Report No. 265

epaResearch
Climate - Water - Sustainability
Identifying pressures • Informing policy • Developing solutions

Challenges of Transformative Climate Change Adaptation: Insights from Flood Risk Management

Authors: Darren Clarke and Conor Murphy

www.epa.ie

Rialtas na hÉireann
Government of Ireland

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

Regulation: *We implement effective regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.*

Knowledge: *We provide high quality, targeted and timely environmental data, information and assessment to inform decision making at all levels.*

Advocacy: *We work with others to advocate for a clean, productive and well protected environment and for sustainable environmental behaviour.*

Our Responsibilities

Licensing

We regulate the following activities so that they do not endanger human health or harm the environment:

- waste facilities *(e.g. landfills, incinerators, waste transfer stations)*;
- large scale industrial activities (*e.g. pharmaceutical, cement manufacturing, power plants)*;
- intensive agriculture *(e.g. pigs, poultry)*;
- the contained use and controlled release of Genetically Modified Organisms *(GMOs)*;
- sources of ionising radiation *(e.g. x-ray and radiotherapy equipment, industrial sources)*;
- large petrol storage facilities;
- waste water discharges;
- dumping at sea activities.

National Environmental Enforcement

- Conducting an annual programme of audits and inspections of EPA licensed facilities.
- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
- Working with local authorities and other agencies to tackle environmental crime by co-ordinating a national enforcement network, targeting offenders and overseeing remediation.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Prosecuting those who flout environmental law and damage the environment.

Water Management

- Monitoring and reporting on the quality of rivers, lakes, transitional and coastal waters of Ireland and groundwaters; measuring water levels and river flows.
- National coordination and oversight of the Water Framework Directive.
- Monitoring and reporting on Bathing Water Quality.

Monitoring, Analysing and Reporting on the Environment

- Monitoring air quality and implementing the EU Clean Air for Europe (CAFÉ) Directive.
- Independent reporting to inform decision making by national and local government *(e.g. periodic reporting on the State of Ireland's Environment and Indicator Reports)*.

Regulating Ireland's Greenhouse Gas Emissions

- Preparing Ireland's greenhouse gas inventories and projections.
- Implementing the Emissions Trading Directive, for over 100 of the largest producers of carbon dioxide in Ireland.

Environmental Research and Development

- Funding environmental research to identify pressures, inform policy and provide solutions in the areas of climate, water and sustainability.

Strategic Environmental Assessment

- Assessing the impact of proposed plans and programmes on the Irish environment *(e.g. major development plans)*.

Radiological Protection

- Monitoring radiation levels, assessing exposure of people in Ireland to ionising radiation.
- Assisting in developing national plans for emergencies arising from nuclear accidents.
- Monitoring developments abroad relating to nuclear installations and radiological safety.
- Providing, or overseeing the provision of, specialist radiation protection services.

Guidance, Accessible Information and Education

- Providing advice and guidance to industry and the public on environmental and radiological protection topics.
- Providing timely and easily accessible environmental information to encourage public participation in environmental decision-making *(e.g. My Local Environment, Radon Maps)*.
- Advising Government on matters relating to radiological safety and emergency response.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

Awareness Raising and Behavioural Change

- Generating greater environmental awareness and influencing positive behavioural change by supporting businesses, communities and householders to become more resource efficient.
- Promoting radon testing in homes and workplaces and encouraging remediation where necessary.

Management and structure of the EPA

The EPA is managed by a full time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

EPA RESEARCH PROGRAMME 2014–2020

Challenges of Transformative Climate Change Adaptation: Insights from Flood Risk Management

(2014-CCRP-MS.15)

EPA Research Report

Prepared for the Environmental Protection Agency

by

Maynooth University

Authors:

Darren Clarke and Conor Murphy

ENVIRONMENTAL PROTECTION AGENCY
An Ghníomhaireacht um Chaomhnú Comhshaoil
PO Box 3000, Johnstown Castle, Co.Wexford, Ireland

Telephone: +353 53 916 0600 Fax: +353 53 916 0699
Email: info@epa.ie Website: www.epa.ie

ACKNOWLEDGEMENTS

This report is published as part of the EPA Research Programme 2014–2020. The EPA Research Programme is a Government of Ireland initiative funded by the Department of Communications, Climate Action and Environment. It is administered by the Environmental Protection Agency, which has the statutory function of co-ordinating and promoting environmental research.

The authors would like to acknowledge the members of the project steering committee, namely Dr Jonathan Derham, Research Programme Manager on behalf of the EPA. They would also like to acknowledge the work undertaken by each member of the JPI Climate *TRANS-ADAPT* research project in their respective countries: Austria – Sven Fuchs and Thomas Thaler; the Netherlands – Caroline Uittenbroek, Heleen Mees, Dries Hegger and Peter Driessen; and France – Mathieu Bonnefond, Sylvie Servain, Marie Fournier, Amandine Gatien-Tournat and Mathilde Gralepois.

This research would not have been possible without the agreement of individuals to participate in this study. The authors are sincerely grateful to the residents of Clontarf and Skibbereen and to officials from the Office of Public Works and Dublin City Council, who agreed to partake in this research and who gave their time so generously. Thanks also to Gerard Weafer, Dr Stephanie Gregorius, Martha Coleman, Pádraig Flattery, Ciara Ryan and Iria Insua-González for helping to distribute questionnaires in Clontarf, and to Dr Fionnuala Ní Mhordha for providing advice on analysis of the questionnaires. Finally, thank you to Dr Irene Lorenzoni at the University of East Anglia who contributed to two publications from which the findings of this research are derived.

Cover Image - Clontarf, Co. Dublin

ISBN: 978-1-84095-811-9 January 2019

Price: Free

Project Partners

Darren Clarke
Irish Climate Analysis and Research UnitS (ICARUS)
Department of Geography
Maynooth University
Maynooth
Co. Kildare
Ireland
Tel.: +353 1 708 6836
Email: darren.clarke@mu.ie

Conor Murphy
Irish Climate Analysis and Research UnitS (ICARUS)
Department of Geography
Maynooth University
Maynooth
Co. Kildare
Ireland
Tel.: +353 1 708 3494
Email: conor.murphy@mu.ie

Contents

List of Figures and Tables

Figures

Tables

Executive Summary

Growing evidence suggests that adaptation will form a key component of successfully responding to climate change risks. This is particularly the case for flooding, with associated risks likely to increase over the coming decades. Discussions surrounding adaptation have, until recently, placed emphasis on incremental change as a means of dealing with flood risks. However, increased attention is now being paid to transformative adaptation, given the current scale of climate change impacts. Owing to its recent introduction into adaptation discussions, however, little is known about the challenges associated with attempting transformative change. This report addresses this shortcoming, drawing on findings from 11 flood risk management case studies across four European countries (Austria, France, Ireland and the Netherlands). Specifically, it examines (1) what institutional settings are needed for societal transformation in responding to changing flood risks and (2) in what ways are changing divisions of responsibilities between public and private actors necessary to increase the resilience of societies and to advance transformative adaptation in practice.

For all case studies the combination of changing flood risk with other societal pressures is driving transformation. Across all case studies attempts at transformation were undertaken during “windows of opportunity”, typically following a major hazard event. This research finds that demands for transformation arise from issues including (1) lack of funding, legal protection and space, (2) communities demanding increased input into planning/implementation and (3) blurred boundaries between public and private spaces and responsibilities. The research from across the four countries demonstrates that priority should be given to identifying ways to increase communities’ participation beyond consultation and information sharing, towards co-creation of flood solutions for transformative adaptation.

A detailed examination of the two Irish case studies where transformation failed (Clontarf, Co. Dublin, and Skibbereen, Co. Cork) yields interesting results. First, current governance processes can constrain transformation in practice. Because flood risk adaptation funding is heavily weighted towards structural flood defence provision in Ireland, decision-making processes tend to rely on technical expertise, often failing to challenge underlying assumptions and embedded practices associated with technical responses to flooding, and ignoring local knowledge in the process. Second, utilising statutory public participation processes in isolation is unconducive to increasing societal support for transformation. Third, with respect to social values, the importance of place attachment processes is a contributing factor in the expression of community attitudes towards proposed flood adaptation planning. Where individuals have a strong attachment to specific places and deem adaptation as threatening to such places, perceptions that transformation is being forced on them is a potential outcome. Finally, the research finds that even relatively modest incremental adaptation measures can prove extremely contentious and difficult to implement when transformation fails, particularly when past learnings are not embedded into governance practices.

The findings have important implications for adaptation policy and planning. First, climate change threatens both tangible and intangible assets. Although current adaptation policies account for tangible assets in assessing the merits of adaptation strategies (e.g. economic damage from flooding), there exists a prevailing need to also explicitly consider intangible assets (e.g. socio-cultural values). Second, knowledge co-production is likely to prove crucial as single actors rarely possess the knowledge, resources or legitimacy to address complex global environmental challenges. Finally, there is substantial merit in integrating virtual technologies to enhance information management between stakeholders in adaptation planning, helping to assist in eliciting emotional responses from individuals and making an abstract concept like climate change locally relevant. However, the research from across European case studies included in this research also points to the need for broad societal transformations to mitigate future climate change, helping to reduce the need for transformative

adaptation in the first instance. The findings emphasise key issues facing decision-makers and communities in the absence of fundamental changes to societal and governance practices concerning climate change and adaptation planning.

1 Introduction

1.1 Overview

Despite efforts to mitigate greenhouse gas emissions, climate change is already occurring. Given the potential impacts arising from climate change, mitigation in isolation no longer suffices (Klein *et al.*, 2005). To respond to climate risks, adaptation is also recognised as necessary. Recognising that the dominant incremental approaches that have defined adaptation planning to date may be insufficient to deal with the large-scale challenges posed by a changing climate, transformative adaptation is now being advocated as one potential solution, particularly as climate change risks and vulnerabilities increase (Kates *et al.*, 2012; Termeer *et al.*, 2016). In this context, incremental adaptation implies "adjustments that are aimed at enabling the decision-maker to continue to meet current objectives under changed conditions" (Smith *et al.*, 2011: 199). However, incremental adaptation has been critiqued because it typically seeks to maintain existing systems, development trajectories and practices (Revi *et al.*, 2014), which is not deemed as commensurate with the rate at which climate change is now occurring (IPCC, 2012). In contrast, transformation is characterised as "a fundamental qualitative change … that often involves a change in paradigm and may include shifts in perception and meaning, changes in underlying norms and values, reconfiguration of social networks and patterns of interaction, changes in power structures, and the introduction of new institutional arrangements and regulatory frameworks" (IPCC, 2012: 465). It thus seeks broader and systemic changes to social and political practices related to adaptation (Wise *et al.*, 2014).

One of the primary ways in which climate change is currently being, and will be, experienced in the future is through increased flood risks in many regions globally, which is likely to result in greater demands for adaptation strategies. For instance, under a warmer climate extreme precipitation events are likely to become more intense and frequent in many mid-latitude locations (IPCC, 2014a). Similarly, global mean sea levels are also expected to rise, compounding flood risks in coastal locations. Specifically, with respect to coastal flooding considerable evidence exists that, if humans continue on a business-as-usual pathway in terms of greenhouse gas emissions, sea levels may rise by up to 1 m by the end of this century, with many mid-latitude locations becoming increasingly exposed to the upper end of this 1-m increase (IPCC, 2014a).

Many mid-latitude maritime countries have already experienced sea level rise and this is projected to continue in the future, increasing risks to coastal communities and assets (OPW, 2015a; Vousdoukas *et al.*, 2017). Climate change is also predicted to increase the frequency and intensity of fluvial and pluvial flooding by the end of this century, with fluvial flood damage alone across Europe expected to amount to approximately €11 billion per annum (Ciscar *et al.*, 2014). Although changes in extreme precipitation vary by region, there is mounting evidence that extreme precipitation will disproportionately affect large parts of northern Europe under a warming climate (Kovats *et al.*, 2014; Donnelly *et al.*, 2017).

The growing importance of transformation as a necessary adaptive response to climate change and the recognition that, if transformation is not voluntarily chosen through proactive measures, forced transformative change is likely (IPCC, 2012) suggests that a greater understanding of the challenges that transformative adaptation encounters is required. Given prevailing flood risks across Europe, and the increasing recognition that transformative adaptation will be needed to manage such risks, this report focuses on examining the challenges associated with attempting such transformative change using case studies of flood risk management strategies from across four European countries.

1.2 Aim and Objectives

This report forms part of a wider Joint Programming Initiative "Connecting Climate Knowledge for Europe" (JPI Climate) research project entitled "Societal transformation and adaptation necessary to manage dynamics in flood hazard and risk mitigation (*TRANS-ADAPT*)". The core objectives of *TRANS-ADAPT* are

to (1) identify indicators and parameters necessary for strategies to increase societal resilience, (2) analyse the institutional settings needed for societal transformation and (3) assess the perspectives of changing divisions of responsibilities between public and private actors necessary to arrive at more resilient societies.

TRANS-ADAPT is centred on case studies in Austria, France, Ireland and the Netherlands. In these countries flood risk management has been institutionalised for decades but within different institutional settings. However, emerging flood risk strategies place primary responsibility on local organisations to determine local strategies to manage local risks and lead adaptation initiatives. The case studies represent a diversity of transformative strategies to respond to flood risks. In Austria, case studies include Galtür (multi-use avalanche dam), Pfunds (multi-use flood defences) and Großkirchheim (multi-use flood defences). The French case studies are centred on Angers (multi-use flood defences), Le Mans (multi-use flood defences and land reclamation) and Blois (forced relocation), whereas, in the Netherlands, Rotterdam (multi-functional flood defences), Tiel (multi-functional flood defences) and Kockengen (extensive urban land elevation) were chosen. Skibbereen, County Cork, and Clontarf, County Dublin, were subsequently chosen as suitable empirical case studies in Ireland. Both Irish case studies were selected based on the following criteria:

- They are considered as transformative in the context of existing definitions of the term.
- They represent transformative flood risk management strategies that were not implemented. These cases were explicitly chosen to understand the challenges and barriers that emerge in the context of transformative change.
- They represent both positive and negative transformative change. Specifically, in Skibbereen transformation was presented by an environmental group as a positive alternative to business-as-usual flood risk adaptation in Ireland, whereas in Clontarf transformation was considered as being imposed and was viewed as negative.
- The Irish case studies differ from those chosen in Austria, France and the Netherlands, where proposed transformative adaptation strategies were successfully implemented in each of the case studies. They therefore offer a unique perspective on the challenges associated with attempting transformative adaptation.

The principle aim of this research was to investigate the challenges associated with transformative adaptation using the case of flood risk adaptation in Ireland.

With respect to this aim, this report is guided by two research questions:

1. What institutional settings are needed for societal transformation to respond to increased climate change risks?
2. In what ways are changing divisions of responsibilities between public and private actors necessary to increase the resilience of societies and to advance transformative adaptation in practice?

1.3 Irish Flood Risk Management Policy

1.3.1 Historical background to flood risk management

Flood risk management in Ireland has been a major issue for several centuries, as recognised by the passing of various Drainage Acts in 1842, 1867, 1925, 1928, 1945 and 1995. Until 1995, however, the approach to flood risk management was centred on improving the productivity of agricultural land, with little attention given to the need to address the wider impacts of flooding. Following extensive flooding in the late 1980s and early 1990s, an amendment to the Drainage Act was passed in 1995 (Government of Ireland, 1995). This amendment led to a strategic change in the management of flood risks such that flood risk management in residential and urban areas became a key priority at a national level. However, the issue of flooding as a strategic concern gained prominence only in 2004 following the publication of a government report on flood risk management (OPW, 2004). This led to the Office of Public Works (OPW), the state's primary engineering body, assuming responsibility for developing and delivering a national flood risk management strategy (OPW, 2004). However, tidal flooding was not integrated into its responsibilities until 2009.

Currently, the OPW's stated approach to flood risk management is based on a dual strategy that prioritises non-structural measures, supplementing these with structural flood relief solutions where necessary (OPW, 2004). Despite recognition by the OPW that non-structural measures are necessary to deal with flood risks and that they should be considered as the primary mechanism for addressing such risks, the dominant strategy for dealing with fluvial and coastal flood risks is currently centred on structural defences, as is evident by flood relief capital investment programmes developed in recent years. A significant barrier to the implementation of non-structural flood strategies is the lack of a national flood forecasting and early warning system. Although the OPW maintains a small number of flood forecasting systems on some rivers, there remains no national flood monitoring or early warning system, despite a review in 2011 detailing the need for such a facility (OPW, 2015a).

1.3.2 Administrative structure of flood risk management decision-making

Following the Flood Policy Review in 2004, flood risk management is also more centralised, with the OPW largely assuming direct responsibility for the issue (OPW, 2004). Although the OPW is the lead agency nationally with respect to advising on and implementing government flood policy, several other bodies have responsibility for certain aspects of flooding. The range of agencies responsible for flood risk management nationally includes local authorities, a national road and rail authority and a national water utility company amongst others. This segregation makes the process of managing flood risks a difficult and disjointed activity, as exemplified by the management of flood events in recent years (Joint Committee on the Environment, Heritage and Local Government, 2010).

Coastal and fluvial flooding is managed by the OPW. The OPW also works in partnership with local authorities when designing, executing and maintaining flood defence schemes. Although most relief works for coastal and fluvial flooding are undertaken by the OPW, in certain circumstances it may confer responsibility to a local authority for major flood relief schemes if it believes that the authority has sufficient capacities to deliver such projects to the required standard. In such instances the OPW provides financial resources to the local authority to complete the necessary works but assumes ownership for maintenance of the scheme post completion.

Supplementary to this, other flood risks are managed by various government authorities or agencies. Local authorities are required to deal with pluvial and groundwater flooding at a municipal level and are the primary government authority with responsibility for preparing for and responding to imminent flooding from coastal, fluvial, pluvial and groundwater sources. A government agency comprising the national rail and road authority (Transport Infrastructure Ireland) is accountable for flood risks pertaining to railways and roads, particularly following a flood event in which road or railway infrastructure becomes flooded. Responsibility for the prevention of, and response to, combined sewerage flooding has been designated to Irish Water since 2014, a semi-state water utility entity, having been previously managed by local authorities. The number of relevant bodies with specific duties in the field of flood risk management is therefore considerable and has increased since 2014 with the establishment and subsequent transfer of certain flood risks to Irish Water.

1.3.3 Flood risk adaptation strategies

Adaptation as a policy issue is an emerging strategy in Ireland. Until 2012, national efforts to deal with climate change were primarily centred on mitigation practices (DECLG, 2012). Following the identification of potential socio-economic impacts and national vulnerability to climate change, however, sectoral and local authority adaptation plans are now being developed to respond to the impacts of climate change. Sectoral plans include 12 areas: water resources, emergency planning, marine, agriculture, forestry, biodiversity, heritage, transport, energy, communications, health and flood risk management (OPW, 2015a).

Since 2004, the OPW has been charged with completing a thorough review of fluvial flood risks at a national level under the Catchment Flood Risk Assessment and Management (CFRAM) programme. In 2009, it also assumed responsibility for managing coastal flood risks. This approach to managing flood risks is now aligned with the EU Floods Directive 2007/60/EC (EU, 2007) and EU Water Framework Directive 2000/60/EC (EU, 2000).

As the lead agency for flood risk management in Ireland, the OPW is responsible for co-ordinating, and in many instances implementing, the National Flood Policy and EU Floods Directive. These obligations are largely met through the national CFRAM programme. The CFRAM programme is centred on reducing and managing flood risks nationally in the medium to long term and was developed as the strategy through which climate change adaptation policies would be executed, with a primary emphasis on flood defences. It subsequently acts as the basis of the climate change adaptation plan developed for the flood risk management sector (OPW, 2015a).

