher and Dodman, 2019), and barriers to adaptation have clear and deep connections with the wickedness of adaptation. However, the current discussion on what causes the wickedness of adaptation and how the wickedness can be addressed is very limited. Also, practical approaches combining with policy studies to manage or address wicked problems are required, beyond conceptual suggestions.

This thesis asserted that social learning theory is the best approach to addressing wicked problems, which can include key factors for better addressing (governance, communication, coordination and learning) and policy study themes. Social learning has been suggested to address wicked problems and has been used in the context of climate change adaptation recently (Albert et al., 2012; Ensor and Harvey, 2015; Mudombi et al., 2017; van Epp and Garside, 2019). Amongst various approaches of social learning theory, this thesis considered a multi-loop learning approach as a reasonable approach in theoretical and practical aspects to apply the social learning theory to adaptation contexts. Also, given that the multi-loop learning approach emphasises its role in detecting and overcoming errors and barriers

that actors face (Argyris and Schon, 1996; Pahl-Wostl, 2009), it is expected that the approach can provide proper theoretical insights into addressing barriers to adaptation policy processes.

Chapter 7 showed how social learning and multi-loop learning theory can inform adaptation policy processes to diagnose the current adaptation levels with identified barriers to the policy process and overcome the barriers. First, it suggested a framework for adaptation context, which adopts and re-defines Pahl-Wostl (2009)'s framework for analysing adaptive capacity and multi-loop learning levels of resource governance. Secondly, the social learning levels of each country's adaptation policy were analysed through interpreting identified barriers in Chapter 6 with criteria in the re-defined framework. Lastly, this chapter suggested directions for potential solutions to overcoming the current barriers to national climate adaptation policy processes in Korea and the UK, aiming to move towards higher social learning levels of adaptation.

Chapter 7 demonstrated that the national climate adaptation policy of Korea is generally in single-loop learning, which means that the Korean adaptation policy system is pursuing solutions for its problems in the policy and its policy process mainly through incremental improvements based on established routines and existing methods/actions. It also focuses on the best means to achieve pre-defined goals within the established system (Pahl-Wostl, 2009; Medema et al., 2015; Tran et al., 2020). In Korea, only regulative institutions and resources categories are in double-loop learning, questioning the related established system, routines and actions. Meanwhile, the general social learning levels of the national climate adaptation policy of the UK are in between single-loop learning and double-loop learning. In the UK, cultural-cognitive institutions, actor networks, multi-level interactions, and governance mode are in single-loop learning, focusing on incremental improvements and the best means to achieve pre-defined goals within the established system, whereas regulative institutions, uncertainty, and resource are in double-loop learning. In the double-loop learning level, the assumptions that govern the established routines, existing methods and actions are called into question, and existing means and goals are recognised as problematic and are required to be changed (Pahl-Wostl, 2009; Flood and Romm, 2018; Tran et al., 2020).

Based on the re-defined framework and analysis results, directions for potential solutions to overcoming the current barriers to national climate adaptation policy processes in Korea and the UK were explained, and specific suggestions for each country were provided in Chapter 7. A higher social learning loop has a better adaptive capacity through better integrating cooperation structures and advancing information management than lower social learning loops (Johannessen and Hahn, 2013; Ensor and Harvey, 2015; Henly-Shepard et al., 2015; Kwon and Nicolaides, 2017; Tran et al., 2020). Thus, the suggested directions and suggestions aim at moving the current social learning loops of each category of adaptation governance to higher social learning loops. Although there is a clear warning against the one-sided preference for higher levels of learning (Pahl-Wostl, 2009; Tosey et al., 2012), this thesis is important because it suggests a direction for what is ideal and practical to improve the current adaptation situation, rather than the one-sided pursuit of higher levels of learning or loops. According to the social learning loop of each category, different directions for potential solutions were explained. For example, Korea and the UK have similar barriers related to the uncertainty of adaptation policy results, but as they have different loops of social learning in this category, different directions for solutions to address the barriers were suggested.

