

ECOLOGIES OF CARE IN TIMES OF CLIMATE CHANGE

WATER SECURITY IN
THE GLOBAL CONTEXT

MICHAEL BUSER



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Preface

The impacts of global warming are here. Even if we stop burning fossil fuels today, people will have to live with the environmental change brought on by human industrial behaviour. Of course, we desperately need more serious action to eliminate the release of carbon emissions into the atmosphere. However, we also need to understand how people and communities are adapting to and managing these circumstances. That these processes play out in local communities means there is potential for further exacerbation of global inequalities. Somewhat ironically, the phrase ‘think globally, act locally’ applies not only to individual activism, but also to the ways in which the impacts and responses to global warming are realized. Too often, our responses to crises are individualized. Rather, it is my contention that we need to recognize our shared dependence. We need to lay bare our interdependencies and the ways in which we manage our (and the planet’s) vulnerabilities and fragilities. This, I argue, helps to see the way care courses through all life. At the heart of the book is the contention that it is through care and care practices that we are able to survive and flourish. Drawing on this frame, the book reviews a range of ways that people are living with and adapting to environmental uncertainty and water insecurity through care. The book is inspired by feminist scholarship on the role of care and how it is understood as an undervalued, hidden and gendered practice. It is also based on my previous experience as an urban planner and my interest in cities, communities and the urban backstage. In part, I have tried to bring these different worldviews and experiences together within the context of water and climate change.

Over the past decade, I have been researching water security and climate adaptation in a diversity of settings. I feel that it is critically important to do research *with* people and communities (rather than research *on* people). This means doing a lot of listening and ensuring research responds to the needs and desires of others. Socially engaged and participatory research can be a real joy. However, it also means that the research can go in unanticipated directions. For me, this has meant that my individual research journey has been somewhat unconventional. This book reflects my effort to bring some coherence to the journey.

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Climate Stories: Making Sense of the Climate Emergency and Water Security

It is 26 January 1917 and a storm is slamming Start Bay and the Devon coast. High tides and strong winds pound the village of Hallsands, a fishing community of little more than 100 people located below the cliffs fronting the bay on the south coast of England. During the night, villagers evacuate their homes to ride out the storm in safety. Their return the following day bears witness to a scene of almost complete devastation. While the storm, combined with high tides, was particularly fierce, some accounts of the disaster suggest that it never should have happened and that poor coastal management was to blame. As the story goes, starting in the spring of 1897, material was dredged from Start Bay over four years for the purposes of construction work at the Plymouth naval dockyard. By 1902, the beach was noticeably eroded and over the next 15 years, storms began to damage the village, culminating in its near total destruction in 1917. Accounts of the experience of Hallsands tell the story of a village and its inhabitants whose culture and livelihoods were entwined with the sea and the coast, but who became vulnerable to disaster directly as a result of human interference and lack of understanding of natural coastal processes (Cooper, 2008).

I came across Hallsands village almost 100 years after these events during a visit to nearby Start Point Lighthouse. Looking back across the bay, my eyes were drawn to a collection of ruined structures perched along and within the cliff. It was a powerful and haunting scene that brought my attention to the power of water, the persistence of environmental change and the vulnerabilities of the coast. Moreover, Hallsands shows first-hand how culture and environment are intimately interconnected. Here was a community organized around the coastal setting that included fishing, sailing and the associated knowledges of living on the coast. Yet, environmental change

disrupted the balance of interdependencies which made life at Hallsands possible, leading to its decline and eventual total abandonment.

Stories and experiences such as Hallsands have existed throughout human history and are likely to become more common as the impacts of global warming are felt more directly. According to recent research, globally, more than 260 million people live on land that is less than two metres above sea level (Hooijer and Vernimmen, 2021) and climate change is increasing the risk of flooding and erosion in these areas. It is my view that the stories we tell about places such as Hallsands and other coastal communities are critical to understanding how people experience environmental change as well as how they manage to adapt and maintain their existence in challenging circumstances. Of course, telling stories is a way of passing along a history of events. But also, in the context of climate change, it is the construction of a narrative of how we understand human–nature relations and possible futures. For example, one could interpret Hallsands as a story about perseverance and resilience of the community, including some of those who lived on at the site for several years following the disaster. It could also be about human interference and disregard for environmental processes, or the precariousness of living in coastal settings and the power of environmental change. It can be these and many other things. It is my contention that how people narrate these experiences is particularly important as they set out the conditions within which someone might feel anger, pity, sadness, fear, justice, and so on. Stories, in other words, are ways of interpreting the changes that are happening around us and motivating action.

The importance of stories and storytelling is something I have recognized across almost all my research on water and environmental change. Many of the colleagues I have worked with over the years are either artists or have arts and humanities backgrounds. From these experts, I have learned that if policies and ‘recommendations’ are to be convincing and effective, they must be framed within the context of narratives – in other words, as stories. Stories about climate change have often focused on tragic scenarios or catastrophes. As the years have progressed, with limited political commitment, climate change is becoming more commonly narrated as a threat. This is exemplified by recent use of phrases such as ‘climate emergency’ and other doomsday scenarios (De Meyer et al, 2020). The human side of these stories often reference those displaced by climate hazards as ‘climate refugees’. These framings present climate change as a crisis and are intended to raise alarm and awareness (Moser and Dilling 2004). For example, in 2018, Bristol City Council declared a climate emergency and pledged to make the city carbon neutral by 2030. Undoubtedly, far too little has been done to address climate change and Bristol’s use of words such as ‘emergency’ and ‘crisis’ point to a new, more insistent discourse. The 2021 film *Don’t Look Up* addresses the challenges of motivating action around planetary concerns. The film uses a

planet-killing meteor as a metaphor for climate change and the inability of people to mobilize or even see beyond their mostly short-term self-interests. Even the prospect of the apocalypse (only six months away!) does little to motivate politicians to save the planet. At one point, one of the scientists begins yelling at the TV audience to take things seriously, only to be mocked and ridiculed on social media which is bursting with unflattering GIF images and memes of a crazy person, completely out of touch with reality.

Remarkably, it has been shown that negative discourse – claims that *the world is ending* – does not necessarily translate into action and can limit the ways people might get involved in addressing climate change (O’Neill and Nicholson-Cole, 2009; Wibeck, 2014). Indeed, research highlights how the dominance of negative, awareness-raising forms of communication can lead to apathy and disengagement (Hulme, 2020). As an alternative, what we need is an action-oriented framing of climate change with ‘people taking action’ at the core of storytelling efforts (De Meyer et al, 2020: 10). In a similar way, Stephen Duncombe (2007) wrote in his book *Dream: Re-imagining Progressive Politics in an Age of Fantasy* how progressive efforts must shift away from a purely rational frame of argument towards a political aesthetic that also connects with people’s dreams and desires. Duncombe’s book argues that to advance a radical agenda, activists and those interested in change must learn how to communicate more effectively in the context of the *Society of the Spectacle* (Debord, 1967). The book asks an apparently simple question: what motivates people? By understanding the way culture taps into people’s desires and motivations, Duncombe argues that we can craft a better process of political engagement. The protagonists in the film *Don’t Look Up* eventually embraced the spectacle by recruiting leading musicians and pop icons to raise awareness and action to address destruction of the Earth.

In recent years, there has been a move to strengthen the relationship and integration of social and cultural knowledge and popular culture into climate science (and other areas of environmental concern). Some of this is evident within the environmental humanities – an emerging area of thought, scholarship and action which looks at human–environment relationships through multidisciplinary and transdisciplinary perspectives (Sörlin, 2012; Emmett and Nye, 2017; Robin, 2018). Critically here, scholars within the environmental humanities do not draw a strict distinction between that which is ‘nature’ and that which is ‘culture’. Rather, they see environmental problems and challenges such as climate change as enmeshed within culture and society (Neimanis et al, 2015). Work in this area often explores environmental change through writing, film and painting. But rather than centring on a singular disciplinary frame, more importantly perhaps, this work shows a desire to place climate change and environmental challenges within human culture, values and norms. As Schmidt et al (2020: 227) point out, the global environmental changes we are witness to can only

be ‘made comprehensible if they are understood as social disasters, whilst promising solutions must take into account the social, cultural and political dimensions of these crises’. For my research, this has meant drawing on the emotional and affective aspects of experience and embracing the meaning that informs people’s struggles with environmental change. I find that this notion of meaning is so very important. A close colleague of mine, Loraine Leeson, once told me that *art makes meaning*. She explained that art helps people understand the world around them and helps them to engage with it in a more meaningful way. I like to think of this book as a way to make meaning. It is perhaps not as creative as Loraine’s work. Yet, it is a creative and even exploratory process which tells a story that is dear to me – my professional research and activity working with people to understand the role of care within the adaptive practices associated with water security and climate change. In my framing, care is an interdependent, often hidden and devalued form of more-than-human labour. In this way, I understand care as an ecology that is made up of a multitude of component parts that come together in different ways, times and spaces (I discuss theories of care in [Chapter 2](#) where I develop my approach in greater detail).

In this book, I draw on several years of studying places and people and researching with communities to build narratives around water and care. While the stories in this book relate varying experiences of environmental change, one characteristic they hold in common is a deep sense and practice of care for others and the environment. My hope is to not only convey the details of these experiences and places, but to construct a narrative that demonstrates the pervasiveness and power of care to contribute to water security and climate change adaptation.

The climate change context

It is now recognized that humans are having a significant influence on the natural environment. Over the last 100 years, the average temperature of the Earth has increased by at least 1°C. According to the Intergovernmental Panel on Climate Change (IPCC) (2012; 2018; 2021), it is likely that anthropogenic global warming of 1.5°C above pre-industrial levels could be reached as early as 2030 (IPCC, 2023a). The impacts of warming beyond this point are said to be potentially catastrophic (with the potential for 3°C by the end of the century) for a range of ecosystems. In an effort to manage the impacts of climate change, the IPCC has set out a strategy to limit warming to 1.5°C. Accomplishment of this goal will require major reduction in greenhouse gas emissions through an overhaul of energy, transport and other polluting industries and sectors. However, the impacts of a 1°C increase are already evident. Research and media regularly highlight how the increase in the severity of hurricanes can be attributed to climate

change (*The Guardian*, 2018), a trend which is potentially irreversible. As such, even with achievement of IPCC goals, over the next several decades it is expected that global warming will contribute to significant environmental change. In the most general sense, dry areas are expected to become drier, with the potential to experience desertification and suffer from drought conditions, while wet areas will see increased precipitation and more severe and extreme storm events (Pilkey et al, 2020). The 2021 IPCC report suggests that without immediate and extensive reductions in greenhouse gas emissions it may not be possible to limit warming to 2°C. At this point, warming would further worsen the variability and intensity of wet and dry events such as monsoon rains, cyclones, hurricanes, droughts and fire. In this scenario, coupled with sea level rise, the situation for coastal areas will be dire with ‘extreme’ 100-year events occurring annually in the most vulnerable locations (IPCC, 2021 2023b).

When scientists speak of ‘greenhouse gases’ related to anthropocentric climate change, they are generally referring to carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) (water vapour [H₂O] also plays an important role in atmospheric warming). In recent years, a significant focus of climate change mitigation efforts has been to reduce the amount of CO₂ released into the atmosphere. Current concentration of CO₂ in the atmosphere is approximately 412.5 parts per million (ppm) which is higher than any point in the last 800,000 years (Lindsey, 2023). The amount of CO₂ concentration in the atmosphere has increased by 47 per cent since the Industrial Revolution (IPCC, 2021). CO₂ is particularly significant for climate change because it has a higher atmospheric concentration when compared with other greenhouse gases such as methane or nitrous oxide. Further, it remains in the atmosphere for thousands of years, compared to methane, which has a comparatively short 12-year lifespan (Pilkey et al, 2020). Analysis shows that the increase in CO₂ has been influenced by human activity – primarily through burning fossil fuels (for example, oil, gas and coal) but also through processes of development and deforestation which have reduced CO₂ storage. Globally, the primary contributors to greenhouse gas emissions are from energy, transport, manufacturing and construction, and agriculture (Ritchie et al, , 2023). However, as global warming continues, more permafrost will thaw, which can release large quantities of methane into the atmosphere. Some have called the potential release of permafrost methane a *ticking time bomb* (Glikson, 2018) as it is a more effective and efficient heat trapping gas (compared with CO₂) which could lead to more rapid and extreme global warming. Nevertheless, it is the Earth’s oceans that have served as the main source of heat trapping. It is estimated that over 90 per cent of the heat associated with anthropocentric global warming has been absorbed by the oceans (Durack et al, 2018; Johnson and Lyman, 2020; Cheng et al, 2021). Ocean warming threatens marine ecosystems and

biodiversity through deoxygenation, acidification and shifting ocean currents (Kwiatkowski et al, 2020). One of the most visible impacts of these trends has been the destruction of coral reefs due to increasing acidification and other forms of heat stress (Barott et al, 2021).

Global warming refers to the specific rise in global temperatures caused by an increase of greenhouse gas emissions in the atmosphere. The year 2020 was the sixth hottest year and the 2010s were the hottest decade on record (WMO, 2021). The data shows quite clearly that the Earth's climate is warming. Climate change indicates the wider series of shifts in climate patterns brought about by human influence and activity (including global warming) which may include increase precipitation or even cooling in some areas. The phrase climate change is sometimes considered less frightening, particularly when compared to the more polarizing term global warming (Benjamin et al, 2017) and more encompassing of the key climate challenges facing the planet (*National Geographic*, 2023). In this book, I primarily use the term climate change as I am discussing the broad changes in climate systems and how these are impacting communities and people across the world. Nevertheless, it is critical to recognize that the warming trend (that is, global warming) is at the heart of these shifts and is the key threat to the Earth's future.

Relatedly, this book is mostly concerned with the ways in which people are adapting to, rather than mitigating, climate change. Climate change mitigation centres on reducing the emissions of greenhouse gasses into the atmosphere. Mitigation efforts are often situated in response to calls to limit global warming to 1.5°C and, as such, are often situated within the context of a climate emergency to highlight the urgency and importance of acting now to limit further warming. The main initiatives in this area involve reducing and eventually eliminating the use of fossil fuels as well as protecting existing carbon capture resources (such as forests or the permafrost) or creating new carbon sinks (including projects that would pump CO₂ underground). The Paris Accord, the 2015 international treaty on climate change, set the aim of limiting the increase in global temperature to 1.5°C while leaving delivery of carbon reductions up to individual countries.

At the national level, in 2019, the United Kingdom set a goal of 'net zero' carbon emissions by 2050. This mitigation effort combines reductions in fossil fuel burning with other strategies such as carbon capture and demand reduction that would result an equilibrium between the amount of carbon produced (for example, by buildings, industry and vehicles) and removed from the atmosphere. And as I mentioned earlier, within the United Kingdom, the city of Bristol (where I live) has been more aggressive in its move to 'decarbonization' and is working towards a goal of being carbon neutral by 2030. Bristol has put together a climate strategy and climate emergency action plan that set out the vision for a sustainable city that does

not produce greenhouse gases. The strategy covers areas such as transport, buildings, food, electricity and the natural environment where carbon reductions and climate mitigation efforts are possible. These climate change mitigation efforts – at local, national and global scales – are largely centred on limiting or stopping the trend of global warming.

Climate change adaptation is sometimes framed as the flip side of mitigation as it centres on changing lifestyles, policies, ways of working and generally adapting to environmental change, rather than stopping it (NASA, 2023). Of course, climate adaptation has always been a way of life for human populations as people moved to respond to changing environmental conditions. However, adaptation takes on new meaning and a new politics within the context of the Anthropocene. The IPCC defines climate adaptation as ‘the process of adjustment to actual or expected climate and its effects’ (2014: 1758). As indicated within this definition, adjustment can be in response to particular events – such as relocating after a serious flood – or preventive and proactive. Anticipatory climate adaptation draws on an understanding of potential future risks and requires trust in projections and studies of environmental change (McDonald et al, 2019). As might be expected, proactive adaptation is politically challenging as it requires a long-term frame and possibly life-altering changes to life and lifestyle for a threat that may not be immediately apparent. In Chapter 4, I discuss the case of Fairbourne, Wales, where residents are being told by their government to move away from the coast in anticipation of future sea level rise associated with global warming. Of course, this forward planning – inviting people to take action based on changes that are not expected to have serious impacts for several years in the future – can be extremely contentious and controversial. Long-term planning for climate change adaptation requires improving communication, raising awareness and building trust in science (while ensuring that studies of climate change are trustworthy!).