1.3.4 Flooding and potential climate change impacts

Climate change is likely to have considerable impacts on flood risks in many regions globally. As mentioned in section 1.1, with respect to coastal flooding considerable evidence exists that, if humans continue on a business-as-usual pathway in terms of greenhouse gas emissions, sea levels may rise by up to 1 m by the end of this century, with many mid-latitude locations becoming increasingly exposed to the upper end of this 1-m increase (IPCC, 2014a). Like many mid-latitude maritime countries, Ireland has already experienced sea level rise and is projected to continue to do so in the future, increasing risks to coastal communities and assets (OPW, 2015a; Vousdoukas *et al.*, 2017). For instance, current scenario planning for flooding suggests that coastal flooding that occurred in Dublin in 2002, which had a return period of once in 50 to once in 100 years, could increase to a once in 2 years event if a 0.5-m rise in mean sea levels occurs, this being the lower end of Intergovernmental Panel on Climate Change (IPCC) sea level rise projections over the coming century (Church *et al.*, 2013). These return periods are likely to be altered even further where sea levels rise beyond this. Similarly, recent research has highlighted how Irish cities are extremely vulnerable to increased river flooding if high impact Representative Concentration Pathway (RCP) 8.5 emissions scenarios are realised. For instance, Cork and Waterford are expected to be some of the worst affected European cities under high-impact emissions scenarios, with river flooding potentially increasing by over 80% in these cities. Dublin is also predicted to be one of the most vulnerable European capital cities from increased fluvial flood risks under such scenarios (Guerreiro *et al.*, 2018).

Climate change is also predicted to increase the frequency and intensity of fluvial and pluvial flooding by the end of this century, with fluvial flood damage alone across Europe expected to amount to approximately €11 billion per annum (Ciscar *et al.*, 2014). Although changes in extreme precipitation vary by region, there is mounting evidence that extreme precipitation will disproportionately affect large parts of northern Europe under a warming climate (Kovats *et al*., 2014; Donnelly *et al.*, 2017). Some of the largest increases in fluvial flooding are expected to occur over the UK and Ireland (Ciscar *et al.*, 2014; OPW, 2015a). Specifically, in an Irish context projected rainfall increases in winter are likely to lead to an increase in fluvial flood risks nationally (Dunne *et al.*, 2008), which is likely to result in heightened demands for adaptation.

In terms of scale and extent, rainfall that affected many parts of Ireland during the winter of 2015–16 caused some of the worst flooding in Ireland's history; current flood records date back to 1763 (OPW, 2015a). Rainfall totals over that period were 189% of normal, contributing to the wettest winter on record (National Directorate for Fire and Emergency Management, 2016). The longevity of the flooding was particularly severe, with flooding continuing in some regions into March 2016. Flooding in winter 2015–16 superseded that which occurred in November 2009, which was, until then, considered to be the worst flooding in recorded history. Infrastructural damages arising from the 2015–16 flooding amounted to approximately €106 million, with over 1100 properties flooded (National Directorate for Fire and Emergency Management, 2016). Similarly, extensive fluvial and pluvial flooding in June 2012 resulted in damage to approximately 170 properties in the south-west of the country. The effects of pluvial and fluvial flooding have also been felt in large urban centres in the east of the country. For instance, in October 2011, approximately 1700 properties were flooded as a result of fluvial and pluvial flooding, causing €130 million in economic losses and contributing to two fatalities in the Dublin region (OPW, 2015a).

Coastal flooding has also been particularly severe in recent decades in Ireland. Specifically, in February 2002 flooding along the east coast of the country,

and in the Dublin region in particular, resulted in approximately 1250 properties being flooded and was estimated to have resulted in economic damage costing €60 million (OPW, 2015a). The issue of coastal flooding has also affected other areas of the country. In 2013–14, winter coastal flooding led to extensive flood damage in two of Ireland's largest cities (Cork and Limerick), with damages estimated at €70 million and two individuals losing their lives (National Directorate for Fire and Emergency Management, 2014; OPW, 2015a).

One of the defining features of historical flooding in Ireland has been the clustering of extreme flood events over the last two decades, which has resulted in increased risks to properties and other assets located in flood-affected areas (OPW, 2015a). Flooding is now considered to be the most significant natural hazard that the country faces in terms of likelihood and impacts (Office of Emergency Planning, 2012), as evidenced by the scale of flood events in recent years. Fluvial and coastal flood risks are recognised as the two most significant types of flooding nationally in terms of hazard and risk (OPW, 2015a). Nationally, approximately 85,000 properties are considered at risk from flooding, 70,000 of which are residential properties (OPW, 2015a).

1.4 Report Layout

This report presents a summary of the opportunities and challenges associated with transformative adaptation using the case of flood risk adaptation. The findings will be of use to policymakers, sectoral and local decision-makers and stakeholders interested in or working on adaptation to climate change. The report is structured as follows. Chapter 2 provides the current state of knowledge of both transformative adaptation and the challenges or barriers that adaptation may encounter. Chapter 3 then introduces the case studies and the methods used for this research. In Chapter 4, the results from Skibbereen, County Cork, and Clontarf, County Dublin, are presented. Finally, Chapter 5 concludes with an overview of the lessons from across the *TRANS-ADAPT* project, in addition to a synthesis of the cross-cutting themes and national policy implications for adaptation planning identified from the Irish case studies.

2 Literature Review

2.1 Introduction

This chapter reviews existing literature surrounding the two research questions of this report. First, in section 2.2 it details the way in which climate change adaptation is currently conceptualised and investigated, specifically describing two broad adaptation typologies: incremental and transformative change. In section 2.3 the barriers associated with adaptation are highlighted, it detailing how socio-cultural, governance, resource-based and physical barriers can impede adaptation. This section examines in detail how specific socio-cultural values and governance processes may disrupt place and impede change, two core components of this research. The chapter concludes in section 2.4 by re-capping the core research questions.

2.2 Conceptualising Adaptation

It is increasingly recognised that socio-ecological systems are reaching critical limits in response to anthropogenic climate change (Bardsley, 2015). To address such environmental problems, researchers argue that responses can be operationalised along a continuum from resistance to incremental change through to transformative adaptation (Handmer and Dovers, 1996; Béné *et al.*, 2012; Rickards and Howden, 2012). Although resistance to the impacts of climate change is an option, some form of adaptation is inevitable under a changing climate (Parry *et al.*, 1998; Stern, 2007; Agrawal, 2010). This report subsequently focuses on incremental and transformative adaptation.

2.2.1 Incremental adaptation

Debates amongst scholars have until recently placed a significant emphasis on how to address the problem of a changing climate without altering present-day regimes that societies have become accustomed to (Smith *et al.*, 2011; Kates *et al.*, 2012; Mustelin and Handmer, 2012). Where such adaptations are occurring, they are typically incremental in nature and tend to involve only minor adjustments to the trajectories of public, private and social institutions (Termeer *et al.*, 2016). Incremental adaptation seeks to maintain existing systems, development pathways and practices (Revi *et al.*, 2014). In this context, it "generally implies that adjustments are aimed at enabling the decision-maker to continue to meet current objectives under changed circumstances (e.g. changing cultivars to continue farming)" (Smith e*t al.*, 2011: 199).

Incremental adaptation has gained prominence for several reasons. First, by focusing on adaptation as a continuous and incremental process, adaptation strategies become more palatable to individuals. Selling adaptation strategies to citizens is easier and the capacities for dealing with future decisions can be formulated in the process (Smith *et al.*, 2011). Second, societies are exposed to multiple stresses including economic, health, social and security issues, which often take priority over environmental concerns such as climate change (Norton and Leaman, 2004; Ratter *et al.*, 2012) given that it is considered to be a distant issue both temporally and spatially (Lorenzoni *et al.*, 2007; Adger *et al.*, 2009a,b). Where adaptation is incremental in nature, individuals are subsequently more likely to have the ability to adapt (Rickards and Howden, 2012), particularly when multiple stresses are accounted for. Finally, policymakers are adept at implementing policies and strategies that have proved successful in other jurisdictions that they feel culturally close to (Devine-Wright and Howes, 2010). Where incremental adaptation strategies are the norm in particular jurisdictions, these may be replicated in similar jurisdictions. In supporting business-as-usual, however, it may potentially lock in existing adaptation pathways, creating a positive feedback and self-fuelling further incremental adaptations. This may lead to maladaptation in the long term (Wise *et al.*, 2014). The issue of maladaptation is particularly likely to arise if we continue to invest in activities and adaptive responses that, at best, are costly and futile if a 4°C warmer world transpires and, at worst, prevent more transformative change (Adger and Barnett, 2009).

2.2.2 Transformative adaptation

To appropriately respond to current and projected climate risks researchers have recently concentrated on transformative adaptation, recognising that incremental adaptation in isolation will be insufficient to deal with these threats (Kates *et al.*, 2012; IPCC, 2014a; Noble *et al.*, 2014; Satyal *et al.*, 2017). Transformation is typified by non-linear change or deviation from the status quo (O'Brien, 2012; Marshall *et al.*, 2016) and is subsequently considered to have a long lead time (Smith *et al.*, 2011; Termeer *et al.*, 2016). Certain theories denote that it is characterised by innovation (e.g. in governance, through challenging embedded assumptions and practices, including questioning technical or institutional processes or social values; Loorbach *et al.*, 2008; IPCC 2014b).

Although transformative adaptation is often assumed to be technological in nature, supportive social settings and the presence of acceptable options and resources are nonetheless crucial enabling components (Kates *et al.*, 2012). Scholars have therefore repeatedly highlighted the need for transformation of both social systems and wider governance systems for transformations to succeed. In this context, both societal transformations to minimise future climate change (e.g. O'Brien and Sygna, 2013) and transformative adaptation in response to climate impacts (e.g. Kates *et al.*, 2012) are equally relevant for adaptation purposes. This can include behavioural transformations at the individual scale to broader transformations of power relations or social and cultural norms within society (O'Brien and Barnett, 2013; Termeer *et al.*, 2016). In this context, transformation can be defined as "a fundamental qualitative change … that often involves a change in paradigm and may include shifts in perception and meaning, changes in underlying norms and values, reconfiguration of social networks and patterns of interaction, changes in power structures, and the introduction of new institutional arrangements and regulatory frameworks" (IPCC, 2012: 465). Examples of transformative adaptation have been identified in the literature and include innovative policy alternatives to manage or avoid climate risks (Wise *et al.*, 2014), relocation (Park *et al.*, 2012; Fenton *et al.*, 2017), diversification of income streams (Marshall *et al.*, 2016) and change in the scale at which systems function (Park *et al.*, 2012).

2.2.3 Difference between incremental and transformative change

Transformative adaptation is deemed to differ from incremental change in that it generally denotes non-linear changes or significant departure from the status quo in how adaptation is typically advanced (O'Brien, 2012; Pelling *et al.*, 2015; Marshall *et al.*, 2016). However, there is currently considerable confusion in the literature with regard to both transformative adaptations taken in response to climate change impacts and societal transformations that minimise risks and the subsequent need for climate change adaptations in the first instance. For instance, O'Brien and Sygna (2013) focus on the latter concept, whereby transformation towards sustainability is seen as the preferred response to minimise future climate warming, thereby reducing the need for transformative adaptation in response to climate change impacts. Others, however, provide examples of transformation taken as a response to climate change impacts (e.g. water-efficient maize production in Africa; Kates *et al.*, 2012), acceding that a significantly warmer world is now inevitable.

Moreover, repeated microlevel incremental changes can lead to transformation over time (Kates *et al.*, 2012; Pelling *et al.*, 2015; Termeer *et al.*, 2016). For example, in the UK, proposals detailed under the Thames Estuary Plan highlight the need for incremental measures to reduce flood risks during the first 25 years, for instance, preserving the current system and adjusting defences incrementally, after which transformative responses may be necessary depending on the degree of climate change experienced, specifically, relocation of development along the floodplain (Kates *et al.*, 2012).

Despite the difficulties in delineating adaptation, the IPCC has called for conceptual clarity in differentiating between incremental and transformative adaptation because it affects how adaptation is managed, how it is integrated into policy and how financial resources are allocated (Noble *et al.*, 2014). To date, however, few studies have empirically explored the relationship between incremental and transformative adaptation, in part constrained by the low frequency with which successful transformation occurs (Revi *et al.*, 2014).

2.3 Barriers to Adaptation

As acceptance of the necessity to adapt increases, studies have started to embrace questions surrounding the social factors that challenge the ability to proactively adapt to current and future climate change challenges. The literature surrounding this topic has characterised these restricting or constraining factors as "barriers to adaptation" (Gifford and Chen, 2016).

Significant agreement now exists that the primary challenge associated with successfully implementing adaptation will be the ability to negotiate the myriad barriers that occur in the face of adaptation (Moser and Ekstrom, 2010). A barrier to adaptation is considered as an obstacle to specified actions, for specific actors in a particular context, emerging from a condition or set of conditions. Different actors may experience barriers differently and they can therefore be overcome or reduced in principle (Patterson *et al.*, 2015). They are distinct from adaptation limits, that is, thresholds after which system features cannot be maintained even in a modified form (Barnett *et al.*, 2015).

2.3.1 Frequently reported barriers

Some scholars attest that there are barriers that are specific to the adaptation process (e.g. lack of guidance; lack of feasible adaptation solutions; reliance on uncertain scientific evidence to identify solutions; conflicting timescales and ambiguities associated with climate change) (Biesbroek *et al.*, 2011, 2013; Ekstrom and Moser, 2014). Outside these, however, research suggests that most barriers are not specific to the governance of adaptation, but are encountered across a range of policy and management processes (Biesbroek *et al.*, 2013; Eisenack *et al.*, 2014).

For some, barriers to transformative adaptation are likely to be different from and more challenging than those related to incremental strategies (Moser and Ekstrom, 2010). Similarly, incremental adaptation is also implicitly considered as a relatively pain-free process compared with transformative change (Adger *et al.*, 2009b). Others attest that barriers to transformation do not differ substantially from those related to incremental change, with ambiguities concerning risks and benefits, perceived costs of change and institutional and behavioural inertia characterising both incremental change (Biesbroek *et al.*, 2013; Wilson, 2014) and transformative change (Olsson *et al.*, 2010; Kates *et al.*, 2012; Rickards and Howden, 2012; O'Brien and Sygna, 2013).

A clearer appreciation of the general nature of barriers is necessary to advance our understanding of the adaptation process, to evaluate climate change adaptation policies and processes (Biesbroek *et al.*, 2013) and to identify appropriate intervention strategies when adaptation fails. In this regard, barriers to adaptation are assumed to arise from multiple and sometimes inter-related aspects and are generally categorised into four primary categories: (1) social and cultural barriers; (2) institutional and governance barriers; (3) resource barriers; and (4) physical or natural barriers (Arnell and Charlton, 2009; Moser and Ekstrom, 2010; Jones and Boyd, 2011; Adger *et al.*, 2013; Biesbroek *et al.*, 2013; Klein *et al.*, 2014; Barnett *et al.*, 2015; Lawrence *et al.*, 2015; Juhola, 2016; Keskitalo *et al.*, 2016). Although each of the categories is distinct, as the following sections demonstrate they are often interconnected, resulting in interaction between, and reinforcement of, particular barriers (Eisenack *et al.*, 2014).

Social and cultural barriers

Social and cultural barriers can arise in response to antecedent worldviews, risk perceptions, beliefs, cultural values or preferences that determine the ways that individuals and societies experience, understand and behave in response to climate change (Lorenzoni and Hulme, 2009; Klein *et al.*, 2014; Armah *et al.*, 2015). When individuals have a desire to avoid uncertainty, they typically have a strong intolerance to change and may be unwilling to compromise when traditional beliefs and worldviews are at stake (Esterhuyse, 2003). These social and cultural characteristics can, however, affect the vulnerability of individuals (Grothmann and Patt, 2005; Nielsen and Reenberg, 2010; Jones and Boyd, 2011). Such traits, it is argued, may become engrained and reinforce internal community structures to resist undesired adaptation (Jones and Boyd, 2011).

The inherently localised nature of adaptation in terms of its impacts at the individual and the aggregate level (e.g. communities) has resulted in greater attention in the literature on the place-specific nature of adaptation and the potential barriers that emerge as a result (e.g. Adger *et al.*, 2013; Marshall and Stokes, 2014).

Researchers have thus called for greater emphasis on understanding transformative change beyond an examination of attitudes and mental models to incorporate cultural dimensions of transformations such as alterations to social identity (Olsson *et al.*, 2010) and culture and cognition (Béné *et al.*, 2012). The merits of integrating context-specific, local place-related values into decision-making and planning is now widely acknowledged if adaptation measures are to receive societal support (Agyeman *et al*., 2009; Devine-Wright, 2011; Fresque-Baxter and Armitage, 2012).

Recent discussions surrounding place-related values have focused significant attention on the concept of place attachment (Williams and Vaske, 2003; Brown and Raymond, 2007; Devine-Wright, 2013). Place attachment describes a usually positive emotional connection to certain locations or to particular landscapes, typically encompassing both physical and social elements (Hidalgo and Hernández, 2001; Manzo, 2003; Knez, 2005; Hernández *et al*., 2007; Lewicka, 2011; Devine-Wright, 2013), which leads to individual and collective actions (Manzo and Perkins, 2006; Devine-Wright, 2009). At the individual level, place attachment often emerges through personal experience with the physical environment (Proshansky *et al.*, 1983). Attributes such as natural environmental qualities, cultural values, mobility, length of residence and recreational opportunities, amongst others, have all been shown to affect the development of attachment (Fried, 1982; Low and Altman, 1992; Kaltenborn, 1997; Kaltenborn and Bjerke, 2002; Hernández *et al*., 2007; Beery and Jönsson, 2017).

Continuity of place may become disrupted for individuals in response to perceived threats to place (Brown and Perkins, 1992; Chow and Healey, 2008; Devine-Wright and Howes, 2010; Anton and Lawrence, 2016; Cretney and Bond, 2017), threatening place attachment processes (Brown and Perkins, 1992; Devine-Wright, 2009; Cheng and Chou, 2015). Disruptions to place may include relocation, physical landscape change, changes to the legal or symbolic designation of a place (Devine-Wright and Howes, 2010) or potential changes (Mihaylov and Perkins, 2014), which often result in negative social and psychological consequences (Devine-Wright, 2013). Individuals subjected to such processes may deploy coping mechanisms in the interim period (e.g. resisting undesired change, re-establishing place meanings or questioning powerful interests) to reduce threats of disruptions and protect their sense of attachment (Chow and Healey, 2008; Fresque-Baxter and Armitage, 2012; Anton and Lawrence, 2016). Those with stronger levels of place attachment are likely to interpret changes in place attachment as transformative as they are passing social thresholds (Marshall *et al*., 2012).

Researchers to date have examined the issue of disruption to communities through purposive questionnaire sampling of residents with direct experience of, or those specifically at risk from, weather-related hazards, for example property flooding (Mishra *et al.*, 2010; De Dominicis *et al.*, 2015), ignoring the views of community members without such experience. Experience of extreme events is important for framing adaptation measures in relation to personal circumstances and emotions, and may help to increase societal support for adaptation (Vasileiadou and Botzen, 2014). Nonetheless, these approaches disregard the views of a cohort of residents who may be unaffected by hazardous events but for whom adaptation planning and place-related values may be no less relevant. Planned adaptation involving changes to the physical fabric of a community has the potential to create disruption for all those who inhabit a place, regardless of their prior experience of weather-related hazards.