Chapter 7 provided important contributions to a theoretical approach for progressing climate change adaptation and overcoming barriers to adaptation. Based on the concepts of wicked problems and social learning, it set a theoretical background and justified why the multi-loop learning approach is adequate for climate change adaptation contexts with connections between barriers to adaptation and wickedness of adaptation (Colins and Ison, 2009; Fisher and Dodman, 2019; van Epp and Garside, 2019). Beyond suggesting a theoretical framework conceptually, this thesis adopted and re-defined a framework that can be applied to the real-world adaptation contexts and showed how it could practically inform adaptation processes about the current status and how to draw potential insights into overcoming the current barriers to adaptation with the framework. It suggests a way to get over the limitation of the lack of theoretical approach in the adaptation barrier study field and to find generalised approaches for addressing barriers to adaptation through operationalising the theoretical framework (Swart et al., 2014). In terms of the social learning study field, this thesis provides a good example that can overcome the limitation in previous

research: a lack of evaluation tools for social learning in system-oriented approaches and a limited range of evaluation approaches for climate change adaptation (Ensor and Harvey 2015; van Epp and Garside; 2019).

8.3. Broader Implication for Theory and Practice

The thesis has analysed barriers to national climate adaptation policy and its process with peer-reviewed articles through a systematic literature review in Chapter 4 and interviews with key stakeholders of national climate adaptation policy processes in Korea and the UK in Chapters 5 and 6. Based on firm theoretical ground, Chapter 7 diagnosed social learning levels of national climate adaptation policy in Korea and the UK and suggested directions for potential solutions for overcoming the current barriers to national climate adaptation policy processes in the UK and Korean cases. Although caution should be applied to drawing general conclusions from the data and the case studies, the thesis provides several key insights into understanding barriers to adaptation and addressing them. These insights include not only valuable theoretical and methodological contributions to understanding the barriers to adaptation in the academic field but also practical contributions to understanding the barriers to adaptation within the adaptation policy or action process and making practical solutions to address the barriers.

1) Introduce the concept of origin, influence, and relationship of barriers to adaptation: There are apparent limitations to understanding and explaining barriers to adaptation in previous studies, especially questions about why the barriers occur, how they affect adaptation processes, and how they interact with each other remain unanswered (Dupuis and Knoepfel, 2013; Wise et al., 2014; Wellstead et al., 2018; Liu et al., 2020). This thesis presented an approach that can find answers to the why and how questions by introducing the concept of origin, influence and relationship of the barriers to adaptation. Chapter 4 provided preliminary insights into developing this concept through a qualitative content analysis of previous studies on barriers to adaptation. Based on the insights, Chapter 5 suggested the concept of origin, influence, and relationship of barriers to adaptation policy processes and defined key terms. To see how barriers to adaptation occur, factors that give rise to the barriers are defined as ‘origin’. In order to analyse how barriers affect adaptation processes, factors affected by the barriers are defined as

‘influence’, which refers to adaptation policy process problems caused by the barriers. ‘Relationship’ refers to connections between factors indicating that a factor contributes to the occurrence of another, which include all relationships between barriers, origins, and influences. Chapters 5 and 6 identified barriers to national climate adaptation policy processes and their origins, influence and analysed relationships between them through qualitative content analysis of 41 semi-structured interview data. As a result, this thesis could explain ‘why a barrier occurs’ with identified origins, barriers, and relationships between them. In other words, it showed what origins and barriers give rise to a barrier to national climate adaptation policy processes and how many factors (sources) are interrelated for the barrier occurrence. By shedding light on sources of the barrier occurrence, this thesis provided insights into elucidating what should be considered together and where it should start in order to address a barrier to adaptation. Also, this approach can contribute to prioritising barriers to adaptation, making it possible to see which barriers need to be addressed first through analysing relationships between barriers and related origin factors. In Chapters 5 and 6, specific influences caused by barriers to national climate adaptation policy processes were presented, which refer to the current adaptation policy process problems that policymakers and stakeholders have encountered. It showed how the barriers negatively affect adaptation policy processes and what barriers are related to an adaptation policy process problem. It also provides a very important contribution to considering the barriers to adaptation within an adaptation policy process, not isolated entities, by connecting identified barriers and the current adaptation policy process problems. This concept of origin, influence and relationship of barriers can be used to further research on barriers to adaptation in other country contexts. Therefore, it is required to collect more evidence of barriers to national climate adaptation policy and its policy process and their origins, influences, and relationships through applying the same approach to multiple national cases. It will not only help to understand and explain the barriers to national climate adaptation policy and its policy process but also lead to generalised solutions to address national-level barriers across contexts. In addition, in sub-national adaptation contexts such as local- or private-level adaptation, the concepts of origin, influence and relationship of barriers can be used. It will provide a deeper and more practical understanding of barriers to the adaptation of the context and help to devise practical solutions. This is substantial progress of research on barriers to adaptation, which can overcome long-standing limitations of previous studies. Besides, this new concept of origin, influence, and relationship of barriers to adaptation