Somewhat paradoxically, some efforts to adapt to climate change might actually work against mitigation. For example, the use of air conditioning to reduce heat stress might be critically important for public health and survival. However, air conditioners use massive amounts of electricity which can lead to the production of more carbon (depending on the type of energy source), contributing to a vicious cycle of global warming to adaptation to exacerbated global warming (WE Forum, 2019a; Underwood 2021).

Furthermore, there is an unequal spatial distribution of climate change impacts. For example, many of the places experiencing the negative effects of sea level rise have some of the smallest carbon footprints in the world. The Small Island Developing States (SIDS) – which includes places such as Tuvalu, Fiji, Solomon Islands and Tonga (among others) in the Pacific – contribute very little in terms of global carbon emissions. Yet, they are some

of the most vulnerable to climate change, particularly by way of sea level rise and an increased frequency and intensity of storms (UNFCCC, 2005). Moreover, populations such as the elderly or poor are more likely than others to experience the negative effects of extreme weather events such as flooding or drought. Research shows that older people are particularly sensitive to heat waves, which can lead to a range of heat-related illnesses as well as death (Åström et al, 2011; Guergova and Dufour, 2011; Varquez et al, 2020). As populations age, and global warming continues, fatalities among older demographics associated with heat stress are expected to increase (Dutchen, 2023).

A key objective of this book is to present a broad geographic spectrum of problems and initiatives in the context of water to demonstrate some of the global differences and similarities across these processes. Adaptation to environmental change has been a constant across human civilization. Yet, anthropocentric climate change presents a new circumstance of planetary environmental challenges. While this is a shared challenge, climate change involves a particular and complex set of factors and processes such as geography, climate, adaptive capacity, and so on, which means that the impacts and ability to adapt or indeed survive will be varied and unequal.

Climate change and water

‘[W]ater is the primary medium through which climate change influences the Earth’s ecosystems’ (UN Water, 2023: np). Warmer temperatures are expected to alter the Earth’s hydrological cycle and adversely impact environmental systems (Mulroy, 2017). The hydrological cycle is made up of the globally interconnected ecosystem of wind, ocean currents, precipitation, evaporation and energy. Of course, water is central to this system (Peters-Lidard et al, 2021) and it is through this system that climate change is being felt and experienced. Climate change impacts are dynamic and, to some extent, the timing, scale and regional variations of future changes are uncertain. However, from the perspective of water, a set of likely consequences of global warming includes, but is not limited to:

- increased severity and frequency of floods and droughts;
- increase in coastal erosion and inundation, leading to displacement and forced migration;
- declining quality and reliability of water sources (UN Water, 2020); and
- an increased potential for conflict over water resources (Welzer, 2015; Michalak, 2016; Werrell and Femia, 2018).

I will spend a bit of time here examining these in the following sections. While this is necessarily a generalized overview of commonly experienced

impacts, the discussion provides a framework through which to examine the water adaptation examples presented in later chapters.

Floods and droughts

In certain places, climate change is leading to an increase in the frequency and severity of both floods and droughts. With respect to flooding, warmer ocean temperatures along with sea level rise are leading to an increased frequency of storms such as hurricanes and cyclones. These storms are generally associated with high wind speeds, storm surges and heavy precipitation which can contribute to flooding and damage to natural ecosystems and coastal communities. Climate change is almost certainly making these storms stronger and more catastrophic. For example, research suggest that the impacts of climate change increased the amount of rainfall associated with Hurricane Harvey in 2017 by 20 per cent (Risser and Wehner, 2017). Of course, flooding events are not limited to the coast and there is evidence that climate change is contributing to interior (for example, river) flooding. One study notes that over the last five decades, precipitation has increased by almost 10 per cent in parts of the midwestern United States (EPA, 2016). In India, data indicates that climate change is making the monsoon season both more erratic and extreme and leading to serious flooding challenges (Deshpande, 2021; IPCC, 2021).

At the same time, droughts are becoming more common (Pokhrel et al, 2021; UNDRR, 2021). A drought is the result of less than normal precipitation that results in a water shortage. It is said to be a *hidden* disaster as droughts can be difficult to observe in their early stages and do not have the singular impact moment often associated with flood events (Jones et al, 2021; Liguori et al, 2021). Often, a drought is identified by a lower-than-normal level of precipitation, less moisture in the soil, drying lakes and rivers, or inadequate water for domestic and industrial uses. The effects of drought can be far-reaching and costly, adversely influencing water security, food security, and human health and wellbeing. Droughts can also increase the risk of fire (Mukherjee et al, 2018), which has been particularly evident in recent years in the western United States. Indeed, the western United States has been experiencing a ‘mega-drought’ with some areas experiencing the most extreme drought conditions in over 1,000 years. The drought’s length (over 20 years) and severity has been attributed to anthropocentric climate change and has contributed to an increase in wildfires, water insecurity and depleting reservoirs, and extreme heat (Williams et al, 2022). The US experience shows how a drought or flood is likely to lead to further dangers or compound environmental events and challenges (Ridder et al, 2020; Ionita et al, 2021).

Coastal change

Coastal transformation associated with climate change will have significant impacts for people across the globe. It is estimated that almost 2.5 billion people, approximately 40 per cent of the global population, lives within 100km of the coast (UN, 2017). Further, somewhere between 600 and 800 million people live in coastal areas of less than ten metres elevation (Lichter et al, 2011; Kulp and Strauss, 2019). Some high growth scenarios project that the number of people living in these low-elevation coastal zones will be 1.4 billion by 2060 (Neuman et al, 2015).

While a vast population lives in these areas, coasts are dynamic spaces where change, including coastal erosion, is a natural process. Yet, climate change is leading to more significant and direct impacts on coasts, through processes of sea level rise. Sea level rise is linked to climate change and global warming due to both the changes in volume and temperature. First, changes in volume of water and ice on land (for example, through melting glaciers) can impact the amount of water in the ocean. Simply stated, melting glaciers means more water in the oceans. Second, when water warms, it expands. In this case, as the oceans absorb heat from the atmosphere, they get warmer and experience thermal expansion leading to an increase in the volume of water. The result of this process is sea level rise. Recent climate change reports indicate that the world's oceans were at record high temperatures in 2023 (*The Guardian*, 2023). Other non-climate factors can also contribute to changes in sea level rise, including land rise and geological uplift, erosion, subsidence and groundwater withdrawal, all of which can impact the dynamic and fragile relationship between land and sea (EPA, 2023a).

During the 20th century global sea level rise increased by around 1.5mm per year (Frederikse et al, 2020). Since the 2000s, the rate has increased to something like 3.2mm per year and is not expected to slow down, even with major climate change mitigation efforts (Griggs, 2021). In total, there has been an average sea level rise of 24cm since 1880 (Lindsey, 2022). By 2050 the global mean sea level rise is likely to increase by another 20–30cm. Many projections estimate sea level rise of 50–100cm by the end of the century (Kulp and Strauss, 2019), although some scenarios (where emissions of greenhouse gasses are not significantly curtailed) project sea level rise over two metres (Le Bars et al 2017). Critically, the sea level rise projections are global averages and do not reflect spatial or temporal variations (Yin et al, 2010; Aral and Chang, 2017). For example, sea level rise will be more significant in Asia than along the Pacific coasts of Central America (Church et al, 2013). Further, the impacts on local communities may fluctuate due to small changes in wind, sedimentation patterns and other environmental factors (Church et al, 2013).

Many parts of Asia are particularly vulnerable to flooding due to sea level rise, including coastal areas in Bangladesh, Indonesia and Thailand (Kulp

and Strauss, 2019). Jakarta (Indonesia) is a commonly cited example of how these factors interrelate and threaten coastal cities. The capital of Indonesia, Jakarta, is a low-lying, topographically flat mega-city of over 13 million people. The city is on the north coast of the island of Java and has grown around a complex geography of wetlands, streams and canals. In recent decades, urbanization and development (with extraction of groundwater) have contributed to subsidence, worsened flooding, and led to displacement (Steinberg, 2007). As a coastal city, the city is further threatened by sea level rise and other climate change impacts (Takagi et al, 2016). Now, partly due to these environmental challenges, plans are in place to relocate the capital city.

Sea level rise is also particularly relevant for the United States. For example, between 2011 and 2015, sea levels along the southeastern coast of the United States rose six times faster than the global average (Hauer et al, 2016; Valle-Levison et al, 2017). As a result, cities are putting together climate adaptation plans to deal with the threat of coastal flooding. New York City, for example, has been developing plans and strategies to protect people and resources in the mega-city. The Eastside Coastal Resiliency Project is a 2.5-mile, US\$1.5 billion flood protection system that will provide lower Manhattan with strengthened coastal protection from sea level rise and associated storm surges (NYC Gov, 2023). Of course, not all places have the resources of New York, and some will struggle to adapt to these conditions. Indeed, many of the SIDS mentioned earlier are particularly exposed to the impacts of climate change due to their location, geographic isolation, size and limited economic resources (Robinson, 2020). SIDS are located across the globe with clusters in the Caribbean, the Pacific Ocean, the Atlantic Ocean (for example, off the eastern coast of Africa), the Indian Ocean and the South China Seas. These countries are at the vanguard of global warming impacts.

Quality and reliability of water

Climate change poses significant challenges for water quality and water supply. In particular, water quality is likely to deteriorate as a result of global warming (Fant et al, 2017; Salerno et al, 2018; Li et al, 2020). Research shows that climate change can reduce or adversely impact drinking water quality in several ways. For example, we know that climate change is altering patterns of precipitation, leading to an increase in the intensity of heavy precipitation events. Particularly in urban areas with extensive impermeable surfaces such as roads, buildings and pavements, heavy precipitation and an increase in the frequency of large storms can lead to an increase in untreated stormwater. In urban areas, this stormwater often carries harmful pollutants into water sources. Further, heavy rain events can contribute to erosion and sedimentation, which can further impact water management systems and the quality of drinking water (Gödeke et al, 2020).

Warmer air and water temperatures (again, a consequence of climate change) can also diminish water quality (EPA, 2023b). Higher temperatures are associated with lower levels of oxygen – conditions that can impact ecological systems by supporting algae growth and increases in bacteria which harm aquatic plant and animal life. Again, this can adversely impact to drinking water systems. Finally, at the coast, sea level rise, discussed earlier, can also impact water quality. Primarily, this occurs as saltwater infiltrates freshwater aquifers and drinking water resources. The United States Geological Survey has been monitoring the ‘salt line’ that forms the barrier between ocean and drinking water for South Florida and the city of Miami (Prinos et al, 2014). The intrusion of saltwater into the Biscayne Aquifer – the aquifer that supplies drinking water to much of South Florida – is attributed to rising sea level as well as increased use and consumption via groundwater extraction. Efforts are being made to lessen or halt the decline of water supplies through demand management (for example, using less groundwater) and the conservation and protection of wetland areas. These issues suggest growing concern related to water security and the ways in which climate change will likely exacerbate the challenges many cities face in terms of providing safe, clean drinking water. Moreover, sustainable water systems will need to account for the ways in which certain climate adaptation efforts such as incentives and requirements for reduced water use might negatively impact certain communities and individuals such as the elderly or poor (Speight, 2018). Later in this book I highlight the case of Flint, Michigan (United States) where water managers made unfortunate choices about water supply which resulted in harm to many residents of this majority African American city. The example signals some of the complex relationships and interdependencies between policy, austerity, racism and prejudice, infrastructure, and water. As climate change adaptation strategies and policies become a more common aspect of city life, it will be critical to examine the ways in which these impact people differently. An awareness of social justice is critical to understanding climate change impacts on water supply. Of course, these changes not only affect human drinking water systems, but everything that depends on water for life and wellbeing. Climate change risks serious impact to societies and economies, as well as biodiversity and environments.

Conflict and water

Civilizations have always been framed by their relations with water. Access and control of water is a precursor for flourishing life and human wellbeing. It is a precious resource that enables cities and populations to grow. Well over a billion people live in areas of the world where water is scarce (Salman, 2005). The United Nations estimates that by 2050 some five billion people

on Earth will experience water scarcity for at least one month of the year (UNWWAP, 2018). Clearly, climate change is contributing to water stress and water insecurity. These conditions suggest the potential for tension and conflict around water supply and the management of water systems, particularly in cross-boundary contexts (Klare, 2020). As Gleick and Iceland (2018: 7) point out, conflict over water resources is rare and people generally tend to ‘muddle through’ or find new ways to collaborate in the face of crisis. Yet, there have been and continue to be conflicts over water resources. The Pacific Institute’s Water Conflict Chronology details 316 incidents where disagreements over water systems and management was the trigger or cause of conflict (Pacific Institute, 2022). One conflict they highlight centres on Mali (West Africa), where many people have been killed and possibly hundreds of thousands displaced, in part due to water shortages (Diarra, 2020). In such places, on top of political conflict and uncertainty, environmental change is contributing to water stress, an increase in drought conditions, desertification, and water and food insecurity (Hegazi et al, 2021). These issues are pushing the capacity of the existing water management system to ensure safe, reliable drinking water for citizens.

In the western United States, climate change and drought conditions have also increased tensions over water. Of course, there is a long history of water conflict in this dry landscape. For example, the skirmishes over Los Angeles’ water supply system, designed by William Mulholland, are notorious. The thirst for water pitted the expanding metropolis against the people of Owens Valley, a water-rich area located in Eastern California (about 250 miles from Los Angeles). Mulholland’s project brought water from the valley to Los Angeles in the early 1900s. While this enabled the city to continue its expansion, it devastated agricultural and economic life in the valley. Seeing their livelihoods ruined, some locals protested while others attacked and disrupted the aqueduct project during construction (Reisner, 1993). These water wars were fictionalized in the 1974 film *Chinatown*, starring Jack Nicholson, which used the aqueduct project as a key narrative device.

More recently, declining water resources in the Klamath River basin, which covers a large area of northern California and southern Oregon, has brought farmers who use the river to irrigate crops in conflict with Native American tribes who rely on these same waters for fish (Flaccus, 2021). With lakes far below acceptable levels and fish dying off in large numbers, irrigation systems were blocked by the US government. Incensed landowners later threatened to destroy the gates that are closing off the water (Baker, 2021).

Yet, these negative stories notwithstanding, most research indicates a tendency towards cooperation and collaboration of water resources. Rather than an impetus for conflict, water tends to be an added stressor in contexts where conflict and instability is already present. However, such conflict (unrelated to water issues) can contribute to worsening water security.

Again, the Pacific Institute tracks incidents of conflict where water supply is a casualty of conflict (either intentional or otherwise), rather than the cause. The database provides details for over 500 such incidents globally where water infrastructure such as dams, wells, tanks, supply facilities and irrigation systems have been destroyed and people have been killed or injured as part of violent conflict.

Vulnerability, fragility and climate change

The previous discussions highlight some of the impacts of climate change in relation to water and water security. They show a diversity of ways in which people's lives are likely to be impacted by climate change (and how this is happening now). However, climate change is not experienced in a singular or universal way. Some areas are even finding short-term benefits. For example, the changes to climate might allow new forms of agricultural production and crops in high mountain areas (Palomo, 2017). Nevertheless, while climate change is a globally shared crisis, the impacts and disbenefits (and even benefits) are not equally distributed (Singer 2018). In particular, the negative impacts of global warming and climate change are likely to be experienced disproportionately by the poorest of the world, particularly people who live in parts of Africa and Asia (Ward and Shively, 2017). Recognition of this spatiality signals a moral and ethical requirement to consider those most vulnerable to the negative impacts of climate change. Vulnerability, in this context, is understood to reflect the 'the extent to which a natural or social system is susceptible to sustaining damage from climate change' (IPCC, 1997, 3; 2018). The concept generally indicates 'susceptibility to harm' (Ford et al, 2018: 191) and the ways in which we might advance understandings of the scope and extent of threat or risk (Kelly and Adger, 2000; Adger 2003). Vulnerability involves a range of elements including exposure to risk as well as the ability of a community to manage risk and adapt to changing environmental circumstances and extreme events. Of course, vulnerability shifts across geographies and over time. For example, a city may become more exposed to climate threats (for example, via sea level rise or worsening drought conditions) but it can also develop its *adaptive capacity* via strategies and programmes intended to build resilience (Companion and Chaiken, 2017; Siders, 2019). While vulnerability provides a framework for understanding the 'where, how and why' of climate change impacts (McDowell et al, 2016: 1), the concept may be less useful in terms of mitigating or adapting to environmental challenges. Indeed, some scholars suggest that the use of vulnerability framings is largely unsophisticated and crude and even potentially detrimental to those so-called *vulnerable* individuals and communities (Luna, 2014). Yet, clearly some parts of the world are more exposed to particular environmental changes than others and this

understanding provides a useful framework for beginning discussions of how to adapt or even the potential for adaptation to climate change.