Governance and institutional barriers

Perceived fairness, equity and transparency of governance processes influences the legitimacy and acceptability of adaptation outcomes (Paavola and Adger, 2006; Gross, 2007). Research by Marshall *et al.* (2016) illustrates that when high levels of trust exist between individuals and formal and informal organisations, transformative adaptation can succeed. Specifically, when a lack of resources such as time and knowledge constrains individuals from engaging in decision-making, trusting relevant organisations and government agencies to make informed and effective decisions can facilitate transformation (Marshall *et al.*, 2016). Several scholars therefore contend that greater perceived procedural equity may be required for transformative adaptation (Bahadur and Tanner, 2012; Mustelin and Handmer, 2012). This may demand re-structuring of historical path-dependent institutional structures, organisational cultures and policy-making

procedures (Burch, 2010a). This calls for leadership from key decision-makers, adopting practices that are fair and transparent to overcome challenges in adaptation processes and subsequently achieve acceptable outcomes (Burch, 2010b; Adger *et al.*, 2016).

Research repeatedly illustrates that reflexivity and learning from past events and actions can open up opportunities for adaptation (Burch, 2010b; Chapin *et al.*, 2010; Jones and Boyd, 2011; IPCC, 2012; Mustelin and Handmer, 2012; Patterson *et al.*, 2015). In the context of governance processes, learning strategies involve monitoring, evaluating and responding to signs of social and environmental change (Olsson *et al.*, 2004, 2010), which if responded to appropriately can help to overcome adaptation barriers (Moser and Ekstrom, 2010). Too often, however, learning is constrained as administrations responsible for adaptation planning attempt to validate, improve and legitimise judgements of the most salient adaptation issues based on technical or scientific expertise (Cloutier *et al.*, 2015). The literature on environmental governance has defined this as "single-loop" learning (Pahl-Wostl, 2009) or "incremental" learning (Holling *et al.*, 2002), whereby learning is carried out by self-referential professionals who consider dealing with such changes as problem-solving (Holling *et al.*, 2002). Actions are taken to improve decision-making without altering established assumptions, routines or decision-making processes (Pahl-Wostl, 2009).

Conversely, "double-loop" learning occurs when inadequacies are identified in underlying systems, policy failures are recognised and problems are re-framed (priorities altered, new aspects introduced, system boundaries changed) (Holling *et al.*, 2002; Pahl-Wostl, 2009). A primary way of facilitating this learning in bureaucratic systems is through the introduction of new actors (Holling *et al.*, 2002). The benefits of co-learning and co-producing knowledge and strategies based on both local and scientific expertise have been repeatedly demonstrated within this approach (Cloutier *et al.*, 2015). Local actors exhibit knowledge of the entire territory in which they live. Although they may not fully appreciate climate projections or other technical information, they are nonetheless well placed to identify common responses to specific meteorological hazards (Cloutier *et al.*, 2015). Moreover, when socially or environmentally unacceptable side effects are ignored or emerge through the governance of adaptation, affected actors may be unforgiving, particularly when learnings from past shortcomings are not evident (Ekstrom *et al.*, 2011).

Resource-based barriers

Resource-based barriers concern technological, human and financial constraints (Moser and Ekstrom, 2010). Such barriers can arise, for example, from the different temporal and spatial uncertainties related to forecast modelling or from insufficient expertise, awareness or information amongst policymakers of the impacts of climate change (Jones and Boyd, 2011; Runhaar *et al.*, 2012). To facilitate transformative change, research suggests that resource-based barriers (e.g. uncertainties associated with future climate change projections) could be overcome by integrating greater flexibility into adaptation planning. For example, risk-hedging across different spatial settings, including the development of context-specific strategies for different locations, could be undertaken by ensuring that strategies are sufficiently robust and flexible to deal with multiple and uncertain climate change scenarios (Smith *et al.*, 2011). Where flexibility exists, resources could be appropriated to whichever future scenario emerges. Risks can be minimised where reversibility and soft adaptation measures are in-built into adaptation planning, and strategies can be abandoned if the future climate that individuals were hedging against does not emerge. However, such an approach demands early consideration of transformative adaptation in the governance of adaptation planning because initial responses need to be congruent with future eventualities (Smith *et al.*, 2011).

Despite their comparatively high adaptive capacity, institutions in developed countries also face challenges in funding adaptation strategies (Klein *et al.*, 2014). For example, studies from across Europe, including the UK, the Netherlands and Germany, have highlighted that a lack of available financial resources can act as a significant impediment to adaptation at local scales of governance (Uittenbroek *et al.*, 2012; Lehmann *et al.*, 2013; Wilson *et al.*, 2014). Equally, financial resources may be curtailed owing to economic crises that limit the availability of funding to institutions engaging in adaptation planning (Ekstrom and Moser, 2014).

Although resource barriers are considered a significant hindrance to adaptation generally, Ekstrom and Moser (2014) highlight that resource barriers to adaptation are less dominant than typically assumed. Furthermore, a lack of financial, technical or human resources does not necessarily infer a need to build greater adaptive capacity but demands that such resources are better utilised to overcome barriers (Burch, 2010a; Biesbroek *et al*., 2011). For instance, whether or not resources are invested in specific adaptation measures is dependent on whether the problem identified is directly considered an area of concern and whether it is subsequently deemed worthy of investment by those who control those resources, for example through the deployment of finance, staff, skills and technology (Ekstrom *et al.*, 2011). Consequently, although transformative change demands significant resource investment (Rickards and Howden, 2012), studies argue that resource-based barriers hindering transformation should be more critically examined in light of social and institutional barriers that may require support to facilitate undergoing changes (Grothmann and Patt, 2005; Jantarasami *et al*., 2010; Lehmann *et al*., 2013; Ekstrom and Moser, 2014).

Physical barriers

Physical barriers can be related to both non-climatic (e.g. geology or land availability/topography) and climatic (e.g. effects of temperature rise) factors. Barriers emerging from physical features of the environment are considered difficult to overcome in practice, although technological innovations may assist in these endeavours (Ekstrom *et al.*, 2011). Physical barriers have significant implications for human adaptation. For example, the distribution and availability of water resources is a characteristic of the physical environment that is affected by climate. Human consumption of freshwater resources in certain regions is now reaching a critical threshold because of over-extraction of groundwater and surface water supplies (Shah, 2009). Regions dependent on water supplies may have reduced capacity to cope with short- or long-term fluctuations. This in turn limits the selection of adaptation measures available to manage water security and has direct consequences for a range of sectors, influencing both agricultural yields and food security (Hanjra and Qureshi, 2010) and energy security (Dale *et al.*, 2011).

Similarly, path dependency linked to historical modification of the physical environment, including the siting of past infrastructural developments, may potentially constrain the range of future options available (Klein *et al.*, 2014). Human alteration of the physical environment is particularly evident in urban locations, where the siting and design of infrastructure influences vulnerability to climate change (Klein *et al.*, 2014). For instance, water infrastructure developed in western US states in the 19th and 20th centuries has constrained the present range of management choices regarding water allocation (Libecap, 2011). Proposed adaptive measures can also be constrained owing to the geographical location of existing communities, which results in lock-in to existing infrastructure and path-dependent trajectories, stifling the emergence of alternative solutions (Wilson, 2014). For example, spatial constraints in urbanised areas may limit available options for future-proofing cities against climate change, for example flood defence planning.

2.4 Conclusion

The principle aim of this report is to investigate the opportunities and challenges associated with transformative adaptation using the case of flood risk adaptation in Ireland, specifically focusing on (1) identifying those institutional settings that are needed for societal transformation to respond to increased climate change risks and (2) changing divisions of responsibilities between public and private actors necessary to increase the resilience of societies and advance transformative adaptation in practice. To this end, this chapter provides the basis for the way in which adaptation is currently conceptualised and examined, specifically describing the two primary pathways that it might follow – incremental and transformative adaptation. In so doing, the chapter also highlights that barriers to adaptation typically span four inter-related dimensions: socio-cultural, governance, resource and physical constraints. Discussions surrounding the barriers that might arise in the context of transformative adaptation are also provided throughout the chapter. These issues are contextualised in the following chapters using the case studies of Skibbereen, County Cork, and Clontarf, County Dublin.

3 Case Studies and Methods

3.1 Introduction

As detailed in Chapter 1, this report forms part of a JPI Climate research project entitled "Societal transformation and adaptation necessary to manage dynamics in flood hazard and risk mitigation (*TRANS-ADAPT*)". The 11 case studies within TRANS-ADAPT are drawn from four European countries where flood risk management has been institutionalised for decades, namely Austria, France, Ireland and the Netherlands. An overview of each of the case studies from Austria, France and the Netherlands, and details of their transformative nature, can be found in the synthesis report related to this research (see Fuchs *et al*., 2017). In each of the case studies across Austria, France and the Netherlands, transformative adaptation was facilitated and implemented. In contrast, the Irish case studies demonstrate examples of transformation that were not implemented. They therefore offer a unique perspective on the challenges associated with transformative adaptation in practice. The two Irish case studies (Skibbereen, Co. Cork, and Clontarf, Co. Dublin) are demonstrative of both positive and negative transformative change. In Skibbereen, transformation was advocated as a positive alternative to business-as-usual flood risk adaptation in Ireland, whereas, in Clontarf, transformation was deemed as being imposed and was perceived as negative. One of the case studies (Clontarf) also offers an opportunity of examining incremental adaptation in the aftermath of failed transformation.

Figure 3.1. Location map of the Skibbereen and Clontarf case studies.

3.2 Case Study Selection

3.2.1 Skibbereen, County Cork

Skibbereen, County Cork, in the south-west of the country is Ireland's most southerly town (Figure 3.1) and has a population of 2500 people. The town is situated on the River Ilen and is the primary residential settlement on the river. The area serves as a gateway to the south-west of the country, one of Ireland's largest tourist regions. The town is primarily exposed to fluvial flooding, but tidal flooding has also occurred in the past, sometimes in combination with fluvial floods. Flooding in recent decades has been particularly severe, with extensive flooding occurring in 1986, 2000, 2009, 2010, 2012 and 2013.

Following flooding in November and December 2009 a local environmental group drafted a proposal to develop an environmental park in a marsh area on the town's outskirts. The environmental park was to serve as a multi-functional facility and incorporate woodlands, water bodies, valleys, hills, numerous habitats and enclosures. These landscapes were envisaged to provide opportunities for walking and recreational and cultural activities, as well as serving as a wetland storage system to protect the town from fluvial and tidal flooding. The amenities proposed within the park in terms of natural and constructed features were to provide a potential communal recreational resource and tourist attraction for the town. The park was to be the first of its kind in Ireland in terms of its multi-functionality in integrating both flood relief measures and recreational features.

The marsh area was owned by the county council, who were considering constructing a car park to accommodate 200 parking spaces at the same time as the development of the environmental park proposal (Eolas, 2009; Skibbereen Town Council, 2009). Based on IPCC definitions of transformation (IPCC, 2014b), this case study is considered transformative to the extent that its development required a fundamental qualitative change in embedded value systems and institutional procedures that define the management of flood risks nationally, which heavily utilise structural defences to manage flood risks.

Prior to the development of the environmental park proposal, a flood committee within the community was advocating for flood relief works to alleviate historical problems of flooding in the town. The local flood committee represented the flooded community of 230 residents and businesses in the town and was keen to ensure that flood relief works would be sufficient to protect the community into the future. Following the 2009 floods, the committee established the Irish National Flood Forum, a national body to represent and advocate the interests of flooded communities with flood authorities, policymakers and elected representatives. It was subsequently involved in lobbying flood authorities for flood relief works both nationally and in Skibbereen. Although the local environmental group presented the environmental park proposal to various community organisations, the town council, local politicians and the OPW, amongst others, the proposal failed to gain the necessary traction and structural flood defences are instead being advanced through a €14 million capital investment.

3.2.2 Clontarf, County Dublin

This section describes two separate flood defences proposed within the community of Clontarf, Co. Dublin (see Figure 3.1) between 2007 and 2016 along different sections of the coast. Specifically, the flood defences discussed in this section relate to Clontarf promenade and Dollymount promenade. Clontarf is a coastal suburban town located approximately 6 km to the north of Dublin city centre, with a population of 31,000 people. The town is bordered to the east by the Irish Sea and to the south by the River Tolka, one of Dublin's three main rivers. The area is characterised by its scenic qualities and recreational opportunities given its location overlooking Dublin Bay to the east and the Wicklow Mountains to the south.

Clontarf promenade

A 3-km promenade runs along the coast in Clontarf and serves as a recreational area for walkers, joggers, exercise enthusiasts and bird watchers. The promenade is unique in terms of the presence of green space in proximity to the sea and the city centre, with large sections of the 3-km stretch consisting of a 30 m-wide green space. The area is also connected to Bull Island to the east, a United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve.

Clontarf has been subject to significant flood events in recent decades. Following a major flood event in 2002, Dublin City Council (DCC) proposed the development of flood defences along the promenade to protect residential and commercial premises from future coastal flood occurrences (Figure 3.2). The proposals involved the development of an earth mound or bund through the centre of the green space; where a mound was not practical at certain locations, a flood wall was chosen. The proposed height of the defences ranged from 0.85 m to 2.75 m along the 3-km course (Figure 3.3). In this instance, the OPW was not responsible for the development of the flood protection scheme, instead agreeing with DCC that the city council would be the lead agent for the project. On completion of the works it was expected that maintenance of the

Figure 3.2. Clontarf flood defence locations. The orange line relates to proposed flood defences for Clontarf promenade. The black line relates to proposed flood defences for Dollymount promenade.

Figure 3.3. View of Clontarf promenade. Left: existing view. Right: virtual depiction of proposed flood defences along Clontarf promenade. Source: DCC (2011b).

flood alleviation element of the scheme would then be transferred to the OPW. The project also consisted of combining flood relief works with the laying of an arterial water main within the finished bund to service the water demands of communities in north Dublin.

Planning permission for the proposal was granted in 2008. However, the initiation of works was delayed for several years. In 2011, local community groups became aware of proposals and opposed the planned flood defences on several grounds. Within a period of 2 months, these community groups successfully mobilised community resources and gained public and political support to compel DCC to revisit the planned proposals. Based on IPCC (2014b) definitions of transformation, the flood defences are classified as transformative from a community perspective given that their realisation would have fundamentally changed existing social values associated with the promenade and its functionality as a focal communal space. Both the residents and the business association in the community have since formed a working group in partnership with DCC to discuss how to progress flood relief efforts for Clontarf promenade. Construction works on flood alleviation are not expected to begin until 2019 at the earliest, over 10 years after planning permission was granted for the original flood relief scheme.

Dollymount promenade

In 2009, DCC initiated a second flood defence project in the community along a different section of the coast to the aforementioned Clontarf promenade flood defence proposals (see Figure 3.2). This involved the integration of flood defence measures, the installation of a new water main for the area and a 2-km cycle track that formed part of a 22-km cycle track around Dublin Bay. The scope of the flood defence measures included improvements to existing sea wall defences and construction of two new retaining wall sections. These included increasing the height of the existing sea wall to ensure a statutory minimum requirement of flood defences, along with an allowance for sea level rise during the 21st century (0.4 m) and resultant wave overtopping, details of which were included in the original planning application (DCC, 2009, 2017).

Public consultation pertaining to the scheme was undertaken in 2012–13. Subsequent to this, planning permission was approved in February 2013. However, when works began in 2015, concerns began to emanate within the community relating to some sections of the flood defences. In 2015, community groups subsequently mounted a campaign to oppose the proposed sea wall development (LoveClontarf.ie, 2015a). Following discussions between community groups and the local authority in 2015–16, a liaison committee was established and a compromise solution reached, resulting in changes to the proposed defences.

The proposed defences are classified herein as incremental based on IPCC Special Report on Extremes (SREX) definitions of incremental adaptation, whereby adaptation measures seek to maintain existing systems and development practices (IPCC, 2012). Specifically, in contrast to the issues that emerged with respect to Clontarf promenade, no fundamental changes to the function of the space was planned. Conversely, existing walkways were to be expanded, increasing the space's amenity value. Additionally, the defences involved maintaining existing national flood defence practices by moderately


Figure 3.4. View of Dollymount promenade. Left: existing view. Right: virtual depiction of proposed flood defences along Dollymount promenade. Source: DCC, 2009.

increasing the height of existing seawall defences (Figure 3.4).

3.3 Research Methods and Data Collection

3.3.1 Interviews

Semi-structured interviews were conducted with 14 key stakeholders deemed central to both case studies between July and November 2015. This comprised interviews with five stakeholders in Skibbereen, eight individuals in Clontarf and one employee of the OPW. Participants were purposively selected based on their involvement in the proposed flood defence strategies or their knowledge of flood risk management practices nationally. Interviews lasted between 1 and 2.5 hours and were recorded with participants' permission and transcribed verbatim. In the results reported in Chapter 4, gender-appropriate pseudonyms are used to preserve participants' anonymity (Table 3.1).

Interview transcripts were coded using MAXQDA 12 software to examine dominant themes between and within transcripts. Thematic analysis involved coding of the transcript data according to the four categories of barriers identified in the literature review (social/cultural, governance/institutional, resource and physical). A grounded theory approach was utilised to take account of additional information emerging during interviews following the assumption of Moser and Ekstrom (2010) that barriers to transformation are likely to differ from those identified in the adaptation literature more generally. Barriers were then independently assessed by a second researcher to ensure inter-rater reliability and rigour of the initial coding.

3.3.2 Desk research

A detailed content analysis of policy documents, literature, websites, reports, social media activity, digital media resources, etc. was carried out for both case studies.

Table 3.1. Details of interviewees for both case studies including pseudonyms

Skibbereen	Clontarf	National
Five interviewees: • former local authority elected representative – interview not drawn on for this report • flood committee members – *Barry, Colm, Matthew* • previously flooded residents and business owners – *Barry, Colm, Matthew* • environmental group representative – interview not drawn on for this report	*Eight interviewees:* • local authority elected representatives – *David, Julie* • residents exposed to flood risks – *Alice, Elaine* • business association member – *Gabriel* • residents' association members – *Alice, Dorothy, Elaine, Keith* • local authority official with responsibility for flood risk management – *Gareth*	*One interviewee:* • national flood authority representative – *Martin*

3.3.3 Questionnaires

Questionnaire implementation was undertaken on two separate occasions with residents in Clontarf. The questionnaires were designed to measure place-related values and perceptions of governance processes for two separate flood defence strategies proposed in recent years: one transformative measure in 2014 (Clontarf promenade) and one incremental strategy in 2016 (Dollymount promenade).

2014 questionnaire: Clontarf promenade

Questionnaires were distributed to Clontarf residents in July 2014. Although this was more than 2 years after the project stalled, awareness levels of the flood defences were still significant for three reasons. First, a protest against the project in 2011 was attended by approximately 5000 people; second, the flood defences received significant national media and political attention; and, third, discussions over alternative flood defences were ongoing in 2014. Residents were frequently informed of these through a community website and newsletter.

Questionnaire distribution employed a drop-and-collect method, whereby questionnaires were circulated on one day and collected the following day. Four fieldworkers were responsible for questionnaire distribution. Each fieldworker was responsible for distribution and collection within the confines of a specific geographical area of Clontarf. One questionnaire was left per household. Residents were divided into those directly adjacent to the promenade and those further inland. Questionnaire distribution occurred within the confines of two parishes (referred to herein as Clontarf) derived from Irish population census boundaries, within which the defences were proposed, namely Dollymount and Clontarf, St. John's (Central Statistics Office, 2014). Every third house on each street was included as part of this sampling technique (see Devine-Wright, 2011). The village of Clontarf is also located at the intersection of these parishes. As Bull Island is largely uninhabited, and flood defences were proposed on the landward side of the island (Figure 3.5), it was not included as part of the sampling area.