can be used in other policy research areas to understand the current policy and policy process problems and to analyse related sources of the problems.

2) Reveal dynamics of barriers and potential causal mechanisms of barriers to adaptation by mapping relationships between barriers, origins, and influences: The dynamics of barriers to adaptation and related causal mechanisms have been regarded as a black box in the research field. Demands for opening this black box could be met with the new research methodology used in Chapters 5 and 6. This thesis presented a barrier map underlying the national climate adaptation policy process of Korea and a common barrier map underlying national climate adaptation policy processes in the UK and Korea by mapping relationships between identified barriers, origins, and influences. The maps visually showed how barriers interact within a barrier category or across barrier categories. It also made it possible to determine key barriers that have more significant roles than other barriers in the whole barrier map based on related arrows that come in and out. This mapping also helped to understand a landscape of barriers and their dynamics in an adaptation policy process and to prioritise what barriers need to be addressed first for the overall progress of adaptation. Also, this thesis presented potential causal mechanisms of barriers to adaptation through the barrier maps visually. Based on identified barriers and their origins, influences, it drew their relationships with arrows so that it visually showed what factors are related to the occurrence of a barrier to adaptation and how the barrier causes adaptation problems in order. This understanding of causal mechanisms provides essential insights into systematically devising solutions to address barriers to adaptation policy processes and adaptation policy process problems caused by the barriers, as the causal mechanisms contain evidence of devised solutions (Wellstead et al., 2018; Biesborek and Candel, 2019; Braunschweiger and Pütz, 2021). It will be concretely explained in the next section. This barrier mapping methodology can be applied in other cases across adaptation contexts and levels, and thus, it will generate a practical understanding of barriers to adaptation. Also, this thesis analysed common dynamics of barriers and potential common causal mechanisms of problems of national climate adaptation policy processes in Korea and the UK. With more evidence from various country cases based on the same methodology, it would be possible to make more generalised mechanisms of barrier occurrences in national climate adaptation policy processes. Therefore, it is demanded that national-level adaptation policy stakeholders develop their

barrier map and compare it with other cases to understand the characteristics of their adaptation policy contexts and barriers.

3) Provide practical insights into devising concrete solutions to overcome barriers to adaptation: Although many countries and various adaptation actors have experienced barriers to adaptation, there were no clear systematic approaches or solutions to overcome them. This situation had led to the reoccurrence of the barriers and consistent ineffectiveness of adaptation actions (adaptation deficits). Solutions in previous studies, which are regarded as panaceas, have weak explanatory power and are not useful for policy advice (Pahl-Wostl, 2009; Clar et al., 2013). This thesis provided practical insights into determining this situation and devising concrete solutions. Chapter 5 suggested a methodology that can diagnose national climate adaptation policy process problems, understand related barriers and origins, and devise concrete solutions. It suggested four-step procedures: 1) identifying factors of barriers, origins, influence and relationships between them, 2) checking current policy process problems among the influence factors, 3) identifying related barriers and origins through tracing the relationships backwards, 4) making an entry point or taking insights to address the barriers with analysis results of the relationships and used/suggested solutions. In order to perform these steps properly, it is important that enough and concrete data for drawing a barrier map should be collected through various stakeholders' participation from national-level adaptation to private- or individual-level adaptation. The methodology makes it possible to collect scattered and fragmented information of barriers to adaptation policy processes, systematically analyse the information, and make practical solutions. Also, Chapter 6 suggested new categories of barriers to adaptation based on the number of related origins, barriers, and influences (simple origins but multiple influences, multiple origins but simple influences, and multiple origins and multiple influences) and highlighted that focusing on overcoming barriers that have relatively simple and a small number of sources first would be practical for real-world adaptation policy processes. Based on this approach, a concept of soft/hard barriers can be suggested. 'Soft barrier' is a barrier that can be overcome with simple and direct solutions or additional efforts. In contrast, 'hard barrier' is a barrier that cannot be overcome with simple and direct solutions or additional efforts because of its complexity or time, financial, and political limitations. This thesis suggests that focusing on addressing soft barriers first would be an effective way to overcome overall