The concept of fragility provides further richness and nuance to understanding how people and communities might respond to these changes. Fragility indicates the interdependency between people, places and the wider environment. Recognizing that humans are – as a species – fragile can be a useful signal to frameworks and practices of care that are required to sustain life. However, in contrast to this care-oriented framing, the concept of fragility is more often used in the arena of international relations to refer to an inability to manage a population, usually at the national or state level (G. Zhou et al, 2020). In this respect it is used similarly to phrases such as failed or weak state which might include characteristics such as political instability, extreme poverty, and lack of durable and trustworthy institutional structures of governance (Nkurunziza, 2019).

Climate change researchers have drawn on these understandings to develop the concept of climate change fragility. Here, the notion of state fragility is joined with an understanding of the vulnerability and potential adverse impacts of climate change and the (limited) adaptive capacities of the state. In this framing, a weak state is unable to support adaptation processes or manage the growing risk of worsening environmental hazards (for example, flooding or drought). As a result, internal social, political and environmental challenges are exacerbated and the ability to adapt to climate change is hampered (Reimann and Burns, 2019). In other words, climate change works as a *threat multiplier*, intensifying the risks associated with the absence of an authoritative, trustworthy or capable system of governance (Rüttinger, 2017). Fragility, in this sense, is expressed as a failure of a state to deliver even a basic level of security and wellbeing for its citizens. Not completely dissimilar to the commonplace or conventional understanding of care, fragility in this interpretation expresses a lack (a need) and is used condescendingly to express an inability to take care of one's situation. I want to move away from this understanding. Rather, as I noted earlier, I see fragility as part of the human condition and our interdependent position in the world. The notion of fragility, from this sense, takes into account that humans are inherently needy, and most importantly, that this is not a failure. All of humanity is fragile. Existence on this planet is fragile. The establishment of security, stability and flourishing lives is accomplished by recognizing the critical points of fragility and providing care or supporting care practices. All states are fragile. That some have robust and effective systems of care in place does not negate this fundamental fragility.

Looking at the global environment, in many parts of the world, environmental changes brought on by climate change have exposed and indeed worsened existing inequalities. Haiti, for example, has been identified as one of the most vulnerable countries in the world (Slagle

and Rubinstein, 2012). It is also considered one of the most fragile in the discourse of developmentalism and international relations. Located in the Caribbean, Haiti is commonly described as the poorest nation in the western hemisphere and characterized as a weak or fragile state that lacks credibility and authority and is beset by corruption and political uncertainty. Indeed, the Haitian government has struggled to protect citizens from natural hazards including earthquakes and hurricanes which have led to significant loss of life and damage. Most notably, the 2010 magnitude 7 earthquake which resulted in at least 230,000 deaths and almost US\$15 billion in damage (Margesson and Taft-Morales, 2010). The catastrophe was followed by an outpouring of aid and humanitarian assistance. However, aid efforts were framed by a (racialized) Orientalist discourse that Balaji (2011) notes largely celebrated aid workers coming to the rescue of needy Haitians. Balaji (2011: 57) explains how the White ‘do-gooders became the privileged subject of stories, while the Haitian victims blurred into the background as merely the objects of the good deeds’. The Haitian experience is extremely important for understandings of care as a framework for thinking about global interdependencies. Indeed, much of the global discourse around climate refugees is framed through a process of ‘Othering’ where victims are represented as dysfunctional and helpless. Again, as Balaji (2011) points out, this framing of subjects as ‘pitiful’ dehumanizes victims of disasters and reifies unequal north/south relations of superiority/inferiority. This is not a strong basis for an ethics of care. Rather, a care-oriented framing of climate change adaptation must be situated in a postcolonial understanding of structural power inequalities. On the one hand, this means that stories are not solely about victims, need, and how suffering individuals and communities must be saved. In place of this, one might look to the way agency is expressed and the way people forge their way in a complicated, challenging landscape. On the other hand, a postcolonial framing of care should be situated in an awareness of inequality – much of which is framed by a global north/global south dichotomy. I will explore these ideas in greater depth in Chapter 2. However, for now, I signal my argument that to see the experience of climate change and human vulnerability through the lens of care, is to see fragility as a human condition – not as a failure. The existence of human suffering is real and undeniable and climate change is leading to further tragedy. Moreover, the people most likely to suffer negative consequences of climate change are often those with the least political, social and economic resources to adapt.

Structure of the book

This chapter has set out some of the central framing between water, climate change and human–environmental fragility. It highlighted the role of narrative and storytelling in making sense of these changes and how these

can be powerful tools for motivating (or demotivating) people and action. The chapter also discussed the current understanding of anthropocentric climate change and global warming and how this works through and impacts the global hydrological cycle. Finally, I looked at notions of vulnerability and fragility and how these differently position people within caring and care-needing communities. In my work, recognizing our human–environment fragility is one of the most important steps in moving to a more care-oriented world.

The book is organized in such a way to look at water and climate change in distinct contexts. Following this introductory chapter, [Chapter 2](#) examines the concept of care in further depth, drawing out how it intersects with water security. In that chapter, I argue that care is fundamental to secure flourishing water futures. [Chapter 3](#) examines some of the vast history associated with efforts to access and provide secure drinking water. Through the cases of Flint, Michigan (United States) and Rajasthan (India), I narrate experiences of care in the mundane work of daily life and how care is visible/invisible and present/absent in the achievement of safe, reliable drinking water. [Chapter 4](#) is centrally concerned with coastal erosion and the impacts of global warming and sea level rise on coastal communities. Examining coastal change in Bangkok (Thailand) and Fairbourne, Wales (United Kingdom), I look at the unevenness of adaptation and management practices in these settings. [Chapter 5](#) turns to the cryosphere and how global warming is leading to water insecurity in some of the coldest and most climatically harsh places on Earth. Images and videos of crumbling glaciers are powerful and all too real symbols of how our world is changing. Yet, people continue to live in much of the frozen Earth. Their adaptation strategies are part of an unfolding and uncertain story of living with environmental change. [Chapter 6](#) draws this material together to build a more robust understanding of ecologies of care in water security. It reviews the book's material and develops a further, more hopeful way of looking at the Earth as fragile, interconnected, interdependent and wholly worth living in.

Care and Water Security

In this chapter, I review key ideas and debates around the concept of care and explore some of the ways in which care and care work is connected to water and water security. I suggest that the achievement of water security is embedded within process that are full of care. For example, safe drinking water or flood protection activities involve purposeful actions such as planning, design and construction of infrastructure, as well as regular processes of repair and maintenance which keep infrastructure up and running. My central argument is that care is central to the mundane, everyday activities which support human life through the management of water and the establishment of water security.

In the first part of this chapter, I review some of the key understandings of care and care work. Subsequently, I frame care as part of a wider caring assemblage that includes people, institutions, laws, ideas and emotions, animals, and all manner of things and objects that make up the material world. A great proportion of these care assemblages, such as drinking water infrastructure, are commonly either hidden or taken for granted until moments of rupture, failure or crisis. I finish the chapter with an introduction to the idea of ‘ecologies of care’, which will be developed more fully in the final chapter. Ecologies of care is my approach to seeing the pervasiveness of care and identifying ways to bolster a care-centric way of living with climate change.

Taking care in, and out of, the home

Care is a contested concept. By this I mean that there is no single definition or universally agreed-upon understanding of care or the work that is associated with providing care. Historically, care work has been framed by the practice of looking after the welfare of ‘vulnerable others’ (Cox, 2010: 114). This might include activities such as feeding a baby, doing housework, or caring for an elderly relative and other activities commonly associated with domestic spaces (Conradson, 2003). These are embodied

practices – requiring hands-on work (for example, wiping a child’s bottom) that have a strong emotional component. It is not just manual labour, but it is *emotional* labour – as care work often requires a great deal of listening, reassuring and, of course, patience. Emotional labour is intimate, relational and involves managing the emotions of others as well as oneself. Partly due to its associations with emotional labour and conventional understandings and expressions of masculinity, care work is often described as a feminized practice. The archetypal space of care is the home. Globally, women perform vastly more care work in the home than men (ILO, 2018). This is the unpaid work that involves taking care of family members (and others) through activities such as cleaning, cooking and feeding, and other household activities. The role of women as primary domestic care workers was exacerbated by the COVID-19 pandemic (Cummins and Brannon, 2022). As M. Zhou et al (2020) point out, the impacts of lockdowns and related restrictions (for example, closure of schools and daycare provision) generally increased women’s responsibility and work in the home. Their research showed how mothers in the United Kingdom spent almost twice the number of hours on childcare than fathers during lockdown periods. Clearly there is a gender inequality associated with domestic care work. Another area of important research in this regard has focused on the experiences of female migrants. In recent decades, migrant women have become a central feature of globalization as the demand for domestic care work has grown (Meintel et al, 2006; England and Dyck, 2012). However, domestic care work is not restricted to women. For example, while the disparity with women still exists, research shows that men in the United States are spending more time with their children than in the past and moving (if slowly) in the direction of more egalitarian parenting responsibilities (Negraia et al, 2018). Further, in many parts of the world, children, particularly girls, spend significant amounts of time involved in unpaid care in the home (Rost, 2021).

Care work is not exclusively located in the home and the care industry makes up a significant proportion of national economies. This includes nurses or other healthcare professionals (Keogh and Gleeson, 2006), but also childcare workers, cleaners, those doing unpaid activist and/or community work (Conradson, 2003). Not unlike domestic care practices, research shows that when care work occurs in the context of wage-labour, it is often undervalued, underpaid and can be exploitative (Lawson, 2007; Cox, 2010; 2013; Green and Lawson, 2011; Pratt, 2012). Over the past several decades, feminist scholars have drawn attention to these injustices and inequalities and have worked hard to ensure care work – domestic and non-domestic – is recognized as legitimate labour practice and valued appropriately. This activism has served to recognize the crucial role of (predominantly female) carers for human lives.

Lawson (2007) examines the way care is devalued and marginalized. She suggests that this marginalization is not accidental, but rather, it is a purposeful, political act that allows the ‘myth’ of the ‘autonomous self-made man to go unchallenged’ (Lawson, 2007: 5). This myth helps to occlude those individuals and activities that facilitate successful and flourishing lives. Take, for example, the process of doing academic work (including writing a book!). Undeniably, the potential for any individual to thrive in academia relies on a robust and diverse community of care workers within and outside familial relations. A quick reflection on my personal circumstances is telling. When my son was younger, he was regularly looked after by non-family members in daycare and, later, in after-school club. At this very moment (as I write these words) he is in secondary school, being educated by teachers, and looked after by those employed in education. Of course, I have been to the GP regularly and supported through a community of care workers associated with the National Health Service. Closer to home, I receive emotional support from family members who encourage me to ‘keep going’ and a partner who co-parents, shares cooking and cleaning responsibilities, and provides care to me when I am unwell. The authorship of this book is in my name. Yet, the process of concealing care facilitates the myth that I am an autonomous individual, that my success is my own, that I am not ‘needy’ or vulnerable. As Lawson (2007: 5) argues, by concealing care we are less responsible to ‘share the fruits of our successes or to dedicate public resources to the work of care’. Yet, our involvement in the world is relational as we are constantly relying on and supporting others. As much we may wish to lay a singular claim to our achievements, these are embedded in collaborations and care practices. We are, in other words, always caught up in networks of care.

In my view, central to the myth that we are autonomous and self-made, is distaste for seeing ourselves as vulnerable and general negative connotations with this characteristic. While characteristics such as resilience, capability and toughness are commonly valued, being vulnerable is not generally seen as a positive attribute. Indeed, research has shown that many elderly care recipients reject the classifications of being dependent and vulnerable. Vulnerability, in such contexts, is commonly understood as a weakness and a failure to meet societal standards of self-care. This view can have devastating consequences for an individual’s sense of self-worth and wellbeing. When understood as lack and failure, it makes sense that we hide the care work associated with vulnerable bodies. As I noted in Chapter 1, there is resistance to the idea of categorizing people and communities as vulnerable. To be seen as vulnerable seems to indicate a lack of agency. Yet, Wiles (2011: 579) argues that vulnerability ‘could also be reconceptualised as openness, susceptibility and receptiveness’. Perhaps, Wiles argues, it would be better if we considered the extent to which ‘all persons are vulnerable’ (Wiles, 2011: 581). Rather

than understanding vulnerability as a deficiency, resulting from some kind of unfortunate event or condition, what if it ‘describes the inherent and continuous susceptibility of corporeal life’ (Harrison, 2008: 427). I think this framing is critical to beginning to see how people and communities always require care. In other words, it is time to start recognizing that we are inherently vulnerable, fragile creatures. That systems of care are in place to allow me to work and support my family is a social and cultural accomplishment that should be celebrated. Yet, more often than not, the care work that makes life possible is either hidden or undervalued, particularly when compared with so-called rational and masculinized work (Tronto, 1993).

Without catastrophizing recent trends, it seems that care is devalued more than ever. Austerity measures and the associated reductions in welfare and social security benefits in the United Kingdom, for example, have disproportionately impacted women (Pearson, 2019). Moreover, the role of care work within the wider economy remains underappreciated and undervalued. However, there are signs of a shift, or at least another approach. Take, for example, US President Joe Biden’s American Rescue Plan. The investment strategy focuses on infrastructure and economic security for the country and signals a desire to ‘solidify the infrastructure of our care economy’ (The White House, 2021: np). Notably, Biden’s plan sees care and care work as part of the American national infrastructure and sought to position activities such as childcare and care for the elderly included within infrastructure funding programmes. As might be expected, defining care as infrastructure was met with a great deal of derision and critique (Tankersley and Smialek, 2021). Yet, some US states have taken these, or similar, measures forward. In New York, for example, the state senate recently developed proposals to enable free childcare for all low-income families (Ashford, 2022). These are initiatives that recognize the ecologies of care that make up flourishing lives. As many will be aware, understanding the role of childcare as critical and structural to society has been long recognized by Scandinavian countries where much more support for childcare is available (WE Forum, 2019b). It is exciting to see New York begin to move towards this progressive view of social infrastructure and wellbeing.

Landscapes of care

As a place-oriented scholar, I am naturally drawn to the spatial elements of social activities. Of course, there is a fascinating place element or spatiality to care. For example, geographers have been exploring the way certain spaces and sites support particular care practices and activities. The most obvious of these *landscapes of care* are the home, nurseries, hospitals, spas and health retreats. These are the places one might go in the case of an injury or illness

or for a bit of mental or physical rejuvenation. Less traditional (or more ‘hidden’) sites that support care practices include cafes, parks and gardens, community centres, and even sporting clubs. For example, research now points to the mental health benefits people can experience through access to and participation in greenspaces. There are even programmes such as ‘wilderness therapy’ or ‘ecotherapy’ that bring people into contact with nature and animals to address significant emotional challenges and mental health illnesses (Barton and Rogerson, 2017; Fernee et al, 2019; Lord and Coffey, 2021).