Census data showed that the population of both parishes in 2011 was 9867 (Central Statistics Office, 2014). In total, 378 questionnaires were distributed,

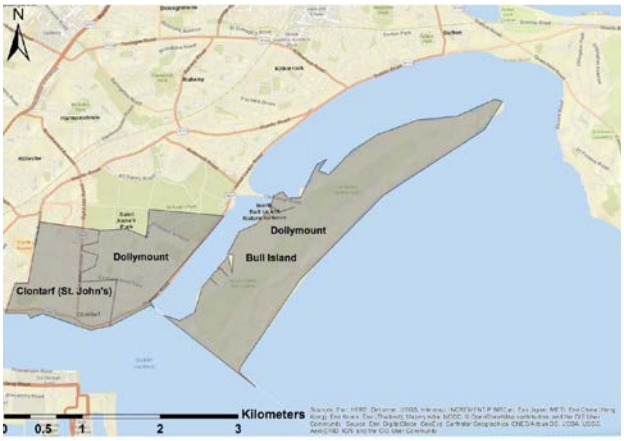

Figure 3.5. Location map of Clontarf questionnaire distribution. Grey shaded areas highlight Clontarf (St. John's) and Dollymount parishes.

with 280 returned (response rate 74.1%). A total of 88.1% of respondents had lived in Clontarf for 10 years or more, that is, prior to the severe flooding in 2004 and the initial flood defence proposals put forward by DCC in 2007. Sample biases were identified using a z-test by comparing proportional differences between the sample size and census data for each socio-demographic category (Table 3.2). Among the survey participants, younger respondents were under-represented whereas older individuals were over-represented. Similarly, participants were significantly more likely to have higher levels of educational attainment. Additionally, retired respondents were over-represented and students were under-represented within the study. Finally, individuals were more likely to own and were less likely to rent their property than in the census data.

2016 questionnaire: Dollymount promenade

To examine processes of place disruption for Dollymount promenade, questionnaires were identical to those developed for Clontarf promenade in content, wording and layout. Refined questionnaires were circulated in November 2016, 8 months after agreement was reached to reduce flood defence heights along Dollymount promenade. The short recall period ensured that respondents were likely to still be aware of the proposals. Questionnaire distribution methods reported for the 2014 Clontarf promenade study were replicated for the 2016 Dollymount promenade study.

Table 3.2. Socio-demographic characteristics for Clontarf promenade and Dollymount promenade questionnaire respondents compared with census data

Demographic factors		Clontarf promenade (%)	Dollymount promenade (%)	Census data: Dollymount and Clontarf, St. John's (%)
Age (years)	18–29	4.4**	1.3**	18.7
	30–44	18.9*	20.0*	26.4
	45–59	37.0**	42.1**	26.9
	60–74	25.2**	28.1**	16.4
	75+	14.4	8.5	11.6
Sex	Male	51.6	48.1	47.1
	Female	48.4	51.9	52.9
Ceased education	Second level	22.5*	15.0**	29.9
	Vocational qualification	8.8	5.3	6.3
	Bachelor's degree or equivalent	34.5*	45.6**	26.9
	Masters/PhD or equivalent	28.5**	27.9**	19.2
	No formal qualifications	1.6*	1.3*	0.4
Employment status	Working full-time/part-time	53.5	59.1	53.2
	Looking after children/home	5.5	4.8	8.3
	Unemployed	2.2	2.2	3.9
	Retired	33.6**	30.9**	18.9
	Student	3.3**	0.9**	12.7
Household status	Buying through mortgage	36.7*	38.7	43.4
	Own outright	59.5**	54.8**	33.9
	Renting	3.4**	6.1**	20.5

Note: * significant at $p<0.05$ and ** significant at $p<0.001$ compared with census data (Central Statistics Office, 2014).

Using 2011 Dublin parish-level census data, the population of both parishes was recorded as 9867 (Central Statistics Office, 2014). In total, 416 questionnaires were distributed, with 242 returned (response rate 58.2%). Sample biases were identified using a z-test by comparing proportional differences between our sample and census data for each socio-demographic category (Table 3.2). Younger respondents were under-represented whereas older individuals were over-represented compared with census-derived data. Similarly, participants were significantly more likely to have higher levels of educational attainment than in census data. Additionally, retired respondents were over-represented and students under-represented compared with census data. Finally, individuals were more likely to own and less likely to rent their property than in census data.

Questionnaire measures

To understand processes of disruptive place change, questionnaires for both Clontarf promenade (2014) and Dollymount promenade (2016) were designed to elicit perceptions of governance processes surrounding flood defences, place attachment, symbolic place-related meanings, place-protective interpretative responses and attitudinal responses. All measures, conditions and data exclusions for analyses are presented herein. In reporting results, pairwise deletion methods were employed for missing data values to maximise valid data (Pallant, 2013). Descriptive statistics for each of the measures is provided in Table 4.1.

Perceived effectiveness of governance and stakeholder groups

To measure the perceived effectiveness of governance processes, eight Likert statements were developed based on a review of existing literature (e.g. Gross, 2007). These items encompassed perceptions of fairness, transparency, accountability, inclusive decision-making, legitimacy and trust. Statements included "The planning process was fair", "Information from DCC was truthful, sincere and open" and "It was easy to access and obtain information about the flood defence plan". Responses ranged from 1 = strongly agree to 5 = strongly disagree. The items were used individually to examine the relationship between oppositional attitudes and perceptions of governance processes.

Place attachment

Place attachment was operationalised using items related to place dependence and place identity. Drawing on a review of the literature, nine statements were used to measure place attachment (e.g. Kaltenborn and Bjerke, 2002; Brown and Raymond, 2007). Place dependence was captured through three Likert statements, whereas place identity was captured through six Likert statements. In line with existing place attachment literature in which multiple individual Likert statements are combined to form a uni-dimensional scale (e.g. Brown and Raymond, 2007; Devine-Wright, 2011), the nine items were merged into a uni-dimensional scale measuring place attachment. A Cronbach alpha test demonstrated the place attachment construct to have good internal reliability ($\alpha = 0.84$) (von Wirth *et al*., 2016). However, an examination of corrected-item total correlations indicated that responses to the place identity statement "Clontarf is seen from outside as possessing prestige" was weakly correlated with the overall scale ($r = 0.26$) and was not considered as measuring the same construct as each of the other eight statements (Pallant, 2013). The statement was subsequently removed from the analysis and the scale's reliability improved ($\alpha = 0.85$). Response options for each statement were measured using five-point Likert statement responses ranging from 1 = strongly agree to 5 = strongly disagree, with 3 = neither agree nor disagree. The scores for each respondent from these eight items were combined and then averaged to create a measure of place attachment (see also Devine-Wright and Howes, 2010; Devine-Wright, 2011).

A Cronbach alpha test for the eight-item place attachment scale also exhibited good internal reliability for the 2016 Dollymount promenade study ($\alpha = 0.84$).

Place protective interpretative responses

Interpretation of proposed flood defence outcomes was measured using nine negatively worded Likert items, for example the proposed flood defences would have … "negatively impacted the cultural heritage of Clontarf", "created an eyesore", "spoiled views of the bay". Each of the statements was captured using a five-point Likert statement response as above.

Attitudes towards flood defences and place disruption

Attitudinal feelings towards place change were measured using two separate five-point Likert statements. Attitudinal support was measured with the statement "I was in favour of the proposed flood defences". During analysis this statement was reverse worded to "I was not in favour of the proposed flood defences" to denote oppositional attitudes to the proposed flood defences, with Likert statement responses also reverse coded (1 = strongly agree to 5 = strongly disagree). A second Likert statement, "Flood defences are necessary to protect Clontarf from flood damage", was included to measure attitudinal feelings towards the general need for flood defences

in Clontarf. Again, this statement used a five-point response as above (1 = strongly agree, 5 = strongly disagree).

Quantifying residential location

Residential location was quantified through two separate measures to examine potential response differences between flood experience and flood risk. Both stratified data sets were used to explore interactions between (1) flood experience and (2) flood risk; and attitudes towards proposed flood defences, place attachment and perceptions of governance processes. First, the question "Have you ever been affected by flooding in Clontarf?" was utilised to capture flood experience, with a dichotomous "yes/no" response option. Those who answered "yes" were asked how they had been affected by historical flooding in Clontarf. Responses were coded into four experiences of flooding: 1 = directly affected (property flooded), 2 = indirectly affected (traffic disruption, road closures, flood threats to property), 3 = affected but not specified and 4 = unaffected.

Second, flood risk was quantified using available flood maps for Clontarf for a once in 200 years flood event (DCC, 2011a). These flood maps assessed flood risk based on local topography, the condition of existing flood defences and extreme tide level scenarios (Royal Haskoning, 2005). Respondents were subsequently divided into two groups. Those objectively at risk, and therefore afforded protection through the proposed flood defences, were classified as "coastal" residents. Those not exposed to these flood risks were defined as "inland" residents. Both measures of residential location were examined because individuals in a flood risk area might be unaware that they are exposed to flood risks, particularly if they have never experienced flooding in the past. They therefore might respond to questions believing that they are not exposed to flood risks.

3.4 Conclusion

This chapter detailed and justified the Irish case studies selected for this research. It also discussed the methods employed in answering the research questions. Specifically, to ensure validity and robustness of the data, a mixed-methods approach was taken, incorporating interviews with key stakeholders pertinent to both case studies, analysis of secondary data sources and repeated implementation of a questionnaire for one of the case studies. The results from each of these methods are presented in the following chapter.

4 Results: The Challenges of Transformative Adaptation

4.1 Introduction

This chapter outlines the results surrounding the aim of this report, which was to investigate the challenges associated with transformative adaptation using the case of flood risk adaptation in Ireland. The results make an important contribution to adaptation policy and planning, which, as explained in Chapter 2, is prone to encountering numerous barriers, thereby constraining adaptation efforts. This chapter explains the conditions through which barriers to transformative adaptation arose in both case studies. It also details how incremental adaptation was perceived in the aftermath of failed transformation in one of the case studies (Clontarf, Co. Dublin).

4.2 Barriers to Transformation

Sections 4.2.1 and 4.2.2 present the results from interviews with key stakeholders pertinent to the Skibbereen, County Cork, and Clontarf promenade case studies (transformative adaptation), an analysis of secondary data sources and the results of questionnaire analysis undertaken for Clontarf promenade. Section 4.2.3 then details the results of questionnaires and secondary data analysis for Dollymount promenade, where incremental adaptation was attempted in the aftermath of failed transformative change.

4.2.1 Institutional barriers

Technical expertise reliance: insights at a national level

Despite a Flood Policy Review over a decade ago recognising that a move to non-structural approaches was needed (OPW, 2004), Irish national discourse remains focused on hard engineering solutions to flood risk. Difficulties with implementing non-structural flood relief measures were evident in the context of budgetary resources allocated for both structural and non-structural flood relief measures following the Flood Policy Review in 2004, with an investment of €26 million recommended for non-structural measures over a 6-year period compared with €440m for structural flood relief projects over a 10- to 15-year period (OPW, 2004). Current practices continue to favour structural flood measures with the national government allocating a further €430 million for structural flood defences for the period 2016–21 (OPW, 2015b).

This institutional mindset was evident in Skibbereen in the context of the local flood committee's support for structural measures as the only practical means of responding to flood risks in the town. The influential role of the flood committee in representing the flooded community, and committee members' direct experience of flooding, served to solidify these practices. Structural flood defences were described as a "total solution" to the flooding problem by one flood committee member and the failure to consider alternatives signified their over-riding preference for engineered flood relief measures:

> **Colm:** Even if you're talking about putting in whatever type of water park you were putting in there, you can't do that until such time as the flood defence solutions are put in to protect the town and you can't have any half flood defence systems to blend in with a water park. The water has to be stopped going into the town full stop.

> **Barry:** We haven't got … a definitive plan of where every wall and where every embankment and where every pumping station and where every non-return valve is going to be [for the approved defences], so … the point I'm making is that [environmental park] wouldn't stand the fool proof test. The fool proof plan is huge.

Preference for structural solutions was directly linked to concerns relating to non-availability of flood insurance. A Memorandum of Understanding between the OPW and the representative national insurance body, in which permanent flood defences were deemed a fundamental pre-requisite by the insurance industry for providing flood insurance, appears to have influenced the flood committee's position (OPW, 2014; Insurance Ireland, 2015; Hilliard, 2016). Although

demountable flood defences are deployed in limited circumstances nationally, flood authorities are reluctant to utilise this option because of risks associated with human intervention each time a flood risk occurs and the exclusion of flood insurance for properties in areas where demountable defences exist (Insurance Ireland, 2015). Subsequently, flood committee members in Skibbereen argued that structural flood defences were the most effective way of increasing the likelihood of insurance companies re-instating flood insurance:

> **Matthew:** Because we don't have flood insurance the value of our properties are worth nothing.

> **Barry:** The big concern for communities like us is the restoration of insurance. It's an issue at government level with the insurance federation that they are very slow to restore full or even partial cover until such time as the risk is gone. What really copper fastens our mandate from the 230 businesses and residents is that practically none of them [can] get insurance so that's what's driving us.

Moving to a system that integrates even relatively small-scale non-structural approaches to flood risk management practices was deemed to be a significant challenge at an institutional level. Although support for greater integration of non-structural solutions exists, the lack of familiarity with these measures compared with traditional solutions makes such strategies increasingly difficult to evaluate and justify, as was exemplified by an official from the national flood authority:

> **Martin:** If the situation arose that we could create a storage area that could be used as some kind of an amenity or create some biodiversity value and that storage area would provide flood risk reduction that we need, then that's fine, we can put that forward as a measure. It's just that the cases that arises in would be few. We haven't really come across it to date.

Thus, the results from Skibbereen demonstrate that, rather than perceiving non-structural strategies as the default strategy around which structural flood relief measures could be designed, the opposite appears to be true.

In Clontarf, elements surrounding technical barriers to change were also evident. The institutional practices and the mindset of those with responsibility for flood risk management in DCC have failed to adapt to Flood Policy Review recommendations from 2004, which recommended prioritisation of non-structural measures:

> **Gareth:** I don't see any point in putting something in that has to be removed in 40 or 50 years. If it's not designed that you can put something else in front of it and make it higher, it's very difficult to retrofit it. Also, the OPW … don't want to go back because it's much more costly to do it twice … they just want to go in and do something once that's going to last the design life of the structure.

Institutional practices of prioritising engineering knowledge and approaches in decision-making were heavily criticised by the community (LoveClontarf.ie, 2011a; DCC, 2011b). Those with a strong technical background were deemed to be responsible for designing the proposed flood defences (LoveClontarf.ie, 2011a; DCC, 2011b), a point that was re-iterated by interviewees. This resulted in a solution that, although the community acknowledged would be effective at preventing flood risks, did not consider other concerns and knowledge:

> **Elaine:** We asked for a multidisciplinary team. We said that we did not consider this as an engineering project and even if something is engineering led … it should never be just the engineers.

> **Dorothy:** It was definitely an engineering job with no other department involved.

One elected representative suggested that engineers were less likely to be connected to, and therefore understand, the concerns of local communities when designing flood relief schemes than politicians, who could be held publicly accountable, with another stating that this compartmentalised thinking was no longer justified and that genuine engagement with affected communities was needed for adaptation strategies to be considered legitimate:

> **Julie:** Engineers are not politicians. They don't understand the political sensitivities of messing with a promenade like the one in Clontarf … it's because I suppose they are not politicians, they don't have to go back to people, they are not going to be personally emailed and they think that in the end when the finished product is there that people will be happy with it.

> **David:** The engineers in my opinion, they really have to buy into it [consultation]. It's a feeling that you get that these people are really listening to you and that they are really taking on board what you are saying.

The importance of integrating local knowledge and viewpoints emerged as a key priority at a local level, resulting in the local authority abandoning plans to proceed with the flood relief scheme in Clontarf in 2011. Following extensive discussions between the local authority and community groups in the aftermath of this decision, the community negotiated the inclusion of two of its representative bodies in a multi-disciplinary consultation group established to identify alternative flood relief options for the promenade.

Regulatory practices from Clontarf promenade

A significant barrier to adaptation along Clontarf promenade centred on planning regulations, specifically those regulations detailing how the public is notified of major infrastructural projects being undertaken by local authorities. Under EU Directives regarding public participation in environmental decision-making (Directive 2003/35/EC; EU, 2003) and Part 8 of the Planning and Development Regulations, 2001 (Office of the Attorney General, 2001), local authorities are required to place a notification of major infrastructural projects in an approved newspaper and to erect notices on the land on which the proposed development is to be sited. Julie, an elected official, described these methods as "stone age" and as not reflecting modern means of communication. This, it was suggested, acted as a primary reason for a lack of community awareness and engagement with the issue until 2011, 4 years after public consultation under the scheme had passed:

> **Julie:** I think the whole Part 8 process should be looked at. We have social media now. We have an awful lot of different ways that we didn't have in the past of getting the message across to people to avoid these kinds of things happening. We need to use that better and we need to update the Part 8 process and take account of new technologies. I think the barriers to having people engaged is rooted in the outdated communication process for the whole Part 8 procedure.

Effective communication strategies and the means of disseminating information about proposed flood relief schemes were also highlighted as a primary concern by officials with responsibility for flood risk management:

> **Gareth:** I think communications is the big element of it. A scheme is proposed … but getting the message to people who it's going to affect, and you don't really know who they are. With flooding you know the people that have been flooded but then you have the people who use a certain facility and they may be miles away or they might drive by there every day. How do you tell all of them what's proposed? … It's really communication I feel is the toughest thing to achieve.

> **Martin:** Some communities … have active flood groups. They may have a flood and some residents and businesses would have come together … and they would be quite proactive about that engagement. I think that would be more the exception than the rule.

The governance process and how decisions were arrived at in relation to the proposed defences in Clontarf were highlighted as a significant concern by the community. David, an elected official, commented that the public consultation process was merely "ticking a box" to the extent that the local authority was not considered to be genuinely interested in community engagement. The community expressed concerns over a number of issues pertaining to public consultation and suggested that it was illegitimate in that it had taken place in areas distant from Clontarf (LoveClontarf.ie, 2011b; Ó Ríordáin, 2011), which subsequently contributed to a lack of local awareness

until after the consultation process had ended. This breakdown in communication ultimately led to a loss of trust between parties, as was noted by several interviewees:

> **David:** They [DCC] never really bought into the public consultation.

> **Keith:** They [DCC] deliberately ignored us and tried to ram it through. People were shocked at the arrogance of the council that this was pushed through without any consultation.

Despite repeated concerns from some interviewees that the local authority was not transparent in notifying the public of the flood relief scheme in Clontarf, it met all statutory requirements relating to public notification and consultation under EU Directives (Directive 2003/35/EC and Directive 2007/60/EC). Statutory methods of communication used for notifying the public of such infrastructural projects do not appear to have been conducive to effective public engagement and had consequential impacts on community perceptions of the governance process. The results highlight that historical institutional practices associated with planning regulations were one of the main causes of residents' opposition and created a lack of trust over how the governance process was managed.

An examination of community-wide perceptions of governance processes was undertaken using responses from the questionnaires related to Clontarf promenade flood defences. Specifically, Spearman's rank correlations were performed between each of the eight items measuring perceptions of the governance process related to public participation and oppositional attitude (i.e. "I was not in favour of the proposed flood defences") (Table 4.2). Significant negative relationships between oppositional attitude and each but one of the statements measuring positive perceptions of the governance process emerged. For example, opposition towards proposed defences was negatively correlated with "trust in Dublin City Council to make flood defence-related decisions regarding Clontarf" (rho = –0.45, $n = 254$, $p < 0.001$), the "community was recognised as a partner in the planning process" (rho = –0.46, $n = 253$, $p < 0.001$) and "the planning process was fair" (rho = –0.48, $n = 249$, $p < 0.001$). Analysis of descriptive statistics subsequently indicated that individuals were largely opposed to the proposed flood defences, believing that governance processes were inadequate (see Table 4.1).