barriers in the adaptation policy process. Although the capacities of adaptation actors are different, it would be a guideline for prioritisation of barriers to address. This methodology can be used in any case of adaptation policy or action processes across contexts and scales as well, and it will lead to substantive changes in existing approaches and measures to address the barriers. It is expected that the next solutions for barriers to adaptation will be more concrete and practical in the real adaptation policy process.

4) Operationalise a theoretical framework for suggesting directions for potential solutions for barriers to adaptation: Adaptation is considered a super wicked problem that includes features of complexity, uncertainty, interdependency, difficulty, a lack of knowledge, complex engagements, controversy, etc. To address this wicked problem, this thesis adopted and re-defined a theoretical framework that can diagnose social learning levels of adaptation policy and suggested directions for potential solutions to overcome barriers to adaptation. This approach is justified with the multi-loop learning approach has functions of detecting and overcoming errors of (or barriers to) the current social learning level, and barriers to adaptation have clear and deep connections with the wickedness of adaptation. Through interpreting data from Chapter 6 with criteria in the framework, this thesis could diagnose social learning levels of national climate adaptation policy in Korea and the UK and suggest directions for potential solutions for the barriers aiming to go towards higher social learning levels of adaptation. In terms of diagnosing, it provides evidence that shows the levels of each county's adaptation policy governance elements (institutions, uncertainty, actor network, multi-level interactions, resource, and governance mode), considering the current barriers to national adaptation policy processes. It means that this approach makes it possible to see which levels each country's national climate adaptation policy is and what is needed to improve the current levels of adaptation. The framework can be applied in various contexts and scales of adaptation. As it showed with national-level cases, it can evaluate the social learning levels of the current adaptation policy or action in various contexts and theoretically suggest the directions for improving their adaptation policy or actions. The lack of generalised directions of solutions for barriers to adaptation has been pointed out as a limitation (Dupuis and Knoepfel, 2013; Biesbroek et al., 2015; Liu et al., 2020). In other words, it was not clear theoretically what we need to do to overcome the barriers to adaptation. However, operationalising the framework can help to overcome the limitation

with clear theoretical backgrounds and criteria that can justify the directions as well as concretely required actions. It also enhances the explanatory power of suggested solutions to address the current barriers. In terms of addressing wicked problems, the approach used in the thesis can provide broader insights. It showed how the key factors for better addressing wicked problems (governance, communication, coordination, and learning) and policy study themes (policy design, policy deliberation, policy reform, effective implementation, policy evaluation, policy legitimation, etc.) can be considered in a theoretical framework and how directions for improving wickedness can be practically drawn.

8.4. Research Limitations and Avenues for Further Research

8.4.1. Research limitations

The research in this thesis has provided interesting and novel insights into a thick understanding of barriers to adaptation, which can overcome the key limitations of previous studies. However, a few limitations need to be pointed out.

In terms of the research design and methodology, this thesis could not involve time-sensitive methods that can explain dynamic changes in barriers to adaptation policy processes and evaluate the effectiveness of solutions to overcome the barriers over time (Eisenack et al., 2014). The research in this thesis focused on the barriers to national climate adaptation policy processes that were identified in previous articles and through policy stakeholders' experiences. Thus, some questions remain unanswered: how the barriers change over time with changes in adaptation action or policy circumstances, how the barriers are changed with specific solutions, and whether a specific solution for the barriers is effective or not. The answers to these questions can be found through research observing the change of barriers over time with a long-term perspective of at least 5 to 10 years, considering that the policy period of national adaptation policies is five years in general.