Of course, no place is automatically a space of care. There is no universal or singular experience of any space. People experience places differently and these are always relational and contextual. The home, for example, can be both a space of love and nourishment as well as one of violence and abuse where care is sadly absent. However, our understanding of care is enriched by exploring how it occurs in particular places. Human activities are always spatial – if we are sitting at a computer, on a train, or in hospital – the experiences we have are framed by our situatedness in some place. That care takes place in any space is a relational, co-produced activity that must be cultivated and nourished. In other words, care is a place-based *political* undertaking. I stress the word political to emphasize the purposefulness to care and the consequent implications for those who benefit and those who do not. The politics of care signals an orientation towards inequalities (Askins and Blazek, 2017) and an ethical framing of what matters. Of course, I am particularly interested in the role of water, and the concomitant spaces of water, that support care practices. There is a great history of water care – the way being near or in water provides both physical and emotional benefits (Strang, 2015). Not far from my home is the city of Bath. It is a World Heritage Site famous for its thermal baths, developed by the Romans and reinvented in the 18th century as Georgians became more interested in the healing and restorative properties of mineral water. Human life is often enriched through connections with water and watery environments.

Unfortunately, there are many potential disadvantages associated with living near water which might include, most obviously, the potential for floods and disease such as cholera. However, research shows that there are also many potential benefits from forging close connections to ‘blue space’. The concept of blue space builds on work that explored the health and wellbeing impacts of being in or near parks and other forms of green space. Blue space might refer to something as vast as an ocean or even a small neighbourhood pond or stream (Volker et al, 2016). Research shows that people can benefit significantly from interactions and engagements with these kinds of resources. For example, Brereton et al (2008) found that people who lived close to the Irish coast were more satisfied with their lives than those who lived further inland. Studies suggest that the benefits of living

near the coast might also lead to higher levels of both mental and physical health (White et al, 2020).

Yet, what I have found particularly interesting about blue space is the relationship with care and how specific spaces can be organized or constructed to facilitate caring experiences and practices. In earlier research (Buser et al, 2020b), my colleagues and I explored and detailed how activists and socially engaged artists used water and watery spaces to connect with people. In our research, we worked with three organizations (Canal Connections; My Future My Choice; Active Energy) involved in water-social activism. Canal Connections is run by a former police officer who sets up canal boat trips for socially isolated, disadvantaged youth in the city of Leeds. My Future My Choice takes children on trips and visits to Bristol's harbourside and sets up boat-building workshops and other activities intended to inspire, build confidence and bring attention to the city's water history. Active Energy draws on the enthusiasm of older people in East London to explore water-based energy opportunities. The project we studied involved building a stream wheel that oxygenated the Bow Creek, improving the watercourse and fish habitats.

What the activists told us was that water was a means to start a conversation. This conversation was intended to be both literal and metaphorical. It is, of course, a conversation between people. But it is also between people and their surroundings. For example, for someone who has never been on a boat, the experience of driving a longboat through the canals of Leeds opens new connections and lines of communication. Such experiences allow water (and associated environments, both built and natural) to speak. They expose the interdependencies which surround us and draw our attention to the potential of corresponding with the world in new ways. To me, this notion of correspondence is very helpful for understanding care. We are not in isolation from the world, but always in some kind of correspondence. Landscapes of care, in my relational framing, are a means to understand the spatiality or placeness of that correspondence.

Care and proximity

So far, I have been discussing the experiences of care that happen more or less in proximity. That is, people giving or receiving care at home, a park, or some other site in face-to-face fashion. The activity is thus one in which a person can directly engage with the care giver. However, alongside these conceptual developments, over the last couple of decades scholars have pushed theories of care and care work to consider activities and practices that are not spatially proximate. As noted by Paula England (2005: 387), the benefits of 'localized' care can travel. For example, passing along healthy lifestyles and habits or providing individual education goes further than an

individual care recipient. As she notes, these ‘indirect benefits of care’ operate as a ‘public good’ producing benefits to people (and things) well beyond the original direct recipients of care (England, 2005: 382). Meanwhile, others have explored the various articulations of care in terms of non-proximate forms of caring (Cox, 2010: 113; Morgan, 2010; Atkinson et al, 2011). For Cox (2010), the potential for care at a distance is particularly evident in the area of food justice. Cox points to the way fair trade, ethical consumption and alternative food schemes can be foundations of connection to distant others (for example, farmers and communities in the global south, the environment) as well as sources of emotional fulfilment and joy. Such an approach helpfully moves care away from the purely domestic setting and ‘beyond parochial self-interest’ (Cox, 2010: 117). The distanced notion of care does not necessarily mean a disconnect or a diminished version of care. In fact, distance can actually magnify the importance of caring activities. Consider, for example, the way Greta Thunberg sparked worldwide climate change protests among students and young people. The activism she sparked brought a new generation of people into the fold of climate justice and planetary health and wellbeing, broadening human care for the planet and those negatively impacted by environmental change. Of course, during the COVID-19 pandemic, a great deal of care work was provided virtually. In my own case, advancements in video-conferencing and internet infrastructure meant I was able to stay in contact with family members who live thousands of miles away. Interestingly, we have maintained many of the communication habits we formed during these times and stay in touch better now than we did any time in the past several decades.

By looking at these non-localized forms of care we can enrich our understanding of the concept and how it may be put into practice in the context of entrenched global challenges. I suggest that a broad understanding of how care works or can work at a distance is critically important for beginning to address issues and challenges – like global warming or water insecurity – that are so massive that they belie easy explanation or any type of quick fix. That any care activity might not be face-to-face or in direct proximity does not eliminate the fundamental component of care. Moreover, this global, non-proximate framing of care could be seen as a means to counter recent inward-looking trends (for example, protectionism, some forms of nationalism) and move towards a type of care cosmopolitanism or global ‘ecological citizenship’ (Roe and Buser, 2016).

Caring with and for things

Care and care work is not only about looking after people but can also involve the practice of looking after things (for example, antiques or machinery) and non-humans (for example, pets and animals). Think, for a moment, about

your city or town. How does it all hold together? While you may be more aware of the potholes, graffiti, sites of disinvestment or decline, there is likely an incredibly active programme of maintenance and repair that keeps all of it running. Human settlements always require care. Here, I start to expand what we might conventionally consider to be care and care work. I want to explore care as an ecology that is not restricted purely to humans. There has been some fascinating research that explores the ways in which care emerges in urban settings. For example, Kim Kullman's (2014) research centres on the pavements of Helsinki and the way children take part in caring activities. Kullman shows how children look after each other when walking to school (and other journeys) and how young people develop an attunement to the city through mundane activities like biking, collecting recycling or petting a dog. These everyday experiences bring children into contact with the city and help develop a relational understanding of people and their environs. People, in other words, are not separate from the city. But, rather, they develop an understanding and even an ethics of care through interactions with the materiality of the city. What I found particularly insightful from Kullman's paper was her expression of 'vulnerable urbanism' (Kullman, 2014: 2876). She notes how vulnerability is not a weakness but a universal condition (particularly among children, which we mostly seem to accept) that signals the need to participate in urban life. By participating (carefully) in urban life, children can begin cultivating points of connection with the city and finding their way towards young adulthood. Vulnerable urbanism, as such, is not eliminated by keeping children in the home. Rather, if vulnerability is recognized as becoming part of the city, children must be supported to explore the city and participate in 'safe' urban interactions. A bit of risk, it seems, allows children to see themselves as fragile but also as active agents in how this fragility can be managed.

While Kullman's research shows how a sense of care emerges among children through mundane and playful interactions in the city, other research shows how the city itself is cared for. Often, this work is conducted by individuals employed by a city, town or local authority. For example, Denis and Pontille (2015) examine the practices associated with maintaining the signage within the Paris metro. During their fieldwork, they shadowed a maintenance team that looked after the signs that help people move around the system. This work of looking carefully at the materiality of society provides yet another way to explore fragility and vulnerability. 'Fragility', they argue, 'is a mode of existence of matter that must be considered if material ordering processes are to be documented in their full complexity' (Denis and Pontille, 2015: 341). In other words, the things we interact with on a daily basis – that help us get around in the world – are in constant states of deterioration and decline. Their ability to perform intended functions (for example, to support wayfinding) relies

on process of maintenance and care which help overcome a condition of vulnerability and fragility. Similarly, Ureta (2016) studied the care practices associated with the management of waste from a Chilean copper mine. One of the key insights of this work was identifying the ways in which care was entangled in the activities of waste management personnel. In one example, Ureta discusses how two workers provided regular, meticulous surveying and maintenance to project infrastructure (including a bridge essential for transporting waste materials). Drawing on Annemarie Mol's scholarship (2008), Ureta (2016: 1541) describes this 'tinkering' as a care practice as it reflected the workers' unique ways of engaging with the bridge's decaying components – a type of 'bodily commitment' and engagement that is experimental and reflective. The word tinkering reminds me of a creative (if somewhat humbling) television show on BBC One called *The Repair Shop* hosted by restoration expert Jay Blades. In each episode, people bring loved items and heirlooms that have fallen into disrepair to the shop. A team of experts then work over several weeks to restore the broken bicycles, watches, cabinets, ceramics, guitars, and so on. On one level, *The Repair Shop* highlights quite clearly how maintenance, repair and restoration practices are entangled with material care. It also demonstrates how people can become so strongly attached to objects. Indeed, this attachment produces something like a commitment or obligation to restore among the show's participants who bring in the items. They often state 'I needed to fix this' while there is generally no practical justification to repair any of these individual items or heirlooms. Rather, it is an emotional need based on an affective attachment to the thing and what (and often who) it represents.

Of course, many things in the world have a very practical and important role to play and must be regularly maintained, repaired and eventually replaced. Water infrastructure is one such thing. Indeed, in my own research (Buser and Boyer, 2021), I found a rich set of care practices and approaches among water engineers involved in maintaining the city of Bristol's water supply. During this research I spent some time shadowing an inspector named Sam who expressed attachment and love for the city's underground pipes and machinery. Sam was employed by the water company and, as such, was of course obligated to ensure the system was properly maintained. However, his engagement with water infrastructure was much deeper than a purely instrumental relationship that might be expected from an employee. Indeed, I remember him telling me that he felt these pipes should be treated as heirlooms (not unlike the heirlooms brought to *The Repair Shop*!). Sam expressed a great deal of enjoyment and satisfaction in his work and referred to himself as a 'gold-plated engineer'. With this somewhat satirical point, Sam suggested that he would go far beyond the conventional expectations of any inspection job. While he gave a high level of care to the city's water

infrastructure, he often told me about the felt, emotional attachment and sense of value he got out of his work, far beyond the pragmatic programme of ensuring a safe and reliable water supply.

In these examples, care is shown to cut across human and non-human boundaries. We are richly entangled in an ecology of things and people such as Sam and Jay Blades provide care and care work to all kinds of non-human things. Of course, all infrastructure requires care through regular maintenance and repair. Vulnerability and fragility are the normal conditions of things and, as with human bodies, not an abnormality. Rather, this inherent vulnerability encourages us to recognize that urban care is always needed.

Things that do care work

Most people will agree that humans care about and take care of things. That these activities might be seen to be care work, as I argued earlier, is a more radical conception. Now, I want to take this a step further. So far, the discussion of care has focused primarily on the actions of people – either looking after loved ones, signs, heirlooms, the planet, or various objects and things. In this section, I look more specifically at the role of non-humans as agents of care.

Not too long ago, I came across the War Childhood Museum. The museum includes donated items that reflected children's experiences of war, such as books, toys, drawings, and all kinds of mundane and everyday things. The museum is based on the idea that our childhood memories are strongly linked to particular objects. When reading about the museum, the object that caught my eye and really moved me was a teddy bear. The object was given to a child who had lost two fingers in a grenade explosion during the Bosnian War. In the exhibition, the injured child gives an account of the role the teddy bear played in uncertain times. On the museum's website, he says 'Whenever I would hear shootings, I would curl up to the wall next to my bed and hug this teddy bear. As long as I slept with it, I felt that everything was going to be okay' ([War Childhood Museum, 2023](#)). The museum provides an account of the trauma associated with war and conflict and gives a voice to children's experiences. It is an impressive platform for understanding and peacebuilding. Yet, I could not shake the idea of this teddy bear and the role it played in that child's life. I can imagine that donating it to the museum was affirming (recognizing the individual experience) and probably simultaneously heartbreaking. Indeed, other stories from children who have now grown express the way these objects continue to play a role in the way they manage trauma. The museum and the experience of this teddy bear highlight a very simple and obvious point, but one that is not always stated in this way – objects can give people care. They can make us feel better.

Undeniably, these objects provided solace, comfort and security to children who experienced trauma. Yet, how do we understand these contributions through the lens of care? Some scholars have focused on the way things give care without even knowing (or being able to know) that they are doing it. Maria Puig de la Bellacasa (2011), for example, explores the role of soil in maintaining ecosystems and shows how humans are not alone in looking after the Earth. Rather, she notes, ‘we are in relations of mutual care’ along with worms and other organic and inorganic material (de la Bellacasa, 2017: 161). Understanding the interdependencies associated with (soil) care in this way suggests that we need to be open to the ways things other than humans make life possible. Moreover, this kind of perspective helps to see how care is always situated in material, more-than-human contexts.

This approach sees non-humans and matter as vibrant with agentic power (Bennett, 2010; Coole and Frost, 2010). Drawing on this post-humanist framing (Braidotti, 2001; 2013), in this book, I attend to the role of the more-than-human within relations of care and seek to extend understanding of who (and what) can participate in care relations. Through attunement to the non-human within networks of urban water infrastructure, I argue that non-human things play an important, active role within assemblages of urban infrastructure maintenance and repair.

Of course, within the context of infrastructure, few would deny the essential role of non-humans. The supply and delivery of clean water to cities and towns relies on pipes, pumps, reservoirs and all kinds of machinery. If you are ever in London, you can see a lot of this kind of infrastructure at the London Museum of Water and Steam. The museum displays a range of artefacts, including gigantic pumps, that have been used over almost 200 years to provide the city’s residents with water. The accomplishment of clean water, flowing out of London’s taps, is a feat of Victorian engineering that is achieved through collaboration with things. During the 20th century, water infrastructure was often associated with progress and modernism. As such, dams, hydroelectric projects, canals and water networks, and other mega-works were often celebrated. Recall William Mulholland’s opening of the Los Angeles Aqueduct in 1913: “Take it, there it is,” he proclaimed to throngs of thirsty onlookers. Yet, today, at least in most of the places where I have lived, we do not seem to celebrate public works in much the same way. Further, while we can visit these historic objects in a museum, very little of our water infrastructure is visible. Indeed, in the global north, water infrastructure is not something people generally recognize in their daily experience. Most do not think about the water distribution network unless it breaks down or is disrupted. Infrastructures are designed to be out of sight – their success is often measured by invisibility – the more successful and effective it is, the less people are aware of it. As Edwards (2017) points out, there is a tendency to hide infrastructure. It does not matter if this is

water supply, electricity, sewers or even home wiring and plumbing – we tend to put it behind walls, underground, or conceal it in some way. When working properly, the use of this infrastructure becomes normalized and taken for granted. This is sometimes referred to as being ‘black boxed’ – a concept that comes from Bruno Latour and Science and Technology Studies – meaning the way the inner workings of systems become invisible due to their success. The more efficient and effective infrastructure systems become, the more difficult it becomes to understand how they work.

According to this theory, infrastructure becomes noticeable when it fails. As Susan Leigh Star (1999: 382) highlighted, ‘when it breaks: the server is down, the bridge washes out, there is a power blackout’ – this is when we become aware of how important these unseen bits of the city can be. Steve Graham and Simon Marvin (2002) developed this idea further in their book *Splintering Urbanism*. According to Graham and Marvin, we are living in a time where infrastructures – rather than unifying places – are setting places apart. This happens through processes of deregulation, privatization and the apparent fragmentation of public services through diverse neoliberal initiatives. Indeed, in the United States and United Kingdom, long gone (or vastly displaced and marginalized) are the publicly run communications companies, television stations and transport systems. In their place is a new regime of choice and individualization delivered through a seemingly limitless collection of packages or bundles of services to meet any need, preference or consumer quirk. Conceptualized as splintered, infrastructure is thus a means to deliver inequality through the mundane activities of life. That this inequality is largely hidden – literally right in front of our noses – through water, communications, transport and other forms of infrastructure makes the project of understanding infrastructure that much more critical.