Table 4.1. Descriptive statistics for place attachment and attitudes to disruptive place change, place-protective interpretative responses and perceptions of the governance process from the Clontarf promenade and Dollymount promenade questionnaires

Questionnaire Item	Clontarf promenade				Dollymount promenade			
	Corrected item–total correlation	Mean	Standard deviation	Median	Corrected item–total correlation	Mean	Standard deviation	Median
Place attachment (one composite item)		1.77	0.64	1.63		1.77	0.67	1.63
Place identity								
Clontarf is part of my identity	0.77	1.77	0.95	1.00	0.77	1.83	1.01	1.00
I have good memories of Clontarf	0.67	1.38	0.59	1.00	0.72	1.45	0.66	1.00
My family has connections to this area from far back	0.46	2.61	1.46	2.00	0.37	2.60	1.59	2.00
I feel that Clontarf is a part of me	0.75	1.87	0.99	2.00	0.82	1.86	1.00	2.00
I feel part of a community in Clontarf	0.70	1.63	0.74	1.00	0.67	1.63	0.79	1.00
Place dependence								
No other place provides the same opportunities to do what I like in my spare time	0.57	1.98	1.02	2.00	0.50	1.97	1.01	2.00
It is important to me how this area develops	0.55	1.27	0.46	1.00	0.55	1.24	0.55	1.00
The area is important to me because of my lifestyle	0.61	1.59	0.78	1.00	0.56	1.60	0.80	1.00
Attitudes to disruptive place change								
I was not in favour of the proposed flood defences		1.81	1.21	1.00		2.27	1.26	2.00
Flood defences are necessary to protect Clontarf from flood damage		2.02	0.90	2.00		2.05	1.07	2.00
Place-protective interpretative responses								
The proposed flood defences would have …								
Negatively impacted the cultural heritage		1.94	1.11	2.00		2.20	1.21	2.00
Decreased security of the place		1.76	1.07	1.00		2.87	1.24	3.00
Promoted anti-social behaviour		1.72	1.03	1.00		2.70	1.28	3.00
Created an eyesore		1.44	0.86	1.00		1.82	1.10	1.00
Spoiled views of the bay		1.32	0.76	1.00		1.63	0.99	1.00
Impacted wildlife		2.51	1.05	3.00		2.42	1.12	3.00
Reduced property values		2.18	1.03	2.00		2.77	1.14	3.00
Damaged tourism		2.02	1.05	2.00		2.50	1.18	2.00
Reduced the recreational value		1.45	0.90	1.00		2.11	1.20	2.00
Perceptions of the governance process		3.86	0.76	4.00		3.91	0.85	4.00
The planning process was fair		3.96	1.05	4.00		3.83	1.10	4.00
The planning process was open and transparent		4.00	1.04	4.00		3.95	1.09	4.00

Table 4.1 Continued

Questionnaire Item	Clontarf promenade				Dollymount promenade			
	Corrected item–total correlation	Mean	Standard deviation	Median	Corrected item–total correlation	Mean	Standard deviation	Median
The local community was recognised as a partner in the planning process		3.92	1.09	4.00		4.01	1.05	4.00
Community views were listened to*		3.69	1.17	4.00		3.91	1.08	4.00
Information from Dublin City Council was truthful, sincere and open		3.78	1.02	4.00		3.79	1.06	4.00
It was easy to access and obtain information about the flood defence plan		3.49	1.11	4.00		3.65	1.03	4.00
I was able to influence the planning and decision-making process*		3.63	1.07	4.00		3.84	1.04	4.00
I trust in Dublin City Council to make flood defence-related decisions regarding Clontarf		4.07	1.02	4.00		3.92	1.15	4.00

Responses were given on a five-point Likert scale: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, 5 = strongly disagree.

Note: * significant at $p < 0.05$ and ** significant at $p < 0.001$.

Table 4.2. Bivariate correlations between opposition to proposed flood defences and perceptions of the governance process related to public participation for Clontarf promenade and Dollymount promenade

Perceptions of governance processes	Not in favour of proposed flood defences	
	Clontarf promenade	Dollymount promenade
The planning process was fair	–0.48**	–0.49**
The planning process was open and transparent	–0.44**	–0.51**
The local community was recognised as a partner in the planning process	–0.46**	–0.53**
Community views were listened to	–0.35**	–0.53**
Information from Dublin City Council was truthful, sincere and open	–0.39**	–0.51**
It was easy to access and obtain information about the flood defence plan	–0.28**	–0.34**
I was able to influence the planning and decision-making process	–0.02	–0.29**
I trust in Dublin City Council to make flood defence related decisions regarding Clontarf	–0.45**	–0.47**

Note: * significant at $p < 0.05$ and ** significant at $p < 0.001$.

4.2.2 Socio-cultural barriers: place attachment in Clontarf

In Clontarf, barriers also emerged when community groups became aware of the flood defence proposals in 2011, 4 years after the public consultation had been completed. Proposals by the local authority to significantly alter the promenade to incorporate flood defences were vehemently resisted by local community groups representing residents and businesses, and by elected representatives. Emotional connection to the promenade, its value as a recreational amenity and its proximity to the coast were frequently suggested as key reasons for this attachment:

> **Julie:** People from Clontarf … firmly believe that they live in the best place in the world. Everybody who lives in Clontarf thinks that they live in the best place in the world, which is a lovely thing. They are very attached to that prom and rightly so because it's a great amenity.

> **Elaine:** You have this beautiful natural setting, and when you're down on the prom here you could put so many things out on the water.

> **Keith:** If you come down here at the weekends or any day of the week you will see people out walking, you see people out jogging. It's a lovely promenade.

> **Alice:** I think what another wonderful outcome was that, and as if we needed it, we all fell in love with the prom even more … I think it needs just tiny little touches to make it that much more of a wonderful place.

The promenade, its recreational features and the natural coastal setting were considered to epitomise people's understanding of what Clontarf meant and how people identified with the place (DCC, 2011b; O'Carroll, 2011). The proposed flood defences were deemed to create a physical barrier between the community and the coast, which it was suggested would result in a decline in usage of the promenade. This would serve to "sterilis[e] the prom" as one interviewee commented, thereby limiting its uses. Severing the community's connection with the promenade was deemed to threaten place attachment and sense of belonging in the process:

> **Alice:** It is a magic place and when we walked with […] and his colleagues along the prom and it was a lovely day and we have the working group there … it was lovely that they [DCC officials] were doing a field trip and appreciating what we love about it. I wouldn't want to change it too much more.

> **Julie:** In many ways it's [the promenade] a better amenity than the equivalent in Dun Laoghaire or other coastal parks because it is such a large grassy facility … parts of it are iconic. Those green structures [on the promenade], the ones that are ionised, if you put them somewhere else there would probably be a protest, but they've become iconic, they have become Clontarf and it's the same for the prom. It's intrinsically wedded in peoples' minds in … their idea of where they come from.

Historical community opposition to unwanted developments in Dublin Bay that were perceived as impacting the community's connection to the landscape (DHPCLG, 2015) was noted by an elected representative as being a key reason for the community's opposition:

> **David:** The port company were going to fill in 52 acres of land and there has been a big fight down there – it's been going on for the last 20 years or so, so there has been a tradition of fighting for that bay down there.

Illustrating the desire to preserve intra- and inter-generational attachment, the promenade's importance as an amenity was deemed to extend beyond the environs of the community (Anon., 2011; LoveClontarf.ie, 2011b), with several interviewees describing the community as its "gatekeepers":

> **David:** The people that live on the [sea]front, even they would see themselves as keepers of the environment there.

> **Keith:** This amenity [promenade] is for everybody, not just Clontarf.

Elaine: The way people responded in terms of how they saw the value of the amenity … as a national and city amenity, but they did not necessarily see it as a local amenity.

For the Clontarf promenade questionnaire, Spearman's rank correlations were performed between place attachment and place-protective interpretative responses (Table 4.3). The findings demonstrated a positive correlation between place attachment and each item related to negative interpretation of change. For example, the relationship between place attachment and interpreting that flood defences would have "created an eyesore" (rho = 0.25, $n = 250$, $p < 0.001$), "reduced the recreational value" (rho = 0.24, $n = 251$, $p < 0.001$), "negatively impacted on the cultural heritage" (rho = 0.40, $n = 251$, $p < 0.001$), "spoiled views of the bay" (rho = 0.23, $n = 249$, $p < 0.001$) or "impacted wildlife" (rho = 0.34, $n = 245$, $p < 0.001$) all displayed statistically significant positive correlations.

To test whether experience of flooding contributes to lower levels of place attachment, a Kruskal–Wallis test was conducted using each of four subgroups. The results indicated no significant difference in place attachment between subgroups (group 1, $n = 22$ directly affected; group 2, $n = 13$ indirectly affected; group 3, $n = 10$ affected but unclear how; group 4, $n = 207$ not affected) [χ^2 (3, $n = 252$) = 6.10, $p > 0.05$], with individuals in each category reporting similar levels of place attachment. The effects of residential location related to flood risk (coastal vs. inland residents) was also explored with respect to place attachment. A Mann–Whitney *U*-test showed no significant differences in place attachment between coastal respondents [test statistic (*Md*) = 1.69, $n = 24$] and inland respondents (*Md* = 1.50, $n = 185$; $U = 2202$, $z = -0.07$, $p > 0.05$, $r < 0.01$).

The association between attitudes towards proposed flood defences and flood experience was examined. Again, no significant difference in support of the

Table 4.3. (a) Bivariate correlation between place attachment and both place-protective interpretative responses and perceptions of governance processes, and (b) bivariate correlations between opposition to proposed flood defences and perceptions of governance processes for Clontarf promenade

Questionnaire Item	Place attachment (a)	Not in favour of proposed flood defences (b)
Place-protective interpretative responses		
The proposed flood defences would have …		
Negatively impacted the cultural heritage	0.40**	
Decreased security of the place	0.24**	
Promoted anti-social behaviour	0.29**	
Created an eyesore	0.25**	
Spoiled views of the bay	0.23**	
Impacted wildlife	0.34**	
Reduced property values	0.35**	
Damaged tourism	0.38**	
Reduced the recreational value	0.24**	
Perceptions of governance process		
The planning process was fair	–0.30**	–0.48**
The planning process was open and transparent	–0.24**	–0.44**
The local community was recognised as a partner in the planning process	–0.21*	–0.46**
Community views were listened to	–0.20*	–0.35**
Information from Dublin City Council was truthful, sincere and open	–0.28**	–0.39**
It was easy to access and obtain information about the flood defence plan	–0.12	–0.28**
I was able to influence the planning and decision-making process	–0.05	–0.02
I trust in Dublin City Council to make flood defence related decisions regarding Clontarf	–0.19*	–0.45**

Note: * significant at $p < 0.05$ and ** significant at $p < 0.001$.

proposed flood defences was observed across subgroups (group 1, $n = 22$ directly affected; group 2, $n = 13$ indirectly affected; group 3, $n = 10$ affected but unclear how; group 4, $n = 218$ not affected) [χ^2 (3, $n = 263$) = 3.64, $p > 0.05$]. The relationship between residential location related to flood risk and attitudes towards proposed flood defences was then examined. No significant differences emerged between groups, with both coastal respondents ($Md = 5.00$, $n = 26$) and inland respondents ($Md = 5.00$, $n = 190$; $U = 2000$, $z = –1.79$, $p > 0.05$, $r = 0.12$) displaying similar attitudes, suggesting that exposure to flood risks was not sufficient to influence support for the proposed flood defences.

The relationship between flood experience and general support for flood defences was then investigated. Again, the results revealed no significant difference between subgroups (group 1, $n = 23$ directly affected; group 2, $n = 14$ indirectly affected; group 3, $n = 10$ affected but unclear how; group 4, $n = 219$ not affected) [χ^2 (3, $n = 266$) = 1.18, $p > 0.05$]. The association between residential location related to flood risk and general support for flood defences was examined. Again, coastal respondents ($Md = 2.00$, $n = 25$) were not statistically more likely to support flood defences in general than those living inland ($Md = 2.00$, $n = 191$; $U = 2367$, $z = –0.08$, $p > 0.05$, $r < 0.01$), further strengthening the argument that neither experience nor risk of flooding contribute to heightened demands for adaptation.

Despite ongoing flood risks, interviews, secondary data and questionnaires highlight that protection of the form and functionality of the promenade was of primary importance, whereby the community did not wish changes to interfere with their attachment to the landscape nor impinge on their sense of connection to the area. The significance of place attachment served to solidify the community's position in opposing flood defences, which would transform the landscape and threaten their connection to it.

4.2.3 Incremental adaptation when transformation fails

This section presents the results from secondary data analysis and the questionnaire pertaining to Dollymount promenade, which was conducted in Clontarf in 2016. The questionnaire was implemented to understand how incremental adaptation proceeds when attempts at transformation fail. Table 4.1 provides an overview of the descriptive statistics for each of the measures used in this study.

Integrating past governance learnings into adaptation planning

To examine perceptions of governance processes surrounding Dollymount promenade flood defences, the relationship between oppositional attitudes and the perceived effectiveness of the governance process was examined. Spearman's rho correlations between the reverse-worded statement "I was not in favour of the proposed flood defences" and each statement measuring positive perceptions of the governance process subsequently displayed negative relationships (Table 4.4). For example, correlation analysis showed statistically significant negative relationships between oppositional attitudes and belief that the planning process was "fair" (rho = –0.49, $n = 221$, $p < 0.001$), "trust in Dublin City Council to make flood defence related decisions regarding Clontarf" (rho = –0.47, $n = 223$, $p < 0.001$) or "community views were listened to" (rho = –0.53, $n = 223$, $p < 0.001$).

A Mann–Whitney *U*-test was conducted to identify potential differences in perceptions of governance processes between the Clontarf promenade and the Dollymount promenade questionnaires. The results showed a relatively small deterioration in perceptions of effective governance between studies related to those statements measuring perceptions of agency and control over decision-making. For instance, individuals were significantly less likely to believe that "community views were listened to" for Dollymount promenade flood defences ($Md = 4.00$, $n = 229$) than for Clontarf promenade flood defences ($Md = 4.00$, $n = 251$; $U = 25{,}704$, $z = –2.09$, $p < 0.05$, $r = 0.09$). Similarly, individuals perceived that they were significantly less likely to be "able to influence the planning and decision-making process" for Dollymount promenade flood defences ($Md = 4.00$, $n = 221$) than for Clontarf promenade flood defences ($Md = 4.00$, $n = 256$; $U = 25{,}083$, $z = –2.22$, $p < 0.05$, $r = 0.10$). All other statements measuring perceptions of governance processes showed no improvements over time (see Table 4.1).

Perceptions that historical failures in governance planning were not addressed following the issues that arose for Clontarf promenade defences were

Table 4.4. Bivariate correlations between opposition to proposed flood defences and perceptions of the governance process for Clontarf promenade and Dollymount promenade

Perceptions of governance processes	Not in favour of proposed flood defences	
	Clontarf promenade	Dollymount promenade
The planning process was fair	–0.48**	–0.49**
The planning process was open and transparent	–0.44**	–0.51**
The local community was recognised as a partner in the planning process	–0.46**	–0.53**
Community views were listened to	–0.35**	–0.53**
Information from Dublin City Council was truthful, sincere and open	–0.39**	–0.51**
It was easy to access and obtain information about the flood defence plan	–0.28**	–0.34**
I was able to influence the planning and decision-making process	–0.02	–0.29**
I trust in Dublin City Council to make flood defence-related decisions regarding Clontarf	–0.45**	–0.47**

Note: * significant at $p < 0.05$ and ** significant at $p < 0.001$.

evidenced from an analysis of secondary data sources used to capture manifest themes, which repeatedly highlighted residents' dissatisfaction with governance processes surrounding Dollymount promenade flood defences:

> **Elected representative:** It is quite unbelievable that no lessons were learned from the debacle that unfolded when a previous flood defence plan for the Clontarf Road was imposed on the local community. (LoveClontarf.ie, 2015b)

> **Local resident 1:** I think it's time the people of Clontarf and surrounding area should have another march like we did before to show DCC that we don't want and will not have this wall. (LoveClontarf.ie, 2015c)

> **Local resident 2:** DCC cannot continue to bombard us with information that they expect us to accept without question. (Facebook.com, 2015)

> **Local resident 3:** Lack of foresight from the council and planning department once again. (Change.org, 2015)

> **Local resident 4:** If the information was clear when planning permission was sought there would have been too many complaints from the local community to go ahead. (Larkin, 2016)

The lack of control felt by individuals over decision-making was further reflected by many individuals who expressed doubts over the necessity for coastal flood defences of any kind along Dollymount promenade, based on historical experience of pluvial flood risks in this area:

> **Local resident 5:** In over 50 years I have never seen a flood at this end of Clontarf. (Facebook.com, 2015)

> **Local resident 6:** I've listened to very experienced locals continually say this area floods from St Anne's Park, not from the bay. (Facebook.com, 2015)

> **Local resident 7:** They're fixing a problem that never existed. (Anderson, 2015)

These sentiments were later reiterated following extensive pluvial flooding along Dollymount promenade in May 2017:

> **Local resident 8:** A total disgrace. We sat across a table for over a year and told them [DCC] they were building a flood defence where there was virtually no tide, that the flooding problem was from the Naniken River in the park. They assured us that the drainage problems in the park had been resolved. Yesterday no tide and yet flooding. (Facebook.com, 2017)

> **Local resident 9:** Well done to those who built the new road and flood defence. You have managed to make the problem worse. Everybody knows the flooding always comes from the park. (Facebook.com, 2017)

> **Local resident 10:** This is beyond a joke. Hundreds of residents have expressed the fact that … "pluvial water" … is the real cause [of flooding]. (Facebook.com, 2017)

> **Local resident 11:** If they [DCC] had asked the local people, we could have told them the floods were from the park and not the sea coming over the wall. (Facebook.com, 2017)

These results demonstrate that, rather than perceptions of governance processes improving between studies based on historical learnings, individuals believed that they had less control over flood defence decision-making for Dollymount promenade than for Clontarf promenade defences. Moreover, failure to integrate local knowledge into decision-making was recognised as a key barrier to transformative adaptation along Clontarf promenade. The re-emergence of this issue along Dollymount promenade, and the perceived inability of the local authority to account for local knowledge in adaptation planning by addressing concerns over more pressing pluvial flood risks specific to Dollymount promenade, is demonstrative of why perceptions of governance processes did not improve over time.

4.3 Conclusion

The results from interviews, questionnaires and secondary data analysis point to the context-specific challenges of implementing transformative adaptation. As demonstrated in Clontarf, latent social values surfaced in response to perceived threats to a valued place and created resentment towards the local authority imposing these changes. Furthermore, processes associated with public engagement and communication practices led to these being perceived as mismanaged and illegitimate by the community. Additionally, in both locations barriers to transformation arose from historically embedded practices prioritising technical experience and decision-making processes at the expense of other forms of knowledge. Moreover, the findings illustrate the difficulties of attempting even modest incremental adaptation when transformation fails, as the case of Dollymount promenade demonstrates.

5 Conclusion

5.1 Introduction

This chapter provides a synthesis of the core findings of this research. It ultimately draws conclusions on emerging patterns across each of the case studies to understand the challenges associated with implementing transformative adaptation. Section 5.2 summarises some of the cross-cutting patterns from each of the European case studies within this research project as well as the main findings of this study. This is followed by an overview of policy implications in section 5.3. Concluding comments are provided in section 5.4.

5.2 Summary of Research Findings

The principal aim of this research was to investigate the opportunities and challenges associated with transformative adaptation using the case of flood risk adaptation.

With respect to this aim, this research was guided by two research questions:

1. What institutional settings are needed for societal transformation to respond to increased climate change risks?
2. In what ways are changing divisions of responsibilities between public and private actors necessary to increase the resilience of societies and to advance transformative adaptation in practice?

5.2.1 Lessons from transformative approaches to flood risk management in Europe

Transformation is often characterised by non-linear changes or departure from the status quo. Climate change is expected to increase flood risk across much of Europe; indeed, changes in the timing of floods as a consequence of human-related climate change has already been detected (Blöschl *et al.* 2017). The *TRANS-ADAPT* research project has resulted in a substantial empirical assessment of how transformation is happening in flood risk management in four European countries (Ireland, Austria, France and the Netherlands). The case studies highlight innovations in flood risk management that are serving to increase the resilience of vulnerable communities. A key challenge, then, is to distil the key learnings and recommendations from across case studies, so that such innovations can inform other locations and jurisdictions.