It also needs to be noted that this thesis does not show every aspect or related factor of barriers to national climate adaptation policy processes. Whilst it provided a deeper and more practical understanding of barriers to national

climate adaptation policy processes and suggested novel research approaches for the barrier research field with in-depth case studies, it did not show every characteristic of barriers to national climate adaptation policy processes because it involved a small number of cases. Especially, about common barriers to national climate adaptation policy processes and their potential common causal mechanisms, the research findings are based on only the UK and Korean cases. Although the research findings provide important insights into common barriers and their potential causal mechanisms at the national-level adaptation policy process, it is hard to say that the findings are a general fact in all countries. Also, this thesis interviewed 41 stakeholders. Thus, although the interviewees were key stakeholders of the national climate adaptation policy process of Korea and the UK, it cannot be said that they revealed all factors or aspects of barriers to national climate adaptation policy processes in Korea and the UK. To overcome the limitations, wider studies with more research participants and more cases are demanded.

In addition, the potential causal mechanisms of barriers to national climate adaptation policy processes that were presented in the barrier maps were drawn based on qualitative content analysis of interview results. Still, there are no other ways to analyse the causality between barriers, origins, and influence with quantitative approaches. Although it can be seen as a limitation of social barriers caused by social contexts or factors, it will continue to have the limitation of objectivity for the causality analysis.

8.4.2. Avenues for further research

Based on the research results of this thesis and the limitations described above, several avenues for further research can be suggested in terms of academic research and practical policy aspects.

First, research on each identified barrier to national climate adaptation policy and its process is demanded. This thesis presented a landscape of barriers to national climate adaptation policy processes in Korea and the UK and identified barriers and their origins, influences, relationships, but it did not look into each barrier in detail. Thus, the next step needs to focus on each identified barrier, especially key barriers. A large number of studies have analysed a specific barrier concretely through literature analysis or empirical research (Proter and Dessai, 2007; Inderberg and Eikeland, 2009; Lorenzoni et al.,

2009; O'Brien, 2009; Dessai et al., 2009; Jones, 2010; Jones and Boyd 2011; Buurman and Babovic, 2016; Howarth et al., 2017). However, the studies still focus on identifying and describing the targeted barrier in their research rather than explaining the barrier's occurrence, influence, and solution. Therefore, with the concept of origins, influences, relationships of barriers to adaptation, which is introduced in this thesis, it is necessary to analyse each barrier deeper, to improve the understanding of each barrier to adaptation and suggest more specific and practical solutions.

Secondly, deeper and wider research on barriers to national climate adaptation policy and its policy process can be suggested. In terms of deeper research, as mentioned above, this thesis did not show every factor or aspect of barriers to national climate adaptation policy processes in Korea and the UK. In order to analyse more factors and aspects and to apply the research results to the actual adaptation policy process, further research should include more policy-makers, high ranked decision-makers, policy practitioners across government departments, and various adaptation levels' stakeholders. Including them, further research needs to aim to share research results (identified barriers to national climate adaptation policy and its policy process and their origins, influence, and relationships, as well as underlying causal mechanisms), develop barriers maps, discuss concrete solutions to address the barriers, and discuss how to apply the solutions in the actual national climate adaptation policy process.

In terms of wider research, research on barriers to national climate adaptation policy and its policy process is still lacking. Many national-level case studies with the same research methodology are required to provide more generally applicable knowledge of barriers to national climate adaptation policy and its policy process. It is insufficient to generalise the research findings with only two national cases, although they presented meaningful insights. Through conducting various national-level case studies and comparing research results, common barriers to national climate adaptation policy and its policy process, their common characteristics and causal mechanisms will be clearer with a large volume of evidence. It will contribute to devising generalised solutions or approaches to address barriers to national-level adaptation across contexts. In addition, by clarifying common barriers and common characteristics, the context-specific factors of each country's policy and policy

process will also be clearly revealed. Then, solutions for context-specific barriers can be suggested more concretely and practically.