In many parts of the world, however, infrastructure is plainly visible. In Mumbai, India, for example, many have written about the daily, time-consuming and arduous efforts to access clean water. In the Mumbai settlement of Dharavi, one of the largest, most dense informal settlements in the world, water infrastructure is literally at one’s feet. Informally laid pipes course through walkways and alongside buildings, bringing water – intermittently – to parts of the city where public service is not provided. In these conditions, water is only available for a short period of the day – sometimes only an hour – and must be pumped to and collected at shared taps and access points. In Dharavi, water infrastructure is always present and never taken for granted. Even in the wealthy parts of Mumbai, water infrastructure is plainly evident, as without 24-hour service, all residents must ensure water is pumped and stored in tanks for use during the day and night.

By paying attention to water infrastructure in this way, one starts to see the role things play in the production of healthy (or non-healthy) lives. Clean water for billions of people is a human accomplishment that is realized

through collaboration with vibrant matter (Bennett, 2010). My framing through this book seeks to draw attention to this accomplishment and recognize those bits of materiality that are so central to flourishing lives.

Water work as care work

In the previous section, I suggested that objects, things and infrastructures such as pipes, pumps and reservoirs are caught up in the care assemblages that provide clear water and enable healthy lives. I want to return, for a moment, to the people involved in these networks and the relationship between those managing water systems and the people who benefit.

In my research on water infrastructure in Bristol, I wanted to see the mundane. I wanted to see how an efficient and functioning water system worked and how it was delivered to people in the city. As might be expected, it took significant effort, approvals and risk assessment form-filling to be allowed to explore parts of Bristol's water infrastructure. And even then, I was restricted to certain areas and activities. I wanted to see where my water came from, the routes it took, how it was managed, who and what cared for it, and what enabled it to get to my house. I wanted to know how my daily life was made possible through water management systems in Bristol. I found, somewhat unsurprisingly, that water suppliers in the area wanted to be known and recognized for providing a public good (that is, clean water). I saw outreach programmes and policies that sought to encourage their 'customers' to forge a relationship with them and water through particular pro-environmental behaviours such as installing low flow taps, reducing lawn watering, or limiting use of pesticides. Yet, for largely understandable safety and security reasons, they were simultaneously hesitant to make these connections (and water systems) visible. Indeed, there are very limited opportunities for people to engage with water infrastructure in Bristol. For example, reservoirs are off-limits, pipes and tunnels are securely hidden underground, and maintenance access points are unmarked, nondescript and securitized. However, I suggest that this kind of securitization and invisibility is incompatible and ill-suited to helping people forge a close relationship with water. It creates fragmentation and isolation, distancing people from the environment and the infrastructure that makes healthy lives possible. Most of us have probably seen the efforts in schools and other settings to make the links between the food on someone's plate to farms, farmers and agriculture more evident. Or programmes that map the lifecycles of things we buy from resource extraction to production, and on through recycling or landfill. But rarely do we see where our water comes from or where it goes after we use it.

Part of the problem, I argue, is that while the delivery of water is understood as a public good that is essential to life, this work is not expressed

as care. The workers I met in Bristol were invested – some enthusiastically so – in ensuring people can drink clean water and flush away sewage without the risk of disease or sickness. They conduct inspections, provide regular maintenance, and repair faults and leaks – they literally look after the infrastructural systems that make life in Bristol possible. On one infrastructure job I witnessed, a team was working on a sewage repair underneath a road in Clifton, a leafy Bristol neighbourhood not far from where I live. During the job, one of the team in the underground space felt some warm water flowing out of a pipe into the wastewater system where they were working. As the water splashed against his boots he commented, somewhat jokingly, “Someone’s having a nice warm bath.” It was a flippant comment, but at the same time, it highlighted an amazingly intimate moment. Here, the care giver and care receiver do not come into physical contact except through the flows of shared bath water. It is a disconnected experience of care, but an important one nonetheless.

The vulnerability and fragility of individual human lives – those people always in need of water – is rarely, if ever, acknowledged. I suggest that such disavowal of the vulnerability of people and their constant need for care reflects a neoliberal framing of water as a product and a service, rather than an essential component for life. Everyone has a need and a right to clean water. That it arrives at my house and flows out of my taps is an achievement that allows me and my family to be healthy and active. In this way, should we not recognize the people, things and institutions that provide clean water to the residents of Bristol as part of a care assemblage? This is, in my way of thinking, the ecology of water-care that enables flourishing life in the city.

Care assemblages

The foundation for my thinking about care is situated in the concept of ‘assemblage’, a theory generally attributed to the philosophers [Gilles Deleuze and Felix Guattari \(1987\)](#). On the one hand, the concept of assemblage brings to mind the relatively easy-to-understand, commonplace notion of a simple collection or grouping. Yet, the framing set out by Deleuze and Guattari provides a great deal more depth in terms of exploring how such collections come together, what holds them in place, and what might burst them apart. Indeed, academic scholarship has drawn on ‘assemblage thinking’ to explore a range of themes and topics ranging from the quality of public spaces ([Buser, 2018](#)) to parkour ([Mould, 2009](#)) and just about everything in-between. While there is no singular definition of assemblage in the academic lexicon, a few key themes are identifiable that set out the overarching way of thinking. Most centrally here is an understanding of assemblages as heterogeneous or mixed collections that are always in process (never static) and made up of diverse parts that are *more-than-human*. I will

quickly review these general framing concepts before looking at how the concept can be applied in the context of water security.

First, an assemblage is not a universal or singular whole but, rather, an expression of the coming together of *heterogeneous* parts. This heterogeneity signals that there is nothing inherent about an assemblage, but rather, it is a relational concept that draws on the individual elements that come together. Yet, by coming together, there is always something more, a type of emergence that forms a type of ‘relational collective’ (Sultan and Duff, 2022: 3). An assemblage, in other words, is more than the sum of its parts. Second, assemblages are never complete or fixed. Assemblages may seem stable. However, they are contingent, always under construction and deconstruction. Deleuze refers to these processes as territorializations and deterritorializations. These are the systems and routes of coordination and fragmentation that push and pull any set of relations. Language is a great example of this as there are formal rules (territorializations) that structure and constrain. Yet, these are always temporary, pushed and pulled apart by informalities, dialects and other linguistic quirks (deterritorializations) that shift how we understand and use language. This constant shifting is also sometimes described as a ‘becoming’. Third, agency, within an assemblage frame, is distributed across social and material entities. Agency, in other words, is more-than-human in that it decentres the human subject and allows action to emerge across all kinds of entities. There is a ‘thingness’ to assemblages that suggests human action is entangled in relations with both material and immaterial components.

In my community-oriented work, I have found these concepts incredibly useful to understand how people come together to work on particular challenges. For example, after completing my PhD, I spent quite a bit of time studying the use and regeneration efforts of activities working in a Bristol public space called ‘the bearpit’ (Buser, 2017; 2018). What I found was that experiences and understandings of ‘publicness’ in the bearpit was constantly shifting, being reterritorialized and territorialized along with flows of investment, crime, activism, weather, seasons, time of day (or night) and so on. One interviewee once described the bearpit as no-man’s land – a battlefield front line between the forces of capitalism (the shopping mall) and resistance (the neighbourhood of Stokes Croft). This flux (both daily and over the span of many years) reflects the plasticity of assemblage and its ability to shift or be moulded by component parts.

There has also been interesting use of assemblage thinking to understand the concept and experience of vulnerability. For example, Sultan and Duff (2022) argue that vulnerability is not a fixed property or characteristic, but rather is an assemblage, constructed by component parts in relation. While vulnerability is central to human existence, it nevertheless exists in association to and with context. This perspective challenges the idea of vulnerability as

a flaw or weakness, as I argued earlier. Rather, an assemblage approach to vulnerability sees it as a becoming that may or may not support particular outcomes (whether beneficial or otherwise).

When looking at issues of resilience or water security, thinking through assemblages helps identify the complex relations, interactions and interdependencies, as well as inequalities. Moreover, while an assemblage approach sees agency as distributed, this does not mean that all things are equal, or all component parts of an assemblage equally determine or influence particular outcomes. The importance of particular components can be understood as ‘bright objects’ – these are the parts of any assemblage that produce high levels of gravity or control. Other parts (whether they be people, things or ideas) gravitate towards them, circling into their orbit, and becoming part of the larger whole. In a traditional family relationship, a mother and father can be seen as bright objects for a young child. Interestingly, over time, the relations and interdependencies of the family assemblage generally shift and deterritorialize. At this point of my life, it certainly feels that my teenage son is the bright object, holding me within his orbit and structuring my familial engagement. At some point in the future (not too soon I hope), my son will likely move out and begin to make his own way in the world. My ability to keep him within my control or orbit with thus be further reduced.

Within the context of this book, assemblage thinking can help to see the way things such as people, weather, infrastructure, fragility and care come together to inform water security. It can help to see the bright objects that structure lives and centre our orbits. The experience of providing clean water for London’s Victorian-era residents is an excellent example of how a care assemblage works in relation to water security. The story revolves around Jon Snow, who is well known for his work researching and identifying the source of London’s deadly cholera outbreaks. Snow was an English physician who had witnessed, studied and treated cholera throughout his life. Cholera is a potentially deadly disease that is commonly transmitted in food and water that is contaminated by human faeces. However, in the mid-1850s, common thinking was that it was transmitted by rotting organic matter in the air. A series of outbreaks in London resulted in thousands of deaths with some 600 people dying during one week in 1854 (Tulchinsky, 2018). Snow investigated an outbreak located in Soho and, after extensive fieldwork and mapping, found that most of the dead lived close to the Broad Street drinking water pump. He also found evidence that the pump had been contaminated with human faeces (Daniel and Markoff, nd). Once he convinced authorities to close the pump, the cholera outbreak ended.

Jon Snow’s work in London is an example of how assemblage thinking can help identify the complexities around water security, including the

presence (or lack) of care elements. London's Victorian cholera assemblage, which would include water, pumps, faeces, maps, health knowledge and ideas about health, and disease, was territorialized around the idea that bad air produced ill-health. This idea held such sway, as a bright object, that it limited the ability to find solutions. It took a line of flight, or deterritorialization away from dogma (through the creativity and perseverance of Jon Snow) to bring new ideas and thinking. I like to think of these parts of the assemblage as machines. They work away, spinning and churning, reinforcing ways of life, culture and practice. It is difficult to force a machine to deviate from its intended purpose. So many machines churn away and plod along. Sometimes, it is necessary to unplug them and build new machines.

When I look at London's cholera story, I can see how Jon Snow used an assemblage approach without calling it so. Snow carefully and systematically explored and mapped the component parts that made up a collective (those suffering from cholera outbreaks), including their routes, built form and the urban materiality they interacted with. He found the dominant way of thinking about cholera (as a disease of the air) was not leading to a solution, rather, it was constraining and did not account for the way the disease spread. The eventual end result, the achievement of a clean and healthy water supply in London, was only possible through a deterritorialization of commonplace understandings of health and disease. I like to frame this kind of thinking as the construction of an assemblage of care where healthy, flourishing lives are enabled. Seeing water security as a care assemblage signals the importance of bright objects that dominate discourse and ways of working. Today, in the United Kingdom, water security is not understood within the frame of care, but rather, as one of commodity. I suggest that a reframing to assemblage perspectives might enable one to uncover the multiplicity of agents or actors that inform water security and flourishing lives.

Ecologies of care: an introduction

So far in this chapter I have set out some of the prevailing and innovative theories related to care. I have shown how an assemblage approach draws attention to the multiplicity of components (or machines) involved in any care practice. In this framing, the delivery of care is rarely an exclusive human-to-human exchange. While care between people may be the leading understanding of how care works, the discussion so far demonstrates how there are other ways of experiencing and constructing care. In these ways, direct person-to-person contact may not be present. Indeed, emotions are not always involved. Further, there may be a distance between care giving and receiving and the care assemblage will likely include a range of things

that facilitate any care-giving act. I refer to this as a distributed framing of care which sees care as the coming together of rich machinic assemblages. Care, in this way, is relational. It works through and with connections between machines that churn away (often out of sight) in their own way. But when they come together, when they are made visible, when we put emphasis on these little caring machines, we can see something richer – a thickness of care.

One may ask, does such a distributed understanding of care mean that care work can be found almost anywhere? Does this theory of care (with an important role for teddy bears and pipes) diminish the central feminist project and critique of patriarchal societies? As noted earlier, feminists have argued that care work is often gendered. In this, the work of care is typically done by women whose work is thus undervalued, underpaid or unpaid. Feminists have rallied to the cause of recognizing how care work is unfairly organized and have made significant (although incomplete) strides in recognizing the structural and daily inequalities that course through care work. This may be working to address the low pay and job security for the millions of cleaners and domestic workers that look after homes. Or, it may be challenging the conventional role of women as the primary care giver in the home. I am a feminist who seeks equality and justice in these areas. My intent is not to diminish these experiences or to devalue these important agendas. Yes, almost all of what is commonly recognized as care work is gendered and unequal. The care economy is framed by this emotional connection to what is often described as feminized, emotional and intimate labour. These are real inequalities based on gender.

Yet, what happens if we see the richness of care in other aspects of life? What if care really is everywhere, but it has been hidden? In my work and in this book, what I would like to do is identify how care works in some of these contexts where it is hidden and reframed, for example, as infrastructure or commodity. The broad argument I make in this book is that care has been removed from many aspects of daily life exactly because it is so undervalued and laden with assumptions about gender. If care is an ethical responsibility, that operates outside modern rationality or consumption models of behaviour, I can understand why it can be threatening. It means that if we were to recognize our responsibility for flourishing, healthy lives, it would be difficult to justify the commodification of infrastructure and water resources. I am convinced that the privatized water companies here in the United Kingdom where I live avoid language around care for exactly this reason. In media accounts, for example, water security work is often rationalized as a masculinist, neoliberal programme of engineering that serves customers. For many, to care is to recognize an emotional connection which can be at odds with neoliberalism. If care is an ethical relationship, it challenges modern and rational ideas around systems of infrastructure.

What interests me here is exposing the care that is present within these systems. I want to poke holes in masculinized framings of infrastructure and water security.

One way to do this is through ecological citizenship, a concept that has been put forward as a means to draw attention to our global responsibility that challenges conventional framings of human–environment relations (Dobson, 2007). Conventionally, citizenship has been associated with state-based rights, such as the rights connected to being British or American. Yet, as the idea connects to particular bounded territories (for example, a nation), it struggles to encapsulate most globally significant environmental challenges. Dobson’s ecological citizenship moves away from national boundaries as a frame for citizenship. In its place is our universal condition of living on Earth. Further, his ideas draw out our moral and ethical responsibility to address an injustice (for example, climate change). Countering market-oriented and neoliberal framing of pro-environmental behaviours – such as the consumerist language around water management – ecological citizenship calls upon our sense of justice as the key motivating trait. A further point of interest here is that ecological citizenship explodes the distinctions between public/private and sees what we do in the home as part of our citizenship due to the impacts of these private acts in the public realm.

In this book, I draw inspiration from Dobson’s writing about human–nature relations and see this way of moving beyond individual self-interest as central to the project of supporting water security. Further, I suggest that the blurring between public and private spheres is particularly helpful as it helps to recognize how private behaviours influence wider publics. Yet, more significantly for me, such blurring destabilizes what we might understand as a public act, which is conventionally positioned as a rational, masculine space, in contrast to the domesticity of the private. Expanding this, an ecologies of care positionality seeks to bring to light those aspects of care that are unseen or hidden in plain sight – in the public sphere.

Joan Tronto wrote that care is ‘everything that we do to maintain, continue and repair our world so that we can live in it as well as possible ... that world includes our bodies, ourselves and our environment, all of which we seek to interweave in a complex, life-sustaining web’ (1993: 103). This powerful statement identifies how care is present across a diversity of engagements with the world – from the everyday to the monumental. It signals that care is interdependent, and a condition of our existence. All too often, these interdependencies are occluded. All too often, particularly in the global north, we fail to recognize (or purposefully deny) our fragility and embeddedness in networks of care (Alum and Houston, 2020). Yet, all people need care. An ecological framing of care draws attention to the pervasiveness of care and works to

make these practices visible. Later in the book, I will highlight other ways of seeing human fragility and how people are caught up in wider ecologies. Inspiration for some of this comes from non-western worldviews such as *sumak kawsay* (an Andean philosophy) which centre on human–nature interdependencies and (commonly) non-individualist ways of being.