The analysis finds that what constitutes transformation is context specific. Whereas the Netherlands has a long history of managing flood risk through multiple land uses, such approaches are only emerging in other jurisdictions. Who and what is transformed is also case specific. Multi-use flood protection, for example, can be transformative for flood risk management governance structures, but it can also be transformative for the communities involved. The *TRANS-ADAPT* research finds that demands for transformation arise from issues including (1) lack of funding, legal protection and space, (2) communities demanding increased input into planning/ implementation and (3) blurred boundaries between public and private spaces and responsibilities.

Across the case studies it is worthwhile pointing out that it is the combination of changing flood risk and other societal pressures that is driving transformation in flood risk management. For instance, in Le Mans (France) and Rotterdam (the Netherlands), changing flood risk, in tandem with a desire for better urban environments that enhance community wellbeing, were key motivating factors. In these cases, urban communities with high levels of social problems and historically deprived of green spaces for sport, recreation and leisure were successful in disrupting the traditional approaches to flood risk management, resulting in two case studies that are leading the way in community-led, multi-use flood defences.

Conversely, where attempts at multi-use approaches failed, such as in the case of Skibbereen (Ireland), the dominant voice of the community was for a simple, traditional, single-function, engineered flood defence, rather than a multi-use flood/environmental park. Interestingly, this was a more rural setting where access to land is not problematic and the

single objective of the community was flood risk reduction. Where successful, the research finds that multi-functional flood protection schemes provide multiple benefits by reducing pressure on limited land, thus mitigating land use conflicts. They can also attract investors, providing new financial resources to complement scarce public finances.

Across all of the *TRANS-ADAPT* case studies, attempts at transformation were undertaken during "windows of opportunity", typically after the occurrence of a major hazard event. For example, in Pfunds (Austria) deliberations commenced following the floods of 2005. Similarly, in Le Mans (France) attempts at change commenced following flooding in 1995, whereas, in Clontarf (Ireland), transformation was proposed following major coastal flooding in 2002 and 2004. However, attempts at transformation in Clontarf were stifled by conflict between the local government and communities. When a window of opportunity appears, successful transformation still depends on a key individual or group acting as an agent of change or a policy entrepreneur. For instance, in the case of Pfunds (Austria) this was the local mayor; in Le Mans (France) it was the local community. In each successful case of transformative change, the policy entrepreneur maintained pressure on government agencies for change and took a leadership role in communicating between communities and government agencies.

In all cases, success at innovation and transformation is predicated on institutions involving and activating the public in planning and implementing flood risk policies in both public and private space. This requires a transformation of governments (facilitation) and the public (taking and keeping charge). However, even when flood management is heavily top-down, opportunities exist for local stakeholders. Identifying and understanding latent social values and concerns early in the adaptation process is crucial if innovation is to progress effectively and efficiently.

"Community-based" initiatives are still dominated by local governments (municipalities) as the key actors, initiators and decision-makers. Institutionalisation enables a clear allocation of responsibilities to local governments and causes a legal obligation to involve residents in these kinds of initiatives, but this is often a basic form of participation (information sharing and consultation). The cases show differences in willingness to participate by the residents. This can be explained by differences in social capacities and by differences in facilitation by local government agencies. The influence of residents, resulting from participation, is often limited to the design of the adaptation measures. In the analysed cases, residents did not have any influence on the selection of the measures themselves.

Increasing the participation of communities is key to realising the benefits of multi-use flood defences and other transformative innovations in flood management. Priority should be given to identifying ways to increase residents' participation beyond consultation and information sharing, towards co-creation of flood solutions. This could be through hiring of people with specific skills or use of existing community managers who are already familiar with the neighbourhood patterns and social structures.

When efforts at transformation have failed, barriers include (1) social and cultural values (communities and institutions), (2) institutional reliance on technocratic approaches above valuing local knowledge, (3) institutional regulatory practices, and (4) failure of public participation. Taken together, these cases offer valuable empirical insights into the process of transformation and an opportunity to learn from empirical examples of what works and what does not when it comes to transformative approaches to flood management.

5.2.2 Lessons from the challenges of transformative adaptation in Ireland

In Skibbereen, the research centred on a town that has experienced significant and repeated flood events in recent years. This case was focused on a proposal developed by an environmental group to construct a multi-functional environmental park on the town's periphery to act as a wetland environment. Specifically, it was expected to combine both flood defences and recreational and tourism opportunities – a transformative strategy in the context of existing flood risk management strategies nationally.

The case study of Clontarf formed the second component of this report. The case study was sub-divided into failed attempts at both transformative change and incremental adaptation in the aftermath of failed transformation. The first of these projects

focused on efforts at implementing transformative flood defences for Clontarf promenade, which were perceived as fundamentally disrupting existing social values ascribed to the promenade and its functionality from a community perspective. An incremental adaptation strategy proposed for Dollymount promenade several years later was also met with resistance, although the proposed flood defence development involved only a moderate increase in the height of existing coastal defences and enhanced the space's amenity value for recreational users.

Detailed quantitative and qualitative methods were utilised to answer each of the research questions, drawing on extensive primary and secondary data. A qualitative approach was used to first contextualise the barriers that arise in the context of transformative adaptation. Quantitative methods were employed to assess in greater detail place-related values and perceptions of governance processes concerning transformation in Clontarf. Finally, both quantitative and qualitative methods were again utilised to understand the challenges associated with attempting incremental adaptation when transformation fails. A brief summary of the main findings is provided in the following sections.

Institutional barriers

Reliance on technical expertise

This research demonstrated the impact of governance processes in terms of constraining transformation. Because flood risk adaptation funding in Ireland is heavily weighted towards structural flood defence provision, decision-making processes tend to rely on technical expertise, often failing to challenge underlying assumptions and embedded practices associated with technical responses to flooding. This practice is strongly linked to the provision of flood insurance, with insurance companies being hesitant to offer property insurance in areas where structural flood defences do not exist.

Regulatory practices

Utilising statutory public participation processes in isolation was found to be unconducive to increasing societal support for transformation in Clontarf (Clontarf promenade). Moreover, despite a more detailed public consultation process for Dollymount promenade, perceptions of the legitimacy of governance processes remained constant over time, and deteriorated to a certain extent where local control over decision-making was concerned. Indeed, concerns raised about the need for integration of local knowledge and expertise into decision-making following failed attempts at transformative adaptation along Clontarf promenade re-emerged for proposed incremental adaptation along Dollymount promenade.

The findings specifically highlight the challenges for institutional authorities associated with implementing relatively modest incremental forms of adaptation in the aftermath of failed transformation. When authorities fail to integrate learnings from past actions into decision-making, a transformation of governance processes is likely to prove necessary to reduce the risk of future adaptation efforts being opposed.

Socio-cultural barriers

With respect to social values, the importance of place attachment processes in Clontarf emerged as a contributing factor in the expression of community resistance towards proposed flood defences. The results highlighted that when individuals had a strong attachment to specific places and deemed adaptation as threatening to such places, perceptions that transformation was being forced on them was a potential outcome.

The relationship between flood experience and flood risk and (1) place attachment and (2) support for adaptation planning was also examined. Findings from this element of the study highlighted several important points. For example, neither flood experience nor flood risk had an impact on the strength of place attachment, support for flood defences or perceptions of governance processes. This provides compelling evidence of the moderating role of place attachment and place-related values in influencing support for adaptation planning.

5.3 Cross-cutting Themes and Policy Implications

The policy implications of this research are now addressed, specifically related to the challenges associated with transformative adaptation planning. This includes consideration of the two research

questions within this report: (1) the institutional settings needed for societal transformation to respond to increased climate change risks and (2) the divisions of responsibilities between public and private actors necessary to increase the resilience of societies and advance transformative adaptation in practice.

5.3.1 Experiencing loss and context-specific adaptation

- **Policy recommendation:** Current adaptation planning largely accounts for tangible, economic losses associated with climate change; however, considering intangible, place-related values in adaptation strategies is equally important to reduce the risk of adaptation efforts failing.

People experience loss when they are dispossessed of the things that they value and for which they cannot readily substitute alternatives (Barnett *et al.*, 2016). Climate change threatens both tangible and intangible assets. For instance, losses from climate change may be signified by dispossession of tangible goods such as property, personal possessions or financial resources. For some, however, losses may be intangible, signified by damage to culture, social cohesion, place attachment, social identity or health. When loss is extensive, significant social and environmental problems can arise (Barnett *et al.*, 2016). Individuals with varying degrees of flood experience are likely to have different thresholds for tolerating flood risks related to how they characterise loss, based on a variety of social, economic and environmental factors. Based on understandings of loss, people are subsequently likely to develop ideologies and conceptions of what successful adaptation looks like.

Recent studies have suggested that an understanding of what people value, how things become valued and how values change over space and time is crucial for successful adaptation (Barnett *et al.*, 2016). Adaptation policies and strategies are typically designed based on economic metrics assessing monetary losses of material assets (Adger, 2013; Graham *et al.*, 2013). However, communities are not homogeneous and neither should adaptation strategies be. Although conducting economic analyses to prevent monetary losses addresses one of the two primary ways in which loss can be experienced, it ignores the intangible element. For instance, this research has demonstrated how losses can be interpreted in a tangible sense when communities are primarily concerned about financial losses because of repeated experiences of flooding (Skibbereen). Equally important for adaptation policy and decision-making are potential losses arising from damage to intangible assets, as the case of Clontarf demonstrates.

Research suggests that coastal flood risks are likely to increase considerably in the future (Nicholls *et al.*, 1999; Jongman *et al.*, 2012; Woodruff *et al.*, 2013) and may even surpass fluvial flood risks towards the end of this century (Hall *et al.*, 2006). Problems associated with coastal flooding are expected to be further compounded by a relative increase in coastal floodplain settlement (Hall *et al.*, 2006). These concerns are also likely to be experienced in Ireland owing to predicted sea level rise and increased storm surges by the end of this century (Desmond *et al.*, 2009) and predicted increases in the population in coastal cities relative to the rest of the country (Central Statistics Office, 2013). Of salience to adaptation is that place-related values such as place attachment are likely to be particularly concentrated in coastal locations (Brown and Raymond, 2007; Mortreux and Barnett, 2009; Novaczek *et al.*, 2011; Graham *et al.*, 2014), where there is likely to be an increased demand in the future for adaptive responses to climate change. Research has shown how recreational, landscape and aesthetic values are likely to be especially strong in coastal settings. The case of Clontarf serves to highlight a potentially growing challenge for coastal communities expected to undergo adaptation, as well as decision-makers responsible for such strategies.

5.3.2 Knowledge diversity and learning for transformative adaptation

- **Policy recommendation:** Knowledge co-production from a range of stakeholders is needed for flood risk management and broader adaptation decision-making. Currently, flood risk adaptation in Ireland is heavily weighted towards reliance on technical expertise at the expense of other relevant knowledge.

Studies suggest that contrasting languages and frames of reference can be a barrier to knowledge sharing and mutual understandings between stakeholders (Cloutier *et al.*, 2015). The flood committee that has existed in Skibbereen for several decades, and which has been proactively working with flood authorities during this time in advocating for structural flood defences, is demonstrative of a group that is aware of and supports the technical aspects of structural flood defences. Moreover, the influence of the flood committee as the representative organisation within the community on flood-related issues is illustrative of how language barriers might be broken down between communities and institutional authorities with respect to understanding complex adaptation strategies. In contrast, despite the flood risks posed in Clontarf the community lacked a designated flood committee to liaise with flood authorities from the outset of each project. This contributed to a lack of awareness until late in the planning process and ultimately a poor understanding at the community level of the technical aspects of the flood defences proposed.

A common finding across both case studies was that technical approaches to adaptation are insufficient. In the context of this research, barriers associated with technical responses to flood risks were largely related to values, worldviews, beliefs, education, experience and interests, rather than technical challenges, that is, it is the individual and political mindsets that are focused on technical responses that frame flood risk problems and solutions in this way (O'Brien and Selboe, 2015), which subsequently constrains transformation. If significant social change is required to move towards more transformative pathways, existing forms of knowledge production and use may not be effective in achieving this. Growing evidence therefore points to the value of co-producing knowledge and including diverse knowledge and experience in decision-making for transformation (Bahadur and Tanner, 2012; van Bommel *et al.*, 2016). Single actors rarely possess the knowledge, experience, resources or legitimacy required to address complex global environmental challenges (Armitage and Plummer, 2010). The literature has therefore shown how transformative change can be supported through the integration of various knowledge forms, including knowledge from science, the private sector, decision-makers and civil society (Olsson *et al*., 2010; Burch, 2016; Satyal *et al.*, 2017). Continuously integrating local knowledge and expertise into adaptation planning will prove crucial to maintaining societal support for adaptation and potential transformation in the long term. Without accounting for context-specific lived experiences and associated local knowledge of climate change risks, communities are likely to have difficulties accepting the legitimacy of external knowledge sources over their own internalised experiences. Equally, local knowledge may also need to be open to external forms of knowledge that extend beyond lived experience, particularly because impacts arising from future climate change predictions are unlikely to be comparable with one's historical or current experiences of extreme weather. Findings from both Skibbereen and Clontarf augment the need for continuous co-production of knowledge and diverse knowledge representation in moving towards transformative adaptation.

5.3.3 Technological transformations for adaptation

- **Policy recommendation:** Technological interventions (e.g. virtual reality technologies) should be integrated into adaptation planning to help individuals visually understand the impacts of potential future climate change scenarios and any adaptation measures proposed.

A defining feature of the Clontarf case study and the resistance to change that emerged for flood defences along both Clontarf and Dollymount promenades was the inability of individuals to visualise what the proposed flood defences would look like on completion. Residents suggested that in both instances they had difficulties understanding the scale of the proposed flood defences and the impact that any changes would have on the landscape. For instance, it was only when objections were raised by residents concerning the height of flood defences along Clontarf promenade that visual images of the defences became available. Similarly, although visual depictions were developed for Dollymount promenade it was not made explicit from these the exact changes to the landscape that would arise, for example that sea views would be obstructed for road users (DCC, 2009).

An emerging field of scientific enquiry with respect to environmental planning is the role of geo-technologies and geo-computation in capturing, analysing,

modelling and visualising spatial data, in particular through the use of visually immersive virtual reality technologies (Orland *et al*., 2001; Ball *et al*., 2005). Considerable evidence also exists of the need for more emotionally engaging scientific communication (Moser and Pike, 2015). Virtual technologies have been shown to enhance information management and the knowledge transfer experience leading to improved public participation (Appleton and Lovett, 2003; Ball *et al*., 2005). Meaningful visualisations representing local climate change futures could assist in eliciting emotional responses from individuals and help to make an abstract concept, such as climate change, locally relevant (Nicholson-Cole, 2005). Although data on sea level rise and climate change scenarios are constantly being revised in response to emerging scientific evidence (Shaw *et al.*, 2009), there exists the potential to integrate such applications into adaptation policy to make tangible the potential impact of sea level rise at a local level and to enable individuals to more easily visualise potential modifications to the landscape where environmental change is proposed.

Awareness of and concern for climate change is considered moderate to high amongst European citizens (Steenjes *et al.*, 2017), yet researchers continue to note a disparity between this awareness/ concern and behavioural responses (Lorenzoni *et al.*, 2007). European citizens continue to believe that risks associated with climate change are both temporally and spatially distant (Steenjes *et al.*, 2017). Individuals fail to see the link between climate change and the impacts that this might have on their local environment and livelihoods. Virtual reality can play a significant role here by making a “distant” threat, such as climate change, locally relevant. Employing such technologies may be particularly effective in contributing to public understanding of locally relevant climate risks, subsequently helping to elicit behavioural responses (e.g. increasing public support for adaptation planning, enhancing individual mitigation efforts). In this context, the use of virtual reality technologies requires a consideration of ethical implications to ensure that their application is equally defensible and emotive and avoids both scaremongering and under-representation of potential future scenarios. Fostering mutual understanding in landscape planning is as much about other stakeholders educating planners as planners educating stakeholders. This necessitates participatory scenario planning to ensure that knowledge used to inform different scenarios is co-produced and agreed on by key stakeholders, such that adaptation planning is informed by consensus and debate.

Evidence of successfully blending advanced visual communication tools and local knowledge in spatial planning already exists, suggesting the potential benefits of exploiting such technologies for adaptation purposes (Portman, 2014). Embedding virtual reality visualisations into environmental planning policy might help to negate those barriers that emerged in Clontarf from arising in other adaptation proposals in the future, particularly as the complexity of climate change impacts and adaptation responses increases.

5.4 Concluding Remarks

This research was devoted to understanding the challenges of transformative adaptation. It has considerable implications for current and future adaptation policy both in Ireland and in a wider context. Specifically, many of the issues identified in this report are not confined to Irish adaptation planning but are representative of similar challenges in other jurisdictions.

The context-specific nature of adaptation means that assessing losses arising from climate change requires understanding both tangible monetary damages and intangible assets. In light of significant expenditure proposed for structural flood defence planning in the coming decade in Ireland, it is an opportune time for policymakers and decision-makers to reflect on the importance of this point. Different communities will ultimately have different concepts of loss arising from climate change. For some, protecting physical assets will remain the over-riding concern. Conversely, although intangible assets have largely been ignored by policymakers in adaptation planning to date, failing to account for such losses is likely to prove counterintuitive to fair or cost-efficient adaptation. The context-specific nature of how individuals experience loss means that adaptation is likely to be heavily dependent on diverse stakeholders co-producing and negotiating various knowledge forms and adaptation measures in the long term. As the scale and intensity of climate change impacts and adaptation efforts increase, integrating innovative technologies into public participation practices will be crucial to assist individuals in contextualising potential losses.

This research has re-emphasised the interconnected and compounding nature of many barriers to transformative adaptation and some of the primary issues that decision-makers, policymakers and communities are likely to have to contend with now and in the future unless fundamental changes are made to both societal and governance practices concerning adaptation planning. Although some transformative adaptation in response to climate change impacts is now inevitable, one way of minimising such adaptations is for fundamental societal transformations to mitigate further climate change before forced transformative adaptations become pervasive and an increasingly necessary adaptative response. Specifically, the diversity of the case studies presented offers useful insights for policy and practice with regard to how and why various adaptation measures come to be resisted and can be navigated by various stakeholders involved in adaptation planning.

References

Adger, N., 2013. Emerging dimensions of fair process for adaptation decision-making. In Palutikof, J., Boulter, S., Ash, A., Stafford Smith, M., Parry, M., Waschka M. and Guitart D. (eds), *Climate Adaptation Futures*. John Wiley, Oxford, pp. 69–74.

Adger, W.N. and Barnett, J., 2009. Four reasons for concern about adaptation to climate change. *Environment and Planning A* 41: 2800–2805.

Adger, N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J. and Wreford, A., 2009a. Are there social limits to adaptation to climate change? *Climatic Change* 93: 335–354.

Adger, N., Lorenzoni, I. and O'Brien, K. (eds), 2009b. *Adapting to Climate Change: Thresholds, Values, Governance*. Cambridge University Press, Cambridge.

Adger, W.N., Barnett, J., Brown, K., Marshall, N. and O'Brien, K., 2013. Cultural dimensions of climate change impacts and adaptation. *Nature Climate Change* 3: 112–117.

Adger, W.N., Quinn, T., Lorenzoni, I. and Murphy, C., 2016. Sharing the pain: perceptions of fairness affect private and public response to hazards. *Annals of the American Association of Geographers* 106: 1079–1096.

Agrawal, A., 2010. Local institutions and adaptation to climate change. In Mearns, R. and Norton, A. (eds), *Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*. World Bank, Washington, DC, pp. 173–198.