In addition, wider research can be achieved with further research on barriers to other level adaptation policies or actions and their process. By applying this thesis's approach to sub-national level adaptation cases, future studies are required to improve the understanding of the barriers in each case, explaining their occurrence, influence, relationship, and practical solution. Applying the same research method makes it possible to compare barriers to the same level of adaptation, which was impossible with the fragmented research results of previous studies. Consequently, it will contribute to improving the current general understanding of barriers to adaptation and the adaptation deficit situation at each level of adaptation.

Lastly, further research is required to trace and manage changes in barriers to adaptation according to changes in adaptation circumstance, application of solutions, and time changes, based on time-sensitive approaches. Research on changes in barriers to adaptation is important as it would enable us to know whether the barriers have been overcome, what factors have become the key to overcoming the barriers, and which solutions are more effective than others. Without such research, it is impossible to overcome the barriers to adaptation beyond identifying and explaining them all the time. In other words, tracing and managing barriers to adaptation over time is the key to overcoming the barriers. In order to see the change of barriers to adaptation, continuous observation of at least five years is required reflecting one cycle of general national adaptation policies is five years. Research that traces and manages barriers to adaptation in policy and actions processes over time would also provide insights into how to deal with soft barriers and hard barriers, respectively.

Chapter 9
Conclusion

Chapter 9
Conclusion

This thesis aimed to provide a thick understanding of the barriers to national climate adaptation policy processes and offer practical insights into overcoming the barriers. Beyond identifying and describing barriers to adaptation, this thesis attempted to explain their occurrence, influence and dynamics. Based on the pragmatism research philosophy, a multimethod research approach was designed with a systematic literature review, case studies, and a theoretical analysis. It made this thesis possible to draw conceptual, methodological, and theoretical contributions to advancing our understanding of barriers to national climate adaptation policy processes, devising concrete solutions for addressing the barriers and ultimately reducing the current adaptation deficit.

A systematic literature review showed the current level of the understanding of barriers to national climate adaptation policy and its policy process in previous studies. Lack of resources, fragmentation and lack of awareness/communication are the most commonly identified barriers to national climate adaptation policy and its policy process in previous studies. The review also provided preliminary insights into the interrelationships between barriers, origins, and influence and highlighted that barriers should be addressed simultaneously through a qualitative content analysis of the selected articles. In addition, it clarified previous studies' limitations and drew questions that need to be answered for a deeper and practical understanding of barriers to adaptation at the national level.

In order to answer the questions from the systematic literature review, an in-depth case study was conducted on the national climate adaptation policy process of Korea. In the research, a new concept of origin, influence, and relationships of barriers to adaptation was introduced. Through semi-structured interviews, the thesis identified 49 factors (16 barriers, 14 origins, 19 influences) related to barriers to national climate adaptation policy processes and explained how the complex interactions of the factors cause challenges for the policy process by mapping the relationships between them. It also suggested a procedure for understanding barriers to national climate

adaptation policy processes and devising practical solutions for national policy-makers and stakeholders.

By applying the same approach to the UK and Korean cases, a comparative analysis was conducted to expand the findings of the single case study. It analysed common factors related to barriers to national climate adaptation policy processes in the UK and Korea. The research found eight key common barriers in new national-level barrier categories. By mapping relationships between factors, potential common causal mechanisms of the barriers and national climate adaptation policy process problems were presented. It also argued that there are barriers that are easier to address with relatively simple and a small number of sources than others and that there is a need to focus on addressing the easier barriers first to reduce the adaptation deficit effectively.

The thesis diagnosed social learning levels of national climate adaptation policy in Korea and the UK and suggested generalised directions for potential solutions to overcome barriers to their adaptation policy process. Based on the wicked problem and social learning theoretical background, a multi-loop learning framework was adopted and re-defined for adaptation contexts. The national climate adaptation policy of Korea is generally in single-loop learning, whereas the national climate adaptation policy of the UK is in between single-loop learning and double-loop learning. According to the social learning levels of each category of the framework, different potential directions for overcoming the barriers were suggested, and this approach can be applied to various adaptation contexts and can provide generalised insights into overcoming related barriers.