Care Practices in the Provision of Drinking Water

This chapter explores efforts to access and provide safe, clean and secure drinking water. The cases and discussions detail specific experiences of care and how these are made visible and invisible through policy, media and practice. In much of this work around water security, the infrastructures of care are variably visible/invisible as well as present/absent and in various states of deterioration. The chapter starts with an overview of water distribution, highlighting the extensive work undertaken to live with and through water systems. The intent is to briefly (and only partially) situate drinking water and concomitant infrastructures in our social and cultural histories. Subsequently, I narrate two contemporary examples of the challenges associated with water distribution based in Flint, Michigan (United States) and Rajasthan (India). The intent of these examples is to highlight the social and cultural aspects of water distribution focusing on the role of care in these experiences and contexts.

A brief review of drinking water systems

Water is essential for life. Humans and human civilizations depend on regular supplies of water for survival and, for thousands of years, people have clustered in settlements near freshwater rivers and streams. Early civilizations centred on rivers such as the Tigris and Euphrates, the Nile and the Indus where water was readily accessible and dependable (Altaweel and Zhuang, 2018). The Nile River, for example, was essential to the establishment and flourishing of Ancient Egyptian civilization (Bunbury, 2019). Regular flooding, which deposited nutrient-rich silt on the banks of the Nile, made it an ideal location for agriculture and cultivation. Riverbanks and delta areas of the Nile have been cultivated for thousands of years, allowing for increased populations and stable societies to take hold. For example, the city of Memphis's position at the entrance to the Nile Valley (at the head of

the delta) meant it was an important site of trade, ruling power, culture and worship for hundreds of years dating back to its founding in circa 3150 BCE (Mark, 2016). Today, the Nile remains a critically important source resource for the people of Egypt, Sudan and the other nations of the Nile basin. It is estimated that some 300 million people within 11 countries depend on the Nile waters for their livelihood (Williams, 2018). The water security challenges of these countries highlight the need for transborder river-basin collaboration and new forms of environmental citizenship. For decades, the downstream states of Egypt and Sudan have dominated use of the Nile waters (their authority over the use of Nile waters was based in colonial treaties agreed in 1929 and 1959). Yet, the status quo has been contested and upset in recent years by the demands and needs of upstream states (Abseno, 2013). Indeed, recent dam-building efforts in Ethiopia (Wheeler et al, 2020) as well as population and economic growth are linked to regional tensions and (some have indicated) an increased potential for water-based conflict (Haile et al, 2020). Of course, water distribution systems are relational. In this I mean that how we use and manage water not only impacts local communities, but always has consequences for others. As an interdependent hydrological system, the realization of water for drinking is never an accomplishment set in isolation.

Drinking water is intimately and invariably tied to infrastructure. For example, for thousands of years people have accessed groundwater from aquifers through springs or by digging wells. Archaeological evidence shows complex water supply infrastructure and management was present in the Indus Valley around 2600 BC at Mohenjo-Daro where water for drinking, baths and public use was provided through some 700 water wells (Jansen, 1989; Birx, 2006). In Ancient Rome, water came to the city and its public baths and fountains through an ambitious distribution system that connected Rome to springs and rivers in the hinterlands. The remains of Roman aqueducts found across Europe and North Africa are physical testaments to their impressive hydraulic engineering skills and the role of water in the empire. The Aqua Marcia aqueduct, for example, was 90km long, bringing water to Rome from the Anio Valley while the system at Carthage (in modern-day Tunisia) was 132km. Within Roman cities, water distribution was facilitated through clay and lead pipes that enabled ornamental and recreational fountains as well as running water in baths and toilets. Many of these ancient water systems involved sophisticated networks of infrastructural engineering that enabled life to advance and for communities to grow and flourish. They enabled and signalled prosperity, power and authority.

Today, as in ancient times, there is a critical connection between water and power. Modern New York City, for example, could not be the global city it is today and a leading financial capital without the vast water distribution network that delivers over a billion gallons of water each day.

With construction of water infrastructure such as the Croton Aqueduct in the 1840s and throughout its time of industrial upheaval and expansion, the city pushed far beyond its borders to secure water for its residents and industry (Gandy, 1997). New York City's system delivers water to 9 million people from reservoirs as far as 200km (125 miles) from the city across the Catskill region in upstate New York (NYC Gov, nd). Transborder and multi-sector cooperation is central to maintenance of the system. For example, the city's water quality is directly related to (and relies on) collaboration with landowners and the agricultural industry through initiatives such as the 'Whole Farm Program' (Muller, 2023). The programme compensates farmers who agree to implement a series of best management practices (for example, reduced pesticide use). These efforts helped the city avoid construction of a US\$6 billion filtration system while contributing to sustainability in the Catskill region (Appleton, 2002; Grolleau and McCann, 2012). The entire programme could be seen through the lexicon of care – in this case, the notion of land 'stewardship' is promoted throughout the region. Here, farming and land use best practices and techniques are promoted that are 'better' for the environment and the natural resources of the watershed. Indeed, New York City's drinking water relies on farmers *taking care*. This means looking after the land directly surrounding reservoirs as well as the larger watershed.

These brief examples demonstrate some of the ways in which water, water management and water infrastructures have been central to the establishment and formation of cities and civilizations. The control of water, for much of human history, has been associated with power and authority – the ability to make and destroy lives and places. I have always been fascinated with how cities have managed water infrastructure and places like New York City show the regional extent and critical role of the so-called hinterland to water security. Similarly, William Mulholland is well known for his role in the creation of Los Angeles' water supply system that allowed the city to grow from a small *pueblo* to the megalopolis and multicultural centre of creativity, finance and commercialism that it is today. Mulholland's controversial innovation was to bring water to Los Angeles from the Owens Valley some 375km (233 miles) from the city (talk about distanced care!).

In the examples that follow I will look at some of the social and cultural challenges associated with the provision of secure drinking water in two distinct locations. The first – Rajasthan, India – narrates a history of water that is built into the very fabric of the landscape, society and daily lives. Water in Rajasthan is scarce, with some locations receiving only a few millimetres of rainfall annually. Traditionally, in this arid place, water security was a collective and community endeavour that required an equilibrium between human activity and the local environment. However, 20th-century trends in water distribution and the emergence of 'modern' development practices

and expectations contributed to a deterioration of this relationship and a significant loss of the ancient wisdom of low impact water management. Yet, the story does not end there. Indeed, in recent years, there has been a remarkable return to traditional water conservation practices and revitalization of the lost knowledges of human–land–water care that have permeated Indian culture and spirituality for well over a thousand years.

The second example – Flint, Michigan (United States) – continues the discussion in this book about the failure or disruption of modern water systems. It centres on the role of care and care assemblages not only in the construction of drinking water systems but also in the way people respond to and live with water insecurity. While this case is not conventionally associated with climate change, it is immensely important for understanding the kinds of water distribution challenges we are likely to see in poor cities that suffer from multiple forms of disadvantage – including, as I will note, the unfortunate reality of intractable, institutional racism in public policy. Moreover, such behaviour and the institutional failures associated with Flint are likely to limit the way cities can adapt to climate change. Flint, in some ways, represents the kinds of places that are most vulnerable to the negative impacts of climate change. This could be increased heat waves, flooding or other hardships associated with global warming. That the water distribution system failed under so-called normal circumstances does not bode well for a more uncertain climatic future in disadvantaged areas of America and elsewhere.

In the cases that follow, I purposefully include examples from the global north and global south. Commonly, drinking water challenges are seen as an issue only in the poorest countries of the world. This is certainly not the case. Further, while I explore ‘what went wrong’ in both cases, I spend time examining how water security is being accomplished ‘against the odds’. In each context, water security is understood to be safe, clean and accessible drinking water. How this is realized in both cases reflects our intimate and bodily connection to water through care and caring practices. Some of the key themes that emerge from the cases include the role of women as water care givers, experiences of hybrid water citizenship, more-than-human make up of water assemblages, climate change, and the visibility/invisibility of water security.

Water security in the land of kings: Rajasthan’s cultures of water

Water culture, knowledge, management and architecture have a long and illustrious history in India.¹ Cities in the ancient civilization in the Indus

¹ Material in this section draws on work previously published in *Water Alternatives* (Buser et al, 2020a).

Valley (3000 to 1500 BC) constructed and maintained an extensive network of hydrological infrastructure including wells, reservoirs, water distribution systems and rainwater harvesting (Singh et al, 2020). Water also played an important cultural role in the Indus Valley. The Great Bath of Mohenjo-Daro is possibly the oldest example of a public water facility and was likely used for religious and spiritual purposes (Bhawan, 2018). Moreover, water and water knowledge were also common themes in many ancient Indian texts. The Vedic texts (approximately 1500 to 900 BC) refer to the spiritual role of water as well as hydrological processes and cycles in hymns and prayers (Bhawan, 2018: 9). There are also very practical discussions of infrastructure and water conservation techniques to support people in times of scarcity. In addition, the texts provide insights into hydrological processes such as condensation, evaporation, cloud formation and rainfall (Government of India, 2023). In the Hindu religion and across India, the view of water as a source of purity is a powerful part of life. For Hindus, water's sacred characteristics are often represented by flowing rivers which have the power to cleanse more than the body. Indeed, water is central to many Hindu rituals, which can include bathing in holy rivers (Sharma, 2008; Kundu, 2019; Singh et al, 2020). The most important of these, the Ganges, is a holy river that purifies by absorbing and carrying away bathers' sins. Here, spiritual care for oneself is practiced through connection to water. Unfortunately, this spirituality has not always translated into care for the waters themselves. The Ganges, sadly, is heavily contaminated by waste and sewage and is one of the most polluted and unhealthy rivers in the world.

Water security in India

While there is a great history and culture surrounding water in India, the country's water security situation is extremely challenging (Sharma et al, 2017). India is home to approximately 18 per cent of the world's population (over 1.3 billion) with only 4 per cent of the world's freshwater resources (World Bank, 2023). According to the World Resources Institute, water stress (a characteristic of the ratio of water withdrawal to available supplies) across much of India is 'extremely high' (WRI, 2023). Moreover, approximately 88 million people lack access to safe water (Water.org, 2023).

In part, these difficulties reflect India's seasonal and geographical context, when and where rains occur, and the country's reliance on groundwater. Groundwater – the water stored in aquifers that has filtered through rocks and soil – accounts for 85 per cent of India's drinking resources (Kumar, 2019). In Rajasthan, approximately 90 per cent of the state's potable water comes from groundwater (Rathore, 2005). Rainwaters are critical to groundwater recharge and India's water security, the vast majority of which falls during the monsoon rains between June and September. The seasonal nature of

rainfall means that there can be too much water (and hence flooding) at some parts of the year and not enough (with drought conditions) during other times. Further, total annual rainfall varies across the country, from 300mm in Western Rajasthan to over three metres in coastal Karavali (Centre for Science & Environment, nd). This geographic variation often means that at one moment there may be a surplus of water in some areas and a scarcity situation in others (Jain, 2019). Put simply, water is not always available where it is needed or when it is needed. Further, climate change is contributing to a more complicated and worsening water security picture due to variability and uncertainty of precipitation (including both more intense rainfall and decreased number of rain events), saline intrusion into aquifers from rising sea levels, and the melting of Himalayan glaciers, among other factors (Cronin et al, 2014).

As such, water security is a significant issue across India. For example, in Mumbai, the city struggles to provide water to all residents, particularly the approximately 60 per cent of Mumbaikars who live in informal settlements. Even for the wealthy, water is supplied for only a few hours a day which is then stored in tanks and often supplemented by other sources such as private tankers (Button, 2017). For the poorer areas of the city, residents often access water via taps shared across several households. Yet, these are known to be unreliable and are commonly supplemented through a range of alternative, often illegal, water suppliers (Graham et al, 2013; Gandy, 2014; Björkman, 2015). In 2019, the city of Chennai made the international news for a water crisis brought on by lower than expected rainfall and monsoon variability (Nigam et al, 2021). As the city's reservoirs ran dry, water was brought in trucks and trains with residents often waiting hours to collect their water rations (Srinivasan et al, 2013; Yeung et al, 2019; Xiong et al, 2020). India's water security challenges are not limited to its large cities. Drinking water supply is a major challenge in the country's rural areas where development and technological changes have led to pollution, over-extraction, and decreasing water quality and availability (Rout, 2014; Bandyopadhyay, 2016; Hutchings et al, 2016).

Recognizing the difficult water security picture in much of India, many activists and communities have begun to reintroduce and reinvigorate ancient water conservation traditions, practices and infrastructures. Much of the knowledge and practice around traditional water management fell into disuse in the 20th century as India pursued a centralized framework based on mega-projects and large-scale water redistribution (Sharma et al, 2018). An exemplification of this modern approach is the Indira Gandhi Nagar canal, which runs for almost 650km, irrigating the Thar Desert in Rajasthan with waters from the Sutlej and Beas rivers. Sometimes called the 'Lifeline of Rajasthan', the canal is credited with transforming vast areas of the state from desert to fertile, agricultural production while providing drinking water

for several districts in western Rajasthan (Government of India, 2020). The Indira Gandhi Nagar canal is an example of the modern vision of India put forward and developed in the post-independence period (Gupta, 2011: 349) and is often recognized as a great success for water security in the desert. Yet, the canal has not been without its critics who view it as contributing to the deterioration of the desert ecosystem and biodiversity (Idris et al, 2009). Researchers have noted a series of environmental impacts, including ‘water logging, deterioration in quality, soil salinity, siltation of canal by sand, water born diseases’ (Tembhurne et al, 2020: 178) which have come about as a result of construction of the canal.

Another significant impact on water security for Rajasthan has been the introduction of electric powered tube wells. In Rajasthan, tube wells began to proliferate in 1970s, leading to significant increases in irrigated areas (Birkenholtz, 2009). However, growth in their use also contributed to groundwater overdraft and decline in the quality of water in many areas of the state. Research from the Centre for Environment and Development Studies, Jaipur noted how Rajasthan’s water resources today are under significant pressure due to ‘population growth, economic expansion, decline in groundwater recharge and over-abstraction caused by the rapid increase in the number of wells and tube wells and the progress in pumping technology’ (Rathore, 2005: 4). It seems that the growth in tube-well construction has, in some ways, improved the lives of farmers and rural people. However, a consequence and cost of their use has been a decline in groundwater levels and water quality (Choubisa, 2018).

Further, some have argued that the technological changes associated with tube wells and modern water systems ‘lead to individualism and breaking down of community ties or sociality, with an overall negative impact on small farmers’ (Gupta, 2011: 350–351). The individualism associated with tube-well construction and use is sometimes contrasted to the collective forms of management often associated with traditional water conservation practices. Often these arguments are coupled with critiques of the modern vision of water distribution, which are typically represented by the mega-hydro projects which have not fully delivered water security to India. Future, changes to the region’s climate are likely to exacerbate these trends and challenges.

Yet, while India, like many other parts of the world, has significant water challenges, the country is home to a great deal of experience in sustainable water management and conservation, and has a rich cultural frame and reverence for water. This context is one that is based in spirituality and care. I now turn to a closer discussion of the water contexts and practices in Rajasthan. This includes a short review of trends in water systems and a focus on a small village project where we studied the reintroduction of traditional water conservation practices.

The death and life of rainwater harvesting at the desert's edge

The Indian state of Rajasthan covers over 300,000 square kilometres and is home to almost 70 million people. The central geographic features are the Thar Desert and the Aravalli mountain range. The Aravalli range runs northeast–southwest and bisects Rajasthan into two distinct water environments. East of the range, there is more precipitation, humidity, rivers and a high level of agriculture and land productivity. The western part of Rajasthan is arid and semi-arid, consisting of sand and sparse vegetation and includes the vast Thar Desert. Annual rainfall in this part of the state can be as low as 10cm. The main river in this area – the Luni – carries water only for a few weeks of the year during the monsoon (GoI, 2019; 2020). Through its history, such limited water resources have contributed to low-density, rural lifestyles based on water conservation and careful water management. In this context, rainfall plays a particularly important role in the survival and livelihood of people living in this arid region. Indeed, rainwater has been harvested and stored in Rajasthan and other parts of India for thousands of years. Essentially, rainwater harvesting structures capture and store rainfall runoff. They can be extremely simple, as in the percolation ponds and contour trenches generally used for groundwater recharge. However, even these modest technologies can be effective ways of ensuring water security during extended dry periods. Critically, these water management approaches are specific to local conditions and reflect intimate knowledge of local environments based on practical, hands-on lived experience (Sharma et al, 2018). Commonly, they are also embedded in community-oriented management systems that ensure fair and equitable access and maintenance protocols across local beneficiaries.