Agyeman, J., Devine-Wright, P. and Prange, J., 2009. Close to the edge, down by the river? Joining up managed retreat and place attachment in a climate changed world. *Environment and Planning A* 41: 509–513.

Anderson, N., 2015. Battle of Clontarf over new flood wall. *Irish Independent*, 2 December.

Anon., 2011. Forces gather at Clontarf for Battle of Flood Barrier. *The Irish Times*, 15 October.

Anton, C.E. and Lawrence, C., 2016. The relationship between place attachment: the theory of planned behaviour and residents' response to place change. *Journal of Environmental Psychology* 47: 145–154.

Appleton, K. and Lovett, A., 2003. GIS-based visualisation of rural landscapes: defining 'sufficient' realism for environmental decision-making. *Landscape and Urban Planning* 65: 117–131.

Armah, F.A., Luginaah, I., Hambati, H., Chuenpagdee, R. and Campbell, G., 2015. Assessing barriers to adaptation to climate change in coastal Tanzania: does where you live matter? *Population and Environment* 37: 231–263.

Armitage, D. and Plummer, R., 2010. Adapting and transforming: governance for navigating change. In Plummer, R. and Armitage, D. (eds), *Adaptive Capacity and Environmental Governance*. Springer, Berlin, pp. 286–302.

Arnell, N. and Charlton, M., 2009. Adapting to the effects of climate change on water supply reliability. In Adger, N., Lorenzoni, I. and O'Brien, K. (eds), *Adapting to Climate Change: Thresholds, Values, Governance*. Cambridge University Press, Cambridge, pp. 42–53.

Bahadur, A. and Tanner, T., 2012. *Transformation: Theory and Practice in Climate Change and Development*. Institute of Development Studies, Brighton.

Ball, J., Capanni, N. and Watt, S., 2005. Virtual reality for mutual understanding in landscape planning. *International Journal of Social Sciences* 2: 78–88.

Bardsley, D.K., 2015. Limits to adaptation or a second modernity? Responses to climate change risk in the context of failing socio-ecosystems. *Environment, Development and Sustainability* 17: 41–55.

Barnett, J., Evans, L.S., Gross, C., Kiem, A.S., Kingsford, R.T., Palutikof, J.P., Pickering, C.M. and Smithers, S.G., 2015. From barriers to limits to climate change adaptation: path dependency and the speed of change. *Ecology & Society* 20: 324–334.

Barnett, J., Tschakert, P., Head, L. and Adger, W.N., 2016. A science of loss. *Nature Climate Change* 6: 976–978.

Beery, T. and Jönsson, K.I., 2017. Outdoor recreation and place attachment: exploring the potential of outdoor recreation within a UNESCO Biosphere Reserve. *Journal of Outdoor Recreation and Tourism* 17: 54–63.

Béné, C., Godfrey Wood, R., Newsham, A. and Davies, M., 2012. *Resilience: New Utopia or New Tyranny? Reflection about the Potentials and Limits of the Concept of Resilience in Relation to Vulnerability Reduction Programmes*. Institute of Development Studies, Brighton.

Biesbroek, R., Klostermann, J., Termeer, C. and Kabat, P., 2011. Barriers to climate change adaptation in the Netherlands. *Climate Law* 2: 181–199.

Biesbroek, G.R., Klostermann, J.E.M., Termeer, C.J.A.M. and Kabat, P., 2013. On the nature of barriers to climate change adaptation. *Regional Environmental Change* 13: 1119–1129.

Blöschl, G., Hall, J., Parajka, J., Perdigão, R.A.P., Merz, B., Arheimer, B., Aronica, G.T., Bilibashi, A., Bonacci, O., Borga, M., Čanjevac, I., Castellarin, A., Chirico, G.B., Claps, P., Fiala, K., Frolova, N., Gorbachova, L., Gül, A., Hannaford, J., Harrigan, S., Kireeva, M., Kiss, A., Kjeldsen, T.R., Kohnová, S., Koskela, J.J., Ledvinka, O., Macdonald, N., Mavrova-Guirguinova, M., Mediero, L., Merz, R., Molnar, P., Montanari, A., Murphy, C., Osuch, M., Ovcharuk, V., Radevski, I., Rogger, M., Salinas, J.L., Sauquet, E., Šraj, M., Szolgay, J., Viglione, A., Volpi, E., Wilson, D., Zaimi, K. and Živković, N., 2017. Changing climate shifts timing of European floods. *Science* 357: 588–590.

Brown, B.B. and Perkins, D.D., 1992. Disruptions in place attachment. In Altman, I. and Low, S.M. (eds), *Place Attachment: Human Behavior and Environment*. Springer, New York, NY, pp. 279–304.

Brown, G. and Raymond, C., 2007. The relationship between place attachment and landscape values: toward mapping place attachment. *Applied Geography* 27: 89–111.

Burch, S., 2010a. Transforming barriers into enablers of action on climate change: insights from three municipal case studies in British Columbia, Canada. *Global Environmental Change* 20: 287–297.

Burch, S., 2010b. In pursuit of resilient, low carbon communities: an examination of barriers to action in three Canadian cities. *Energy Policy* 38: 7575–7585.

Burch, S., 2016. *Will Ontario's Climate Change Action Plan Transform Communities?* Centre for International Governance Innovation, Waterloo, ON, Canada.

Central Statistics Office, 2013. Regional population projections 2016–2031. Available online: https://www.cso.ie/en/releasesandpublications/er/rpp/regionalpopulationprojections2016-2031/ (accessed 23 November 2018).

Central Statistics Office, 2014. Census 2011 small area population statistics. Available online: http://www.cso.ie/en/census/census2011smallareapopulationstatisticssaps/ (accessed 10 May 2016).

Change.org, 2015. Owen Keegan of Dublin City Council: stop the Clontarf sea wall. Available online: https://www.change.org/p/owen-keegan-of-dublin-city-council-stop-the-clontarf-sea-wall/c?source_location=petition_show (accessed 26 May 2017).

Chapin, F.S. III, Carpenter, S.R., Kofinas, G.P., Folke, C., Abel, N., Clark, W.C., Olsson, P., Smith, D.M.S., Walker, B., Young, O.R., Berkes, F., Biggs, R., Grove, J.M., Naylor, R.L., Pinkerton, E., Steffen, W. and Swanson, F.J., 2010. Ecosystem stewardship: sustainability strategies for a rapidly changing planet. *Trends in Ecology & Evolution* 25: 241–249.

Cheng, C.-K. and Chou, S.-F., 2015. The influence of place change on place bonding: a longitudinal panel study of renovated park users. *Leisure Sciences* 37: 391–414.

Chow, K. and Healey, M., 2008. Place attachment and place identity: first-year undergraduates making the transition from home to university. *Journal of Environmental Psychology* 28: 362–372.

Church, J., Clarke, P., Cazenave, A., Gregory, J., Jevrejeva, S., Levermann, A., Merrifield, M., Milne, G., Nerem, R., Nunn, P., Payne, A., Pfeffer, W., Stammer, D. and Unnikrishnan, A., 2013. Sea level change. In Stocker, T., Qin, D., Plattner, G., Tignor, M., Allen, S., Boschung, J., Nauels, A., Xia, Y., Bex, V. and Midgley, P. (eds), *Climate Change 2013: The Physical Science Basis.* Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp. 1137–1216.

Ciscar, J., Feyen, L., Soria, A., Lavalle, C., Raes, F., Perry, M., Nemry, F., Demirel, H., Rozsai, M., Dosio, A., Donatelli, M., Srivastava, A., Fumagalli, D., Niemeyer, S., Shrestha, S., Ciaian, P., Himics, M., Van Doorslaer, B., Barrios, S., Ibáñez, N., Forzieri, G., Rojas, R., Bianchi, A., Dowling, P., Camia, A., Libertà, G., San Miguel, J., de Rigo, D., Caudullo, G., Barredo, J., Paci, D., Pycroft, J., Saveyn, B., Van Regemorter, D., Revesz, T., Vandyck, T., Vrontisi, Z., Baranzelli, C., Vandecasteele, I., Bastita e Silva, F. and Ibarreta, D., 2014. *Climate Impacts in Europe. The JRC PESETA II Project*. Publications Office of the European Union, Luxembourg.

Cloutier, G., Joerin, F., Dubois, C., Labarthe, M., Legay, C. and Viens, D., 2015. Planning adaptation based on local actors' knowledge and participation: a climate governance experiment. *Climate Policy* 15: 458–474.

Cretney, R.M. and Bond, S., 2017. Shifting relationships to place: a relational place-based perspective on SES resilience. *Urban Geography* 38: 8–24.

Dale, V.H., Efroymson, R.A. and Kline, K.L., 2011. The land use–climate change–energy nexus. *Landscape Ecology* 26: 755–773.

DCC (Dublin City Council), 2009. *Dollymount Promenade and Flood Protection Project (DPFPP) Environmental Impact Statement*. DCC, Dublin.

DCC (Dublin City Council), 2011a. Clontarf flood defence scheme. Available online: http://www.dublincity.ie/clontarfflooddefence (accessed 21 September 2016).

DCC (Dublin City Council), 2011b. *Clontarf Flood Defence Project: Final Report to Dublin City Council*. Meeting 5 November 2011. DCC, Dublin.

DCC (Dublin City Council), 2017. Sutton to Sandycove Sea Wall Works – James Larkin Road Sea Wall Works Part VIII Proposals. Roughan & O'Donovan Consultants, Dublin.

De Dominicis, S., Fornara, F., Ganucci Cancellieri, U., Twigger-Ross, C. and Bonaiuto, M., 2015. We are at risk, and so what? Place attachment, environmental risk perceptions and preventive coping behaviours. *Journal of Environmental Psychology* 43: 66–78.

DECLG (Department of the Environment, Community and Local Government), 2012. *National Climate Change Adaptation Framework*. DECLG, Dublin.

Desmond, M., O'Brien, P. and McGovern, F., 2009. *A Summary of the State of Knowledge on Climate Change Impacts for Ireland*. Environmental Protection Agency, Johnstown Castle, Ireland.

Devine-Wright, P., 2009. Rethinking NIMBYism: the role of place attachment and place identity in explaining place-protective action. *Journal of Community & Applied Social Psychology* 19: 426–441.

Devine-Wright, P., 2011. Place attachment and public acceptance of renewable energy: a tidal energy case study. *Journal of Environmental Psychology* 31: 336–343.

Devine-Wright, P., 2013. Think global, act local? The relevance of place attachments and place identities in a climate changed world. *Global Environmental Change* 23: 61–69.

Devine-Wright, P. and Howes, Y., 2010. Disruption to place attachment and the protection of restorative environments: a wind energy case study. *Journal of Environmental Psychology* 30: 271–280.

DHPCLG (Department of Housing, Planning, Community and Local Government), 2015. *Dublin Port Company – Alexandra Basin Re-development.* DHPCLG, Dublin.

Donnelly, C., Greuell, W., Andersson, J., Gerten, D., Pisacane, G., Roudier, P. and Ludwig, F., 2017. Impacts of climate change on European hydrology at 1.5, 2 and 3 degrees mean global warming above preindustrial level. *Climatic Change* 143: 13–26.

Dunne, S., Hanafin, J., Lynch, P., McGrath, R., Nishimura, E., Nolan, P., Ratnam, J., Semmler, T., Sweeney, C., Varghese, S. and Wang, S., 2008. *Ireland in a Warmer World: Scientific Predictions of the Irish Climate in the Twenty-First Century*. McGrath, R. and Lynch, P. (eds). Community Climate Change Consortium for Ireland (C4I), Dublin.

Eisenack, K., Moser, S.C., Hoffmann, E., Klein, R.J., Oberlack, C., Pechan, A., Rotter, M. and Termeer, C.J., 2014. Explaining and overcoming barriers to climate change adaptation. *Nature Climate Change* 4: 867–872.

Ekstrom, J.A. and Moser, S.C., 2014. Identifying and overcoming barriers in urban climate adaptation: case study findings from the San Francisco Bay Area, California, USA. *Urban Climate* 9: 54–74.

Ekstrom, J.A., Moser, S.C. and Tom, M., 2011. *Barriers to Adaptation: A Diagnostic Framework*. Lawrence Berkeley National Laboratory, Sacramento, CA, USA.

Eolas, 2009. The case for an environmental climate change park. Available online: http://www.eolasmagazine.ie/the-case-for-an-environmental-climate-change-park/ (accessed 3 March 2017).

Esterhuyse, W.P., 2003. The challenge of transformation: breaking the barriers. *South African Journal of Business Management* 34: 1–8.

EU (European Union), 2000. Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy. OJ L327, 22.12.2000, p.1–73.

EU (European Union), 2003. Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC. OJ L 156, 25.6.2003, p.17–25.

EU (European Union), 2007. Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks. OJ L 288, 6.11.2007, p.27–34.

Facebook.com, 2015. Save our seafront. Available online: https://www.facebook.com/pg/SaveOurSeafrontClontarf/posts/ (accessed 26 May 2017).

Facebook.com, 2017. Clontarf.ie video update 2. Available online: https://www.facebook.com/Clontarf.ie/ (accessed 29 May 2017).

Fenton, A., Paavola, J. and Tallontire, A., 2017. Autonomous adaptation to riverine flooding in Satkhira District, Bangladesh: implications for adaptation planning. *Regional Environmental Change* 17: 2387–2396.

Fresque-Baxter, J.A. and Armitage, D., 2012. Place identity and climate change adaptation: a synthesis and framework for understanding. *Wiley Interdisciplinary Reviews: Climate Change* 3: 251–266.

Fried, M., 1982. Residential attachment: sources of residential and community satisfaction. *Journal of Social Issues* 38: 107–119.

Fuchs, S., Bonnefond, M., Clarke, D., Driessen, P., Fournier, M., Gatien-Tournat, A., Gralepois, M., Hegger, D., Mees, H., Murphy, C., Servain, S., Thaler, T., Uittenbroek, C. and Wenk, M., 2017. *TRANS-ADAPT. Societal Transformation and Adaptation Necessary to Manage Dynamics in Flood Hazard and Risk Mitigation, Synthesis*. INTERPRAEVENT Journal Series 1, Report 4, Klagenfurt, Austria

Gifford, R.D. and Chen, A.K.S., 2016. Why aren't we taking action? Psychological barriers to climate-positive food choices. *Climatic Change* 140: 165–178.

Government of Ireland, 1995. *Arterial Drainage (Amendment) Act, 1995*. Office of Public Works, Trim, Ireland.

Graham, S., Barnett, J., Fincher, R., Hurlimann, A., Mortreux, C. and Waters, E., 2013. The social values at risk from sea-level rise. *Environmental Impact Assessment Review* 41: 45–52.

Graham, S., Barnett, J., Fincher, R., Hurlimann, A. and Mortreux, C., 2014. Local values for fairer adaptation to sea-level rise: a typology of residents and their lived values in Lakes Entrance, Australia. *Global Environmental Change* 29: 41–52.

Gross, C., 2007. Community perspectives of wind energy in Australia: the application of a justice and community fairness framework to increase social acceptance. *Energy Policy* 35: 2727–2736.

Grothmann, T. and Patt, A., 2005. Adaptive capacity and human cognition: the process of individual adaptation to climate change. *Global Environmental Change* 15: 199–213.

Guerreiro, S.B., Dawson, R.J., Kilsby, C., Lewis, E. and Ford, A., 2018. Future heat-waves, droughts and floods in 571 European cities. *Environmental Research Letters* 13: 034009.

Hall, J.W., Sayers, P.B., Walkden, M.J.A. and Panzeri, M., 2006. Impacts of climate change on coastal flood risk in England and Wales: 2030–2100. *Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences* 364: 1027–1049.

Handmer, J.W. and Dovers, S.R., 1996. A Typology of resilience: rethinking institutions for sustainable development. *Organization & Environment* 9: 482–511.

Hanjra, M.A. and Qureshi, M.E., 2010. Global water crisis and future food security in an era of climate change. *Food Policy* 35: 365–377.

Hernández, B., Carmen Hidalgo, M., Salazar-Laplace, M.E. and Hess, S., 2007. Place attachment and place identity in natives and non-natives. *Journal of Environmental Psychology* 27: 310–319.

Hidalgo, M.C. and Hernández, B., 2001. Place attachment: conceptual and empirical questions. *Journal of Environmental Psychology* 21: 273–281.

Hilliard, M., 2016. Insurance sector rules out blanket flood cover. *The Irish Times*, 26 January.

Holling, C., Carpenter, S., Brock, W. and Gunderson, L.H., 2002. Discoveries for sustainable futures. In Gunderson, L. and Holling, C. (eds), *Panarchy: Understanding Transformations in Human and Natural Systems*. Island Press, Washington, DC, pp. 395–417.

IPCC (Intergovernmental Panel on Climate Change), 2012. Managing the risks of extreme events and disasters to advance climate change adaptation. In Field, C.B., Barros, V.R., Stocker, T., Qin, D., Dokken, D., Ebi, K.L., Mastrandrea, M., Mach, K.J., Plattner, G., Allen, S., Tignor, M. and Midgley, P. (eds), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.

IPCC (Intergovernmental Panel on Climate Change), 2014a. *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Report on Climate Change. Pachauri, R. and Meyer, L. (eds). IPCC, Geneva.

IPCC (Intergovernmental Panel on Climate Change), 2014b. Summary for policymakers. In Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R. and White, L.L. (eds), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp. 1–32.

Jantarasami, L.C., Lawler, J.J. and Thomas, C.W., 2010. Institutional barriers to climate change adaptation in US national parks and forests. *Ecology and Society* 15: 33.

Joint Committee on the Environment, Heritage and Local Government, 2010. *Fourth Report of the Joint Committee: The Management of Severe Weather Events in Ireland & Related Matters*. Houses of the Oireachtas, Dublin.

Jones, L. and Boyd, E., 2011. Exploring social barriers to adaptation: insights from Western Nepal. *Global Environmental Change* 21: 1262–1274.

Jongman, B., Ward, P.J. and Aerts, J.C., 2012. Global exposure to river and coastal flooding: long term trends and changes. *Global Environmental Change* 22: 823–835.

Juhola, S., 2016. Barriers to the implementation of climate change adaptation in land use planning: a multi-level governance problem? *International Journal of Climate Change Strategies and Management* 8: 338–355.

Kaltenborn, B.P., 1997. Recreation homes in natural settings: factors affecting place attachment. *Norsk Geografisk Tidsskrift – Norwegian Journal of Geography* 51: 187–198.

Kaltenborn, B.P. and Bjerke, T., 2002. Associations between landscape preferences and place attachment: a study in Røros, Southern Norway. *Landscape Research* 27: 381–396.

Kates, R.W., Travis, W.R. and Wilbanks, T.J., 2012. Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences of the United States of America* 109: 7156–7161.

Keskitalo, E.C.H., Juhola, S., Baron, N., Fyhn, H. and Klein, J., 2016. Implementing local climate change adaptation and mitigation actions: the role of various policy instruments in a multi-level governance context. *Climate* 4: 7.

Klein, R.J., Schipper, E.L.F. and Dessai, S., 2005. Integrating mitigation and adaptation into climate and development policy: three research questions. *Environmental Science & Policy* 8: 579–588.

Klein, R.J., Midgley, G.F., Preston, B.L., Alam, M., Berkhout, F.G., Dow, K., Shaw, M.R., Botzen, W., Buhaug, H. and Butzer, K.W., 2014. Adaptation opportunities, constraints, and limits. In Field, C., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R. and White, L.L. (eds), 2014. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp. 899–943.

Knez, I., 2005. Attachment and identity as related to a place and its perceived climate. *Journal of Environmental Psychology* 25: 207–218.