In conclusion, this thesis provides important contributions to both the academic research and practical policy fields. By introducing the concept of origin and influence of barriers to adaptation, it provides a conceptual contribution to answering the questions: why the barriers occur and how the barriers affect adaptation processes. It also leads to that barriers are considered within adaptation processes by identifying concrete influences of the barriers, not as isolated entities. The thesis provides a methodological contribution to understanding an underlying dynamic web of barriers by mapping the relationships between barriers, origins, and influences, which

also visually presents potential causal mechanisms of the barriers and national climate adaptation policy process problems. Based on common factors related to barriers to national climate adaptation policy processes in Korea and the UK, this thesis offers preliminary insights into the theorisation of barriers to national climate adaptation policy processes and approaches to deal with them. In addition, it provides a practical contribution to national climate adaptation policy and its policy process, suggesting a methodology that can diagnose national climate adaptation policy process problems, understand related barriers and origins, and devise concrete solutions. This methodology can be practically used in adaptation policy processes in any other context too. Lastly, based on the social learning theory, this thesis adapted and re-defined a theoretical framework to diagnose social learning levels of national climate adaptation policy and identified social learning levels of national climate adaptation policy in Korea and the UK, considering identified their barriers. It also justifies why social learning, especially the multi-loop learning approach, is the most proper theoretical approach for addressing barriers to adaptation. Directions for potential solutions to overcome the barriers to national climate adaptation policy processes are suggested, which lead to moving towards higher levels of social learning that have higher adaptative capacity. With these contributions, it is expected that this thesis will help reduce the current adaptation deficits in various adaptation contexts across sectors and scales. Ultimately, I expect humanity to adapt more effectively and efficiently to the changing global environment and climate.

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Appendix A
List of Final Data (SLR)

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Appendix B
Semi-structured Interview Protocol

Content
Pre-interview checks
Before we start, there are a few things that I'd like to confirm with you. Purpose of research and interview The aim of this study is to answer two questions 1) what national adaptation policies and their barriers are, and 2) how can the national climate adaptation policy processes be improved? This interview is conducted to collect primary data related to the barriers to national climate adaptation policy process based on major stakeholders' experiences, opinions, and views. Definitions of key terms To prevent a confused understanding or use of key terms that are used in this interview, we define key terms as below. 'National climate adaptation policy' refers to 'Barriers to national climate adaptation policy' refers to If you have any question about definitions or concepts of any terms that are used in the interview, feel free to ask it anytime during the interview. General information of the interview This interview will take approximately 30 mins to 1 hour. If it is needed to shorten, there is no problem, it can be tailor to suit This interview will be recorded, are you happy to be recorded? If you don't want to answer specific questions, you can freely reject to answer. In addition, you have the right to withdraw your participating within 2 months after this interview without giving any reason. Details about your right are in this consent from. Before we start, please take a few minutes to read and sign it. You can also keep a copy of this consent form. If you have any concerns about this, do not hesitate to ask any question to me. Ok, are you happy to start interview or do you have any question before we start?

Introduction and Warm-up
Tell me a little bit about your background. Questions What is your current job? What was your role in the process of national climate adaptation policy? Have you participated from the first national climate adaptation policy?
Barriers to national climate adaptation policy
Questions (Barriers) Based on your experience, what were the barriers to national climate adaptation policy? Can you tell me specific examples? (with stages of policy process) These are seven clusters of barriers that have been identified in previous research. With these seven cluster, was there any other barrier that you can remember? What was the biggest barriers among the barriers and why?
Questions (Influence and Origin of the Barriers) You said A, B, C…. were the barriers to national climate adaptation policy. Then, what problems were caused or what problem did you experience because of the barriers? Can you tell me specific examples? You said A, B, C…. were the barriers to national climate adaptation policy. Then, why do you think each barrier occurred? In other words, what do you think the reason of the barrier? Is there any reason you think so? Do you think that the barriers occur because this is the national climate adaptation policy or other national policies have similar barriers too?
Solutions for the Barriers
Questions (Solution that were used) To overcome or reduce the barriers that you encountered in the process of national climate adaptation policy, what did you do? Were the solutions different depending on each barrier? Why did you use the solution? (What made you use the solution?)
Questions (Results and Evaluations of the Solution) By using the solutions, did you overcome or reduce the barriers? The barriers were completely solved? In your opinion, was the solutions good and why? If not, is there more effective and efficient solution that you think?