The historical importance of water is also reflected in the architecture and design in the state's main cities. For example, Jaipur – the *pink city* – includes the picturesque Jal Mahal or water palace. Built in the 1700s as a royal hunting retreat, the palace sits within the Man Sagar Lake, an artificially constructed lake that historically had provided drinking water to the area. After almost two centuries of neglect, the palace and lake have been the focus of extensive renovation and remediation efforts that are bringing the site back to its former glory and status. The desert city of Jodhpur – known as the *blue city* – includes many water harvesting structures including stepwells and artificial lakes dating back several hundred years (Thilak, 2019).

Through the centuries, people in Rajasthan have developed robust water management tools and mechanisms and resilience to live in the dry environment. Anyone who has visited this part of the world will recognize the monumental stepwells as some of the most notable architectural features of Rajasthan. These structures are found in many parts of the state but are particularly common along the Aravalli range. Stepwells are deep

structures – sometimes nine stories deep – lined with stone and steps that provide access to water. One of the most famous of these – the Chand Baori – dates back to the 8th century and was constructed both as a site to conserve water as well as for social gathering and assembly. Many, such as the Queen’s Stepwell (or Raniji ki Baori) in Bundi, include ornamental sculptures and engravings of Hindu gods (Chabra, nd). Stepwells were tremendously important spaces that brought together sociality, faith, architecture, art and water conservation. Yet, in Rajasthan, as in much of India, most of these fell into disuse during the period of British colonialism. Moreover, after independence in 1947, much of the ancient wisdom and knowledge of water conservation in India fell out of favour in the context of the country’s modernization programme that focused on large distribution networks, dams and other hydro projects. Today, while some stepwells have been rehabilitated as tourist sites and spaces of contemplation, they are rarely used for water conservation. During my visits to Rajasthan, we often came upon these sites. None of the stepwells we saw were active. Yet, they still provide a physical connection – a mnemonic– that is quite magical. They provide clues about different ways of life and different ways of living with the environment.

Care played an important role in the maintenance and upkeep of these local infrastructures. For example, beneficiaries of water reservoirs would organize a community-wide clean-up of the catchment area before the monsoon season. This community-oriented management of resources and infrastructure is a common thread across many traditional water systems. It highlights how intimate connections to water infrastructure can be forged when the role these technologies play is clearly visible. The visibility of infrastructure draws our attention to it. Most often in the global north, visible infrastructure is broken infrastructure. In other words, we only truly see it when it malfunctions. In many parts of India, infrastructure is almost always visible. The traditional water systems are not visible because they are broken. Rather, they are celebrated and decorated. The stepwells were grand public works projects that brought communities together. They made up part of the system of local health and wellbeing, providing clean and secure water for the local population. The stepwells of Rajasthan show the reciprocity of care needed around water security. In this way, people care for the ‘thing’ through maintenance and careful practices (for example, removing shoes) and, in return, clean water is provided for drinking and agriculture. Water infrastructures are thus a part of life and part of a narrative that positions people within their built and natural environments.

Following a long period of decline, since the 1990s there has been renewed interest in traditional and small-scale water management technologies. Indeed, there is a powerful narrative of lost knowledge and traditions associated with rainwater harvesting. This includes not only the ability

to carefully manage limited water resources, but also the associated small-scale and collectivist cultures and lifestyles. Books such as *Man in the Desert* (Bharara, 1999) and *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems* (Anil and Narain, 1997) describe the ancient ways of India's rainwater harvesting history and culture and argued for the return to these systems. One of the key figures of this movement is Rajendra Singh, commonly known as the 'water man of India' due to his extensive work supporting water conservation and revitalization of rainwater harvesting infrastructure and practices (Das, 2015). As leader of Tarun Bharat Sangh, Mr Singh has supported water security in rural villages across Rajasthan and other parts of India through advocacy (for example, for local river catchment management and protection) and the construction of rainwater harvesting infrastructure such as *johads* – earthen dams that contribute to groundwater recharge (Sebastian, 2001). Across Rajasthan and India, rainwater harvesting has become an important part of addressing water insecurity, with many non-government organizations (NGOs) and communities actively involved in rebuilding the knowledge and infrastructures of traditional water conservation. In the next section I reflect on the experiences of a village in rural Rajasthan where rainwater harvesting, after years of neglect, has returned as a significant component of local water security.

Jal: cultures of water

Not too long ago, I was able to see these practices first-hand. In 2018, I took part in a project investigating the role of rainwater conservation practices and infrastructures in Rajasthan. In this section, I draw on material from this research project funded by the Arts and Humanities Research Council in the United Kingdom and a paper we published in *Water Alternatives* (Buser et al, 2020a). The research was interdisciplinary and community focused. Our team was a collaboration of United Kingdom and India-based academics, rural development experts, artists, historians and NGO representatives involved in rural water management. Our lead partner, the Centre for Environment and Development Studies (based in Jaipur), had worked for several years on water issues with communities across Rajasthan and organized a series of outreach efforts for the team. We collaborated with Ramkrishan Jaidayal Dalmia Seva Sansthan, an NGO that had conducted extensive water conservation advocacy and implementation in the Shekhawati region of the state. We centred our activities and study in the village of Jhakhoda in the Jhunjhunu district. In this village, the public supply of water was deteriorating both in terms of quality and quantity. Each year, the water table in this area is falling, making groundwater extraction more difficult. Further, Ramkrishan Jaidayal Dalmia Seva Sansthan indicated that the lower water table was making the water more likely to be polluted with high levels

of fluoride. Excessive fluoride in drinking water can contribute to dental fluorosis (which was clearly visible in residents), arthritis and other human health challenges (Solanki et al, 2022).

The objectives of our work in Jhakhoda were to learn more about water conservation in the area and to explore the role of art and creative practices to support the wellbeing of people in the village. Working with Indian artists, we developed two small projects through which we could investigate water conservation and contribute to the local narratives around water security and conservation. The first project was called *Jal: Telling It Together* and involved mural painting in the local vernacular. It was led Indian artist and storyteller, Nina Sabnani. Project artists combined the Shekhawati and Phad painting styles to produce a 10' by 22' mural on a school building in the village centre. The mural (and an associated canvas scroll called a *phad*) provide a history of water use in Jhakhoda through the last 100 years, covering its traditional methods, the modernization period (and loss of this wisdom), their reintroduction in recent years, and a flourishing future of environmental and social sustainability. The four panels of the mural tell a common story. The story starts with a traditional way of life where people lived simply and were in balance with nature. Modernization and development challenges these ideals and brings about development, speed, mobility, and social and cultural change. The environmental impacts are tragic. The village can only be rescued by returning to a sensitive and reciprocal care-oriented understanding of its position in the environment. I have found versions of this story across much of my research where people argue that we must find ways to recapture what we knew regarding our place in the natural world before modernism and western-style development took hold.

The second village project element was called *Water Detectives* and brought school children and their families together through puppetry to explore and tell the stories of water. This component was led by Anurupa Roy, a puppeteer and founder of Katkatha Puppet Arts Trust, an applied puppetry collective that explores critical social issues through performance. The *Water Detectives* engaged around 30 children from Grades 6, 7, 8, 9 and 11, encouraging them to examine their relationship with water through songs, folklore and rituals. The children also worked as detectives and gathered stories from village elders about village life before modernization and public water. One of the stories, called 'worshiping the well', became the focus point of the puppetry performance. In this story, the goddess of the well brings good luck and wellbeing to a disparaged sister who prays and shows respect to the well, water and the deity. People today continue to 'worship the well' yet few remembered the story the elder told and that made its way into the children's performance.

The arts projects in Jhakhoda provide some interesting points of departure for understanding water security in modern times. For example, we found

that through storytelling and by drawing on local social and cultural resources, people can begin to see more clearly how water management is part of their lives and, most critically, how they can participate in changing practices. Our stories brought out the technological and the mystical in a challenge to the modern form of rationality that tends to dominate water security discussions. People in these stories draw on their sense of environmental belonging and the intimate connections between water and human beings. This kind of framing suggests that people are in a reciprocal relationship with water – more like *caretakers* than users or consumers. My experience in Rajasthan suggests that people can rebuild the traditional forms of living that bring them in close proximity to their water resources. Further, this does not have to be at the expense of modern ‘luxuries’. Rather, it suggests a form of hybridity that respects alternative, non-linear framings of how we live in the world.

The Flint Water Crisis

In October 2014, a General Motors (GM) engine plant in Flint stopped using the city’s public water for its manufacturing processes. The water, it realized, was so corrosive it was damaging parts and even rusting engine blocks (Colias, 2016). After a few attempts to eliminate these corrosive qualities, GM switched its water provider from the city to Flint Township – a neighbouring municipality which still accessed water from Lake Huron (Craft-Blacksheare, 2019). At the same time, Flint residents were complaining about the colour, taste and smell of their water but, unlike GM, were not able to switch to another source. While local officials reassured residents that the water was safe to drink, residents complained of a range of ill-health symptoms such as rashes and hair loss and later some experienced outbreaks of Legionnaires’ disease due to bacteria in the water (which is said to have killed at least 12 people). There was also evidence found of increased levels of lead in the bloodstream of children living in Flint (Hanna-Attisha et al, 2016).

The Flint Water Crisis was the outcome of the intersection of many local and non-local factors. These include specific managerial and technical faults associated with the water infrastructural system, the politics and impacts of austerity in Flint, Michigan (and in local government more widely), deindustrialization and wider processes of globalization and mobile capital associated with the automobile industry as well as racial segregation, depopulation and White flight (Pauli, 2020). It is also clear that the crisis was a result of structural racism. Structural racism is part of a dynamic process that reproduces inequality over time, often through the institutions and organizations that make up daily life such as healthcare, housing, transportation and so on (Hammer, 2019). These processes are

evident when looking at the Flint Water Crisis, how the crisis was handled, and the experiences of those who have suffered the worst consequences of these events. These are issues that are, of course, directly relevant to how communities are (and will be) managing climate change in the next years and decades. Furthermore, while not a direct result of climate change, I argue that the Flint Water Crisis is a consequence of a breakdown of care. As such, it provides a useful lens through which to see issues associated with water security, vulnerability and environmental justice, which are critical to understanding climate change adaptation.

Morckel (2017) has argued that the Flint Water Crisis reflects a lack of care for shrinking cities. Shrinking cities are generally found in those parts of the world where demographic, social and economic conditions push people away. The result can be that these cities are left with decaying infrastructure built for larger populations as well as specific demographic challenges (for example, high levels of poverty, ageing society, diminishing tax bases). I certainly agree with Morckel's assessment but I want to take the care perspective a bit further. In this section, I will explore how care courses through the entirety of the Flint Water Crisis, and this will include the caring role of 'water gatherers', parents, activists, healthcare workers, scientists, water managers and politicians (among others). The lack of care evidenced by politicians and water managers has been well documented. Yet, I also suggest that the Flint case works as a particularly informative example of more-than-human care and the role of 'things' in water management and water crises. Together, these framings help see the interactions and interdependencies between water and multiple forms of care.

The shrinking of Flint

Flint is a shrinking city. Its population is less than half of what it was in 1960. Today, it is also a majority non-White city. In 1960, Flint's White population was well over 160,000. The figure today is closer to 35,000, while Black residents make up almost 60 per cent of the city's population (US Census, 2022). Flint is a poor city with almost 40 per cent of its population estimated to be in poverty. These trends are embedded in a dynamic, structural process of (post)industrialization that both 'made' Flint into an automobile manufacturing powerhouse in the mid-20th century and today's shrinking city of declining revenue, low employment, abandonment and austerity.

The concept of *shrinking cities* generally refers to those places that are experiencing both population and economic decline. The causes of this decline are varied but generally are attributed to shifts in global economic processes (for example, deindustrialization), regional development patterns such as suburban growth, and demographics – particularly lower birth rates and the ageing of society (Buffell et al, 2012; Döringer et al, 2020). Research

on shrinking cities emerged in the 1980s in East Germany where many cities were experiencing decline in the post-reunification period. Today, other parts of Europe are experiencing similar issues. In fact, you can buy entire Italian villages on some property websites. In the United States, population growth, while still increasing, is slowing. More and more of this growth is coming from immigration, as birth rates slow and society ages. In some parts of the United States (for example, Florida, Texas and North Carolina), cities are still growing quite fast. However, many American regions, cities and towns – including those in the so-called ‘rust belt’ – are experiencing significant population and economic decline.

One of the central challenges facing shrinking cities involves infrastructure. These cities often have extensive infrastructural systems, designed for peak population growth during times of expansion. Traditional infrastructural services such as water and sewage systems, transport and communications are commonly designed to facilitate future growth and the potential for increased demand. As such, they are often constructed with excess capacity. For example, Flint’s water distribution system was expanded regularly during the city’s heyday with the expectation that population growth would continue far into the future (Pauli, 2019). Further, large infrastructure systems are often inflexible and can be difficult to adapt to the changing circumstances associated with shrinking cities. As a result, costs per resident or household can rise significantly. In part, this is because the costs of maintaining the system generally remain the same even when the number of users is reduced. The costs of running infrastructure, in other words, are generally fixed, even if fewer people are using the service. Further, in American cities, declining populations mean reduced tax income to the city – the number of households and businesses paying for public services such as water. The reduced tax base places further pressure on the city to raise rates, cut costs where possible (for example, jobs) and reduce service, all of which can further exacerbate depopulation trends as people and businesses look for more affordable and competitive places to live and work.

Flint is a prime example of a post-industrial shrinking city. Since the 1960s, the city has experienced continual decline in terms of unemployment, depopulation, reduced tax base and other ill-effects of deindustrialization. This decline is commonly attributed to the downsizing of GM in Flint and regional development and migration patterns away from urban centres (Pallagst et al, 2017). The Flint Water Crisis is situated within this dynamic context of deindustrialization, depopulation, White flight and decline of the city. By the 2010s, Flint was in financial trouble as debts and costs regularly exceeded income. According to Michigan state law, in these circumstances, the governor is allowed to appoint an Emergency Manager who then replaces local officials in public service management activities and decisions. Notably, most Emergency Managers in Michigan have been appointed in majority

Black cities, raising concerns that it is a racially influenced and unequal form of city governance (Pauli, 2020). In Flint, Emergency Managers controlled city finances roughly from 2011 to 2015. As public finance managers responsible to the state of Michigan (rather than the local population of Flint), the managers oversaw an austerity programme of cost-cutting and service reduction to reduce the city's financial debt (Nickels et al, 2020). Examples of austerity measures included eliminating (firing) staff, reducing salaries and pensions, and raising the fees for water services. All of this was done to address and improve the city's financial troubles (Fasenfest, 2019).

One of these cost-saving efforts was to end the city's reliance on the Detroit Water and Sewerage Department (DWSD), which used water from Lake Huron. On 25 April 2014, the city switched to the Flint River as its water source in the hopes of saving approximately US\$5 million (Roy and Edwards, 2019a). The plan was that this change would be temporary until a new pipeline was constructed to Lake Huron (the pipeline was not built and Flint was eventually forced to return to the DWSD). However, not long after the switch to the river, it was clear that something was wrong with Flint's water. Residents began complaining about the changes they saw, smelt and tasted in the water coming from their taps. There are many accounts of residents experiencing rashes, hair loss, bone and muscle pain, lethargy, tooth decay and more (Pauli, 2019).