Kovats, R., Valentini, L., Bouwer, L., Georgopoulou, E., Jacob, D., Martin, E., Rounsevell, M. and Soussana, J.-F., 2014. Europe. In Barros, V.R., Field, C.B, Dokken, D.J., Mastrandrea, M., Mach, K.J., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R. and White, L.L. (eds), 2014. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp. 1267–1326.

Larkin, L., 2016. Deluge of complaints for council's 'Berlin Wall on the Clontarf Road'. *Evening Herald*, 26 January.

Lawrence, J., Sullivan, F., Lash, A., Ide, G., Cameron, C. and McGlinchey, L., 2015. Adapting to changing climate risk by local government in New Zealand: institutional practice barriers and enablers. *Local Environment* 20: 298–320.

Lehmann, P., Brenck, M., Gebhardt, O., Schaller, S. and Süßbauer, E., 2013. Barriers and opportunities for urban adaptation planning: analytical framework and evidence from cities in Latin America and Germany. *Mitigation and Adaptation Strategies for Global Change* 20: 75–97.

Lewicka, M., 2011. Place attachment: how far have we come in the last 40 years? *Journal of Environmental Psychology* 31: 207–230.

Libecap, G.D., 2011. Institutional path dependence in climate adaptation: Coman's "Some unsettled problems of irrigation". *The American Economic Review* 101: 64–80.

Loorbach, D., Van Der Brugge, R. and Taanman, M., 2008. Governance in the energy transition: practice of transition management in the Netherlands. *International Journal of Environmental Technology and Management* 9: 294–315.

Lorenzoni, I. and Hulme, M., 2009. Believing is seeing: laypeople's views of future socio-economic and climate change in England and in Italy. *Public Understanding of Science* 18: 383–400.

Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L., 2007. Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change* 17: 445–459.

LoveClontarf.ie, 2011a. Flood defences – but at what cost? Available online: http://www.loveclontarf.ie/news/flood-defences-but-at-what-cost (accessed 11 September 2016).

LoveClontarf.ie, 2011b. Clontarf Residents' Association and Clontarf Business Association: letter to councillors. Available online: https://www.loveclontarf.ie/news/response-to-the-final-report-to-dublin-city-council-meeting-5th-december-2011 (accessed 11 September 2016).

LoveClontarf.ie, 2015a. Stop the sea wall – how you can help?! Available online: http://www.loveclontarf.ie/news/stop-the-sea-wall-how-you-can-help (accessed 26 September 2016).

LoveClontarf.ie, 2015b. Statement from Sean Haughey – sea wall. Available online: https://www.loveclontarf.ie/news/statement-from-sean-haughey-sea-wall (accessed 26 September 2016).

LoveClontarf.ie, 2015c. Sea wall in Clontarf – latest update. Available online: http://www.loveclontarf.ie/news/sea-wall-in-clontarf-latest-update (accessed 12 January 2016).

Low, S.M. and Altman, I., 1992. Place attachment. In Altman, I. and Low, S.M. (eds), *Place Attachment: A Conceptual Enquiry*. Plenum Press, London, pp. 1–12.

Manzo, L.C., 2003. Beyond house and haven: toward a revisioning of emotional relationships with places. *Journal of Environmental Psychology* 23: 47–61.

Manzo, L.C. and Perkins, D.D., 2006. Finding common ground: the importance of place attachment to community participation and planning. *Journal of Planning Literature* 20: 335–350.

Marshall, N. and Stokes, C., 2014. Identifying thresholds and barriers to adaptation through measuring climate sensitivity and capacity to change in an Australian primary industry. *Climatic Change* 126: 399–411.

Marshall, N.A., Park, S.E., Adger, W.N., Brown, K. and Howden, S.M., 2012. Transformational capacity and the influence of place and identity. *Environmental Research Letters* 7: 034022.

Marshall, N.A., Crimp, S., Curnock, M., Greenhill, M., Kuehne, G., Leviston, Z. and Ouzman, J., 2016. Some primary producers are more likely to transform their agricultural practices in response to climate change than others. *Agriculture, Ecosystems & Environment* 222: 38–47.

Mihaylov, N. and Perkins, D.D., 2014. Community place attachment and its role in social capital development. In Manzo, L.C. and Devine-Wright, P. (eds), *Place Attachment: Advances in Theory, Methods and Applications*. Routledge, New York, pp. 61–74.

Mishra, S., Mazumdar, S. and Suar, D., 2010. Place attachment and flood preparedness. *Journal of Environmental Psychology* 30: 187–197.

Mortreux, C. and Barnett, J., 2009. Climate change, migration and adaptation in Funafuti, Tuvalu. *Global Environmental Change* 19: 105–112.

Moser, S.C. and Ekstrom, J.A., 2010. A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences of the United States of America* 107: 22026–22031.

Moser, S.C. and Pike, C., 2015. Community engagement on adaptation: meeting a growing capacity need. *Urban Climate* 14: 111–115.

Mustelin, J. and Handmer, J., 2012. Triggering transformation: managing resilience or invoking real change? *Proceedings of Transformation in a Changing Climate*, Oslo, 19–21 June, pp. 24–32.

National Directorate for Fire and Emergency Management, 2014. *Report on Severe Weather From 13 December 2013 to 6 January 2014*. Department of the Environment, Community and Local Government, Dublin.

National Directorate for Fire and Emergency Management, 2016. *Report on Flooding December 4 2015 – January 13 2016*. Department of Housing, Planning, Community and Local Government, Dublin.

Nicholls, R.J., Hoozemans, F.M. and Marchand, M., 1999. Increasing flood risk and wetland losses due to global sea-level rise: regional and global analyses. *Global Environmental Change* 9: S69–S87.

Nicholson-Cole, S.A., 2005. Representing climate change futures: a critique on the use of images for visual communication. *Computers, Environment and Urban Systems* 29: 255–273.

Nielsen, J.Ø. and Reenberg, A., 2010. Cultural barriers to climate change adaptation: a case study from Northern Burkina Faso. *Global Environmental Change* 20: 142–152.

Noble, I.R., Huq, S., Anokhin, Y.A., Carmin, J., Goudou, D., Lansigan, F.P., Osman-Elasha, B., Villamizar, A., 2014. Adaptation needs and options. In Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P. R. and White, L. L. (eds), 2014. *Climate Change 2014: Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp. 833–868.

Norton, A., Leaman, J., 2004. *The Day After Tomorrow: Public Opinion on Climate Change*. MORI Social Research Institute, London.

Novaczek, I., MacFadyen, D., Bardati, D. and MacEachern, K., 2011. *Social and Cultural Values Mapping as a Decision-support Tool for Climate Change Adaptation*. Institute of Island Studies, University of Prince Edward Island, Charlottetown, Canada.

O'Brien, K., 2012. Global environmental change II: from adaptation to deliberate transformation. *Progress in Human Geography* 36: 667–676.

O'Brien, K. and Barnett, J., 2013. Global environmental change and human security. *Annual Review of Environment and Resources* 38: 373–391.

O'Brien, K. and Selboe, E., 2015. Social transformation: the real adaptive challenge. In O'Brien, K. and Selboe, E. (eds), *The Adaptive Challenge of Climate Change*. Cambridge University Press, New York, NY, pp. 311–324.

O'Brien, K. and Sygna, L., 2013. Responding to climate change: the three spheres of transformation. In *Proceedings of Transformation in a Changing Climate*. University of Oslo, Oslo, pp. 16–23.

O'Carroll, S., 2011. Clontarf residents object to "insane" flood defence plans. *The Journal*, 12 October.

Office of Emergency Planning, 2012. *A National Risk Assessment for Ireland*. Department of Defence, Dublin.

Office of the Attorney General, 2001. *Planning and Development Regulations, 2001*. Available online: http://www.irishstatutebook.ie/eli/2001/si/600/made/en/print (accessed 20 September 2016).

Olsson, P., Folke, C. and Hahn, T., 2004. Social-ecological transformation for ecosystem management: the development of adaptive co-management of a wetland landscape in southern Sweden. *Ecology and Society* 9: 2.

Olsson, P., Bodin, Ö. and Folke, C., 2010. Building transformative capacity for ecosystem stewardship in social-ecological systems. In Plummer, R. and Armitage, D. (eds), *Adaptive Capacity and Environmental Governance*. Springer, Berlin, pp. 263–285.

OPW (Office of Public Works), 2004a. *Report of the Flood Policy Review Group*. OPW, Trim, Ireland.

OPW (Office of Public Works), 2014. *Memorandum of Understanding between Insurance Ireland and the Office of Public Works*. OPW, Dublin.

OPW (Office of Public Works), 2015a. *Draft for Consultation Climate Change Sectoral Adaptation Plan Flood Risk Management (2015–2019)*. OPW, Dublin.

OPW (Office of Public Works), 2015b. Minister Simon Harris announces major €430m capital investment in flood relief measures. Available online: https://www.opw.ie/en/pressreleases/articleheading,35339,en.html (accessed 8 August 2016).

Ó Ríordáin, A., 2011. Topical issue debate – flood relief. Available online: http://oireachtasdebates.oireachtas.ie/debates%20authoring/debateswebpack.nsf/takes/dail2011101300009?opendocument (accessed 11 September 2016).

Orland, B., Budthimedhee, K. and Uusitalo, J., 2001. Considering virtual worlds as representations of landscape realities and as tools for landscape planning. *Landscape and Urban Planning* 54: 139–148.

Paavola, J. and Adger, W.N., 2006. Fair adaptation to climate change. *Ecological Economics* 56: 594–609.

Pahl-Wostl, C., 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change* 19: 354–365.

Pallant, J., 2013. *SPSS Survival Manual. A Step by Step Guide to Data Analysis using IBM SPSS*, 5th edn. Open University Press, Maidenhead.

Park, S.E., Marshall, N.A., Jakku, E., Dowd, A.M., Howden, S.M., Mendham, E. and Fleming, A., 2012. Informing adaptation responses to climate change through theories of transformation. *Global Environmental Change* 22: 115–126.

Parry, M., Arnell, N., Hulme, M., Nicholls, R. and Livermore, M., 1998. Adapting to the inevitable. *Nature* 395: 741–741.

Patterson, J., Schulz, K., Vervoort, J., Adler, C., van der Hel, S., Schmidt, A., Barau, A., Obani, P., Sethi, M., Hissen, N., Tebboth, M., Anderton, K., Börner, S. and Widerberg, O., 2015. *Transformations towards Sustainability. Emerging Approaches, Critical Reflections, and a Research Agenda*. Earth System Governance Project, Amsterdam.

Pelling, M., O'Brien, K. and Matyas, D., 2015. Adaptation and transformation. *Climatic Change* 133: 113–127.

Portman, M.E., 2014. Visualization for planning and management of oceans and coasts. *Ocean & Coastal Management* 98: 176–185.

Proshansky, H.M., Fabian, A.K. and Kaminoff, R., 1983. Place-identity: physical world socialization of the self. *Journal of Environmental Psychology* 3: 57–83.

Ratter, B.M.W., Philipp, K.H.I. and von Storch, H., 2012. Between hype and decline: recent trends in public perception of climate change. *Environmental Science & Policy* 18: 3–8.

Revi, A., Satterthwaite, D., Aragón-Durand, F., Corfee-Morlot, J., Kiunsi, R.B.R., Pelling, M., Roberts, D., Solecki, W., Gajjar, S.P. and Sverdlik, A., 2014. Towards transformative adaptation in cities: the IPCC's Fifth Assessment. *Environment and Urbanization* 26: 11–28.

Rickards, L. and Howden, S.M., 2012. Transformational adaptation: agriculture and climate change. *Crop and Pasture Science* 63: 240–250.

Royal Haskoning, 2005. *Final Report Volume 1 – Main Report. Dublin Coastal Flooding Protection Project*. Dublin City Council, Dublin.

Runhaar, H., Mees, H., Wardekker, A., van der Sluijs, J. and Driessen, P.P., 2012. Adaptation to climate change-related risks in Dutch urban areas: stimuli and barriers. *Regional Environmental Change* 12: 777–790.

Satyal, P., Shrestha, K., Ojha, H., Vira, B. and Adhikari, J., 2017. A new Himalayan crisis? Exploring transformative resilience pathways. *Environmental Development* 23: 47–56.

Shah, T., 2009. Climate change and groundwater: India's opportunities for mitigation and adaptation *Environmental Research Letters* 4: 035005.

Shaw, A., Sheppard, S., Burch, S., Flanders, D., Wiek, A., Carmichael, J., Robinson, J. and Cohen, S., 2009. Making local futures tangible – synthesizing, downscaling, and visualizing climate change scenarios for participatory capacity building. *Global Environmental Change* 19: 447–463.

Skibbereen Town Council, 2009. *Skibbereen Town Development Plan 2009–2015*. Skibbereen Town Council, Skibbereen, Ireland.

Smith, M., Horrocks, L., Harvey, A. and Hamilton, C., 2011. Rethinking adaptation for a 4°C world. *Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences* 369: 196–216.

Steenjes, K., Pidgeon, N.F., Poortinga, W., Corner, A., Mays, C., Poumadère, M., Tvinnereim, E., Böhm, G., Arnold, A., Ruddat, M., Scheer, D. and Sonnberger, M., 2017. *European Perceptions of Climate Change (EPCC). Topline Findings of a Survey Conducted in Four European Countries in 2016*. Cardiff University, Cardiff.

Stern, N., 2007. *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge.

Termeer, C.J., Dewulf, A. and Biesbroek, G.R., 2016. Transformational change: governance interventions for climate change adaptation from a continuous change perspective. *Journal of Environmental Planning and Management* 60: 558–576.

Uittenbroek, C.J., Janssen-Jansen, L.B. and Runhaar, H.A.C., 2012. Mainstreaming climate adaptation into urban planning: overcoming barriers, seizing opportunities and evaluating the results in two Dutch case studies. *Regional Environmental Change* 13: 399–411.

van Bommel, S., Blackmore, C., Foster, N. and de Vries, J., 2016. Performing and orchestrating governance learning for systemic transformation in practice for climate change adaptation. *Outlook on Agriculture* 45: 231–237.

Vasileiadou, E. and Botzen, W., 2014. Communicating adaptation with emotions: the role of intense experiences in raising concern about extreme weather. *Ecology and Society* 19: 36.

von Wirth, T., Grêt-Regamey, A., Moser, C. and Stauffacher, M., 2016. Exploring the influence of perceived urban change on residents' place attachment. *Journal of Environmental Psychology* 46: 67–82.

Vousdoukas, M.I., Mentaschi, L., Voukouvalas, E., Verlaan, M. and Feyen, L., 2017. Extreme sea levels on the rise along Europe's coasts. *Earth's Future* 5: 304–323.

Williams, D.R. and Vaske, J.J., 2003. The measurement of place attachment: validity and generalizability of a psychometric approach. *Forest Science* 49: 830–840.

Wilson, G.A., 2014. Community resilience: path dependency, lock-in effects and transitional ruptures. *Journal of Environmental Planning and Management* 57: 1–26.

Wilson, L., O'Brien, G., O'Keefe, P. and England, K., 2014. Barriers to adaptation in Newcastle upon Tyne, UK: preliminary findings. *Urban Climate* 7: 33–46.

Wise, R.M., Fazey, I., Stafford Smith, M., Park, S.E., Eakin, H.C., Archer Van Garderen, E.R.M. and Campbell, B., 2014. Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change* 28: 325–336.

Woodruff, J.D., Irish, J.L. and Camargo, S.J., 2013. Coastal flooding by tropical cyclones and sea-level rise. *Nature* 504: 44–52.

Abbreviations

CFRAM	Catchment Flood Risk Assessment and Management
DCC	Dublin City Council
IPCC	Intergovernmental Panel on Climate Change
JPI	Joint Programming Initiative
OPW	Office of Public Works
RCP	Representative Concentration Pathway
SREX	IPCC Special Report on Extremes
TRANS-ADAPT	Societal transformation and adaptation necessary to manage dynamics in flood hazard and risk mitigation
UNESCO	United Nations Educational, Scientific and Cultural Organization

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil
- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol
- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn
- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta
- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas
- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil
Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:
- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

EPA Research Report 265

Challenges of Transformative Climate Change Adaptation: Insights from Flood Risk Management

Authors: Darren Clarke and Conor Murphy

Given the scale of extreme events that have impacted European countries in recent decades, there is growing emphasis on adapting to climate change in both the short and the long term. Significant evidence suggests that current adaptation efforts are incommensurate with the scale and rate at which climate change is occurring. To effectively respond to increasing climate change risks, large-scale transformative adaptation is being proposed. This report examines the opportunities/challenges associated with transformative adaptation in the context of flood risk management using empirical examples from across Europe. It subsequently examines findings from two Irish case studies in detail.

Identifying Pressures

For all *TRANS-ADAPT* case studies the combination of changing flood risk with other societal pressures is driving transformation. Across all *TRANS-ADAPT* studies attempts at transformation were undertaken during "windows of opportunity", typically following a major hazard event.

In Ireland, the publication of the first statutory National Adaptation Framework in 2018 placed a primary emphasis on developing appropriate short- and long-term responses to extreme weather, with a core focus on flood risks. This research first identified common challenges to transformative adaptation by drawing on an extensive review of the literature. The research engaged a broad range of sources including academic resources, policy documents and grey literature. Interviews for the Irish empirical studies were subsequently conducted with key stakeholders connected to proposed transformative flood risk adaptation measures (Clontarf, Co. Dublin, and Skibbereen, Co. Cork). In addition, questionnaires were distributed to residents in one of the case studies (Clontarf) on two separate occasions to examine in detail some of the core socio-cultural and governance challenges associated with attempting transformative adaptation.

Informing Policy

TRANS-ADAPT research finds that demands for transformation arise from issues including (1) lack of funding, legal protection and space, (2) communities demanding increased input into planning/implementation and (3) blurred boundaries between public and private spaces and responsibilities.

More specifically, the Irish case studies illustrate (1) that current governance processes can constrain transformation (because flood risk adaptation funding prioritises structural flood defences in Ireland, decision-making tends to rely on technical expertise, often failing to challenge underlying assumptions and practices associated with technical flood responses); (2) that utilising statutory public participation processes alone tends to be unconducive to increasing societal support for transformation; (3) the importance of place attachment processes as a contributing factor in the expression of community resistance towards proposed flood defences (when individuals had a strong attachment to specific places and deemed adaptation as threatening to such places, perceptions that transformation was being forced on them was a potential outcome); and (4) even relatively modest incremental adaptation implementation can prove contentious when transformation fails, particularly when past learnings are not embedded into governance practices.

Developing Solutions

TRANS-ADAPT studies demonstrated that priority should be given to identifying ways to increase communities' participation beyond consultation and information sharing, towards co-creation of flood solutions for transformative adaptation. However, broad societal transformations to mitigate future climate change are needed, helping to reduce the need for transformative adaptation in the first instance. The findings emphasise key issues facing decision-makers and communities if there are no fundamental changes to societal and governance practices concerning climate change and adaptation planning.

Separately, Irish case study findings have important implications for adaptation policy and planning. First, climate change threatens both tangible and intangible assets. Although current adaptation policies account for tangible assets in assessing adaptation strategies (e.g. economic damages from flooding), they also need to explicitly consider intangible assets (e.g. cultural values). The potential that flood defences proposed under the States's €430 million investment between 2016 and 2021 may negatively transform communities/valued places suggests that this may be a key way of measuring successful future adaptation. Second, knowledge co-production and stakeholder trust for adaptation planning is likely to prove crucial as single actors rarely possess the knowledge, resources or legitimacy to address complex environmental challenges. Finally, there is merit in integrating virtual technologies to enhance information management between stakeholders in adaptation planning, helping to elicit emotional responses from individuals and making climate change locally relevant.

EPA Research: McCumiskey House, Richiew, Clonskeagh, Dublin 14.

Phone: 01 268 0100
Twitter: @EPAResearchNews
Email: research@epa.ie

www.epa.ie

EPA Research Webpages
www.epa.ie/researchandeducation/research/