Ending
Thank you very much for your time and answer for this interview. Your opinions are really helpful for my research. I have included my contact information on the consent form, so if you have any concerns or questions about this interview, or if you want to further clarity some of your comments, please do not hesitate to contact anytime. Also, please forgive me if I have any followed-up questions to ask and bother you again in the future. Thank you again for your help in this interview.

Appendix C
Participant Consent Form

*Please initial next to statements where you agree

I confirm that I have read and understand the Information Sheet explaining the above research project and that I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and I am free to withdraw within 2 months after the interview without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline.	
I understand that my name and identity will be protected by code numbers* in the report or reports that result from the research, and that the anonymised transcripts and findings by the code numbers will be shared more widely.	
I agree for the data collected from me to be stored and used in relevant future research in an anonymised form.	
I understand that relevant sections of the data collected during the study, may be looked at by individuals from the University of Leeds or regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change.	

* Participants from the UK are coded with 'U-', Korean participants are coded with 'K-'. Each group of interviewees is coded next. The group of public officials of a general department is A, the group of public officials of government departments is B, the group of experts of official groups (institute) is C, the group of experts of each sector or department is D, the group of members of NGOs is E. And each interviewee of each group is numbered by the order of interview. For example, the third interviewee of public officials of government departments of Republic of Korea is coded as K-B3.

Name of Participant	
Participant's Signature	
Date	

Name of Researcher	
Researcher's Signature	
Date	

To be signed and dated in the presence of the participant.

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

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Appendix D
List of analysed official documents

1. Legal documents

Korea

저탄소 녹색성장 기본법 (2010)

저탄소 녹색성장 기본법 시행령

United Kingdom

Climate Change and Sustainable Energy Act 2006

Climate Change Act 2008

2. Policy and policy action plan documents

Korea

제1차 국가기후변화적응대책(2011-2015)

제1차 국가기후변화적응대책 수정안(2013-2015)

제1차 국가기후변화적응대책 세부시행계획

제2차 국가기후변화적응대책(2016-2020)

제2차 국가기후변화적응대책 세부시행계획

United Kingdom

Climate Change the UK Programme 2006

The National Adaptation Ptrgramme 2013

The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting 2018

3. National Climate Change Risk Assessment reports

Korea

기후변화 영향을 고려한 리스크 목록 구축(2019)

United Kingdom

UK Climate Change Risks Assessment: Government Report 2012

UK Climate Change Risks Assessment 2017: Synthesis report

4. Reports from official supporting organisations or advisory organisations (KEI, KACCC, and CCC)

Korea

국가 기후변화 적응 마스터플랜 수립 연구(2008)
기후변화 적응대책 우선순위 평가방법론 분석(2011)
부문별 기후변화 적응대책 우선순위 평가 연구(2012)
국가와 지자체의 기후변화 적응대책 실효성 제고를 위한 연계강화 방안(2013)
적응대책 평가 및 환류체계의 주류화・제도화 방안 모색(2014)
기후변화 적응강화를 위한 법안 마련 연구(2014)
제2차 국가기후변화적응대책 수립방안 연구(2014)
기후환경 리스크 전망과 국가전략(I)(2014)
기후변화 적응 모니터링 지침 마련(2015)
제2차 국가기후변화적응대책 수립 운영 및 지원(2015)
기후환경 리스크 전망과 국가전략(II)(2015)
기후변화 적응 법령안 마련 및 법제화 지원(2016)
제2차 국가기후변화적응대책 세부시행계획 수립 및 이행지원 (2016)
국가 기후변화 리스크 관리체계 구축(2017)
제2차 국가기후변화적응대책 이행 모니터링 및 평가 지원(2017)
기후변화 적응정책 10년: 현주소 진단과 개선방안 모색을 중심으로(2019)

United Kingdom

Progress in preparing for climate change 2015 report to Parliament
Progress in preparing for climate change 2017 report to Parliament
Progress in preparing for climate change 2019 report to Parliament
Scottish Climate Change Adaptation Programme: An independent assessment for the Schottish Parliament (20160
Research to provide updated indicators of climate chnage risk and adaptation action in England (2017)