By the summer of that year, resident activist groups were protesting and calling for a return to the DWSD, blaming the city's switch to the Flint River water for a variety of health symptoms. Meanwhile, city and government officials argued that the water was safe to drink. Nevertheless, many residents began using bottled water for drinking, cleaning, cooking and showering. Through much of 2014, residents continued to push the city to recognize and address the water crisis, although with very little progress. Eventually, residents found support for their cause in the form of individuals who would help draw national attention to the crisis. One key figure in this regard was Dr Mona Hanna-Attisha, a paediatrician who became concerned about the quality of Flint's water after identifying unusual health symptoms in her patients. Dr Hanna-Attisha went on to investigate and document increased levels of lead in young children living in Flint and has gone on to testify to US Congress as well as present and publish her experiences and research on water quality and water injustices in Flint (Hanna-Attisha, 2019).

Another central figure in uncovering the extent of the water contamination was Professor Marc Edwards from Virginia Tech (Roy and Edwards, 2019b; Flint Water Study, 2023). Edwards had previously uncovered extensive water contamination in Washington, DC where residents were exposed to high levels of lead for several years. Professor Edwards and his colleagues conducted testing on Flint's water and found that it exceeded national and international standards for potable water. The Virginia Tech team got involved after an

invitation by Flint resident LeeAnne Walters. Ms Walters and her family had been experiencing hair loss, rashes and other unexplained symptoms, such as lethargy, since the switch to the Flint River. After months of research and testing, the Virginia Tech research produced evidence that the water was contaminated with lead.

Lead is harmful to humans and has been shown to negatively impact brain development and central nervous symptoms. Tragically, the developmental effects of lead on children – such as reduced IQ and behaviour disorders – are understood to be irreversible. In this way, the harm done from the water crisis was not only to the immediate health of individuals, but to the prospects and future potential of children across the city. In the United States, lead is present in many older water infrastructure systems. This includes water service lines, pipes, components and even fixtures such as faucets in the home (Roy and Edwards, 2019a). There are literally millions of miles of lead service lines still in use in the United States, servicing millions of people (Cornwell et al, 2016).

Many of the service lines that bring water to homes in Flint were constructed with lead. Previously, this had not led to increased lead as the DWSD had the appropriate corrosion controls in place for the water from Lake Huron. However, when the city switched to the Flint River, officials did not account for the corrosive impacts this would have on the city's lead pipes. Corrosion control is required by the US government to limit exposure to lead in water systems. In some cases, this is accomplished by adding orthophosphate to water distribution systems. Orthophosphate is a chemical corrosion inhibitor that is added to water in cities across the United States to prevent lead from leaching into the system. It provides a type of protective coating that ensures lead does not escape into drinking water sources as it is delivered to homes, businesses, families and children. Without this protective ingredient, the Flint River began eroding the pipes and releasing lead into the water supply. Unfortunately, the corrosion also enabled the growth of bacteria, which contributed to an outbreak of Legionnaires' disease that resulted in the deaths of at least 12 people. The failures of corrosion control have been identified as perhaps the most critical technical fault of the switch to the Flint River that led to contamination and the local health impacts.

The research from Virginia Tech, along with Dr Hanna-Attisha's investigation, was instrumental in pressuring and persuading officials to declare a health emergency and begin addressing the problem (Donnelly, 2019). In December 2015, the city finally recognized the extent of lead contamination and advised residents not to drink the city's water. Bottled water distribution centres for residents were set up across the city. The Flint Water Crisis is part of an ongoing tragedy. While lead pipes are being replaced in Flint (Fonger, 2021), they remain part of the water distribution network for many cities in the United States and elsewhere. Further, the political,

historic and structural challenges that contributed to the crisis have not gone away. Of course, the lead contamination will go on to impact the families of those who experienced tragic deaths and the children whose long-term development was affected.

Reflections on care in the Flint Water Crisis

In this section, I want to draw out some of the ways the Flint Water Crisis reflects interconnected notions of care and fragility in modern societies. Account after account from newspaper reports, documentaries and blogs as well as academic articles and books on the Flint Water Crisis call attention to the impact contamination had on families and, in particular, on children. In his book on the crisis, Benjamin Pauli highlights the ‘intimate character of the harms caused by contaminated water’ (2019: 218). He points out that the water contamination in Flint was essentially a domestic crisis and, as such, mothers became central activists leading the charge for clean water. If you watch almost any television news story or documentary on the crisis you will likely see parents (most often mothers) talking about their children’s symptoms, often from the kitchen or other domestic spaces. You will also likely see mothers facing off with government officials at public events demanding their right to clean, safe water. For Flint residents, as the crisis went on, the rhythm of daily life changed dramatically. No longer could something like cooking, brushing teeth, showering or bathing an infant child be taken for granted. These were now hazards and even possibly life-threatening activities. With tap water unsafe, residents were forced to obtain bottled water from distribution sites around the city. The trek across the city to access clean water for families became part of a new daily routine and a new hardship that landed largely on mothers.

While there has been an increase in the percentage of men participating in daily care routines, women remain the principal carers in the home. Across the world, it is estimated that women account for some 75 per cent of unpaid domestic care work (Power, 2020). As such, women often take on most of the responsibility related to managing the household impacts of water contamination events (Pauli, 2019). In Flint, it was women and mothers who were the most directly impacted in terms of their responsibility as carers and care givers. Domestic work has long been understood and described as a care practice. The work of looking after families, cleaning and managing a household takes effort.

If one examines the media surrounding Flint, in addition to narrating the tragedy unfolding, one strong message was how residents were providing a healthy existence for loved ones. In the media, residents – mostly women – were pictured making special trips to acquire clean water, bathing children in bottled water and, of course, protesting and advocating for change. The

Flint Water Crisis shows the gendered nature of (domestic) care practices, and the intersection between the care for loved ones and resilience. This is a critical lesson related to water security – resilience around water security is largely a gendered and domestic practice. Environmental change associated with global warming is likely to put more burdens on women and further exacerbate gender inequalities.

As discussed earlier, the city of Flint has experienced decades of population and economic decline. Among other challenges, it is one of the poorest cities in the United States, with high unemployment and crime, an inadequate public education system and limited prospects for healthy eating. [Morckel \(2017\)](#) noted that, at the time of the crisis, there was not even a major supermarket within the city. Yet, concern for Flint only emerged in a significant way once the lead poisoning crisis was exposed. One might ask, why is it acceptable for places like this to exist in these conditions? Flint is not alone as a declining city. Rather, the type of splintering, exclusions and geographic divisions are sadly commonplace. The crisis in Flint was situated in a very local failure. Yet, it is also framed by numerous structural processes – globalization, deindustrialization, regional sprawl, racism, and so on. The lack of care for places like this and the lack of a shared (global) responsibility points to a failure to see our place as co-inhabitants on Earth.

From an exclusively technical perspective, the Flint Water Crisis was the outcome of poor maintenance and management of the city's water distribution system. Reports and studies about the crisis note that people involved lacked the maintenance and repair expertise needed and made avoidable errors. Eliminating the disastrous decision to switch water sources, all infrastructure requires regular maintenance and upkeep. This is meticulous and often boring work that involves inspections, cleaning, repair and renewal of the things that keep cities running. There is a growing body of research that sees the work of maintenance and repair as a care practice. In my research, I argued that people doing this kind of activity (often working underground and out of sight) are taking care of things that have impact on people's lives ([Buser and Boyer, 2021](#)). Clearly, there was a deficiency and breakdown in the system of care. In part, this reflects what happens to care under austerity – care in public services needs to be compensated. Healthcare professionals do not work for free. And, if they are underpaid, overworked and stressed, mistakes are more likely to happen and the quality of care may diminish. The same goes for those who care for infrastructural systems. As with my discussion of Rajasthan, water systems are fragile and require regular and systemic care.

However, there is another way to look at infrastructural care. While people must care for infrastructure through regular maintenance and upkeep, these 'things' also provide critical care services. I found the story of orthophosphates to be particularly revealing of the role of non-human

things in care assemblages. It shows how human lives are entangled with the qualities and capacities of so many ‘things’ like pipes and pumps but also chemicals. These things do not have emotional capacities but have an affective capacity. This framing draws on recent geographical engagement with the notion of affect and authors who have explored the non-cognitive make up of interactions (Thien, 2005; Anderson, 2006). Often inspired by the philosophy of Gilles Deleuze, contemporary geographical takes stress affect’s capacity – its potential – that works in relation to other bodies (Pile, 2010; McCormack, 2014). Affect has also been described as a way of understanding what bodies do, how they interact (Schaefer, 2019) or simply ‘an ability to affect or be affected’ (Shouse, 2005: np). The chemicals in Flint’s water supply clearly do not have an emotional component. Yet, there is something strongly affective here. Orthophosphate has an affinity for the surface of metal pipes (a particular way of relating to/affecting metal). In Flint, without the orthophosphate in the water supply, lead was released from the pipes and exposed people to contamination (Roy et al, 2019). The example shows quite clearly how things are critical components in caring systems and have important roles to play in keeping us safe.

Of course, conversely, it could be argued that the authorities and individuals in Flint, who switched the water supply, lacked attention to care. Their concern was for budgets and fiscal policy – which trumped the potential impacts on the wellbeing of people who were likely to drink the water. The situation was made worse when officials denied the severity of the situation (which resulted in criminal prosecutions). Water managers and policy makers in Flint had a duty of care – that they ignored. I suggest that the lack of visibility and attention to the interdependencies that make up water security provides a buffer, almost a disavowal or negation of care. Failure in Flint, in other words, is often presented as a technical or managerial failure. However, I argue that it is a failure of care. It is a failure to signpost the caring practice of providing clean drinking water. It is also a failure to recognize that there are fragilities all along the way. Those of us interested in and involved in water security must see the emotional and life-sustaining components in water distribution. These should be central to our understanding and to the practice of water management. Thus, water management is reframed as a care practice and not as the more commonly presented western framing as commodity and technical-managerial, rational, transaction.

A dialogue on drinking water and care

Water for drinking relies on an ecology of agents and actors – people and things that reflect our social and cultural relationship with water. In Rajasthan water is precious, rare, erratic and fragile. As such, it has been celebrated through history in art, culture and religion, and architecture. In the western

setting, water is more commonly framed by a customer–client relation. Distances (physical and symbolic) make it difficult to see the connections.

The challenges of water security are not limited to cities and locales in the global south. In this chapter, I purposefully included examples from both the global north and global south. Commonly, drinking water challenges are seen as an issue only in the poorest countries of the world. This is certainly not the case. In each context, water security is understood to be safe, clean and accessible drinking water. Yet, how this is realized in both cases reflects our intimate and bodily connection to water through care and caring practices. Some of the key themes that emerge from these discussions include the role of women as water care givers, experiences of hybrid water citizenship, more-than-human make up of water assemblages, and the visibility/invisibility of water security through techno-managerial water practices. Finally, I am most struck by the issue of absence – the absence care and care agents, such as the orthophosphates that are so integral to living healthy, flourishing lives.

The Water–Land Interface: Care in the Face of Coastal Change

This chapter focuses on the challenges associated with coastal change. In the first part, I review some of the relations and associated challenges between climate change and coastal processes. In that section, I highlight some of the urgency around these issues and how coastal communities are starting to plan for uncertain futures. The chapter includes longer discussions of two cases. The first, Ban Khun Samut Chin, is located outside of Bangkok, Thailand and has experienced such extreme coastal erosion that some residents have relocated their homes three or four times over the past few decades. The second case draws attention to planning for the future of sea level rise in the village of Fairbourne, Wales. In this example, the threat of future inundation has led to plans to abandon the village.

Coastal processes and the impacts of climate change on coastal communities

The coast – where land and sea come together and interact – is an area of dynamic environmental change. It is much more than what we commonly understand as the shoreline or, in everyday parlance, the beach. The coastal zone is a wide area that encompasses the ‘landward limit of marine influence and the seaward limit of terrestrial influence’ (Haslett, 2016: 3). This encompasses not only beaches and dunes, but the entire coastal plain which can stretch inland for miles in some places. The coastal zone also reaches out to sea and includes the underwater areas of the shore (Haslett, 2016).

Coasts are not fixed, but instead undergo constant transformation through the interaction of waves and tides which contribute to erosion, sediment transport and deposition. However, these processes and transformations can be intensified by high winds, storms and storm surge events. At the start of this book, I narrated the experiences of coastal change at Hallsands

village. Today, these ruins are powerful reminders of the precarity of life on the coast. However, coastal change is not limited to erosion and land loss. Take, for example, another site in Great Britain – Harlech Castle in west Wales. Harlech Castle, like many medieval fortresses, was positioned at a strategic location near water. Indeed, the coastal location on the Irish Sea and Cardigan Bay allowed the castle to be supplied by water in times of siege via a water gate and a 100-step staircase that led down to the water. Yet, if you go visit Harlech Castle, there is no water. In fact, over several centuries, this area of the Welsh coast filled in via sedimentation. Today, if you stand on the walls of Harlech Castle you will see Cardigan Bay and waves lapping at the beach almost one kilometre away (Bachelor, 2023). Harlech and Hallsands are both part of the British coast and tell the same story – the story of coastal change, disruption and energy transfer – through different experiences and outcomes. What may look like stability is, in actuality, a temporary state. Dynamism, ephemerality and change are all characteristics of the coast. However, coastal areas around the world are often treated as permanent and static forms. We build homes, communities and industry on the coast. Of course, they are also important areas for leisure, relaxation and sport.

Many of the world's largest cities are located on the coast. Globally, almost one quarter of the world population lives within 100km of the coast (Masselink and Gehrels, 2014; 2015). According to recent research, there are over one billion people living in areas at serious risk from sea level rise (MacManus et al, 2021). Further, cities along the coast are not only some of the largest, but they are also some of the fastest growing. For example, Myrtle Beach, South Carolina, located along the Atlantic coast of the United States, added over 120,000 people since 2010 (Stebbins, 2021) and most of the other fastest growing cities in the United States are located along the coast. Furthermore, large coastal cities, looking to take advantage of growth and development opportunities, have actually grown outwards into the coastal zone. New York's Battery Park City was built in the 1970s and 1980s on landfill (made up of material extracted during construction of the World Trade Center) and is now home to some 40,000 people. Boston's Back Bay was literally a tidal bay that, today, includes some of the most desirable and expensive addresses in the city. When controlled by the British in the 17th century, Mumbai (then Bombay) consisted of seven scattered islands extending into the Arabian Sea. Over the next 150 years, embankment and reclamation projects connected the islands and enabled growth of the city. Today, the Mumbai metropolitan area is home to some 20 million people, many of whom live in extremely high densities in flood-prone parts of the city. In these and many other coastal cities, what looks and feels like solid ground hides a history of infill, reclamation and modernist approaches to land-water management. Unfortunately for those living in these areas,

flooding and other challenges serve as reminders that these areas are still part of dynamic coastal processes.

Moreover, whether the land is reclaimed or not, climate change will have serious consequences for people living in the coastal zone (Suskind 2010). Most critical here is that by the end of the century it is expected that we will see anywhere from a one- to two-metre rise in sea level. This sea level rise is occurring due to a combination of thermal expansion (which will continue even if we eliminated fossil fuel use today) and glacial melting. Moreover, warmer temperatures are also altering the severity and variability of storms (Masselink and Gehrels, 2014; 2015). We also know that the impacts will vary from place to place as processes such as sea level rise are not uniform across the globe. Indeed, some areas, such as coasts in the Baltic Sea, are not expected to see significant changes in sea level rise. In the case of the Baltics, the increase in sea level is being offset by land rise (a result of post-glacial rebound). It is expected that differences in sea level rise across regions will be exacerbated in the future (NASA, 2015), with some places being more impacted than others.

These challenges are further complicated by issues of global inequality. For example, of the top 20 largest cities exposed to coastal flooding, 17 of these are located in the global south (Nicholls et al, 2007). Further, a great deal of those living in coastal areas are considered vulnerable, with some 14 per cent of the population in least developed nations inhabiting areas less than ten metres above sea level (O'Neill et al, 2016). This lower elevation area can be particularly susceptible to storm surges, flooding from tides and other ocean processes. Again, the effects of climate change will worsen these conditions and trends. Broadly speaking, high levels of urbanization and development are at odds with what we know about the dynamism and ephemerality of the coast. Moreover, the coastal communities most likely to be adversely impacted by climate change are those with relatively fewer resources and the adaptive capacities needed to manage long-term environmental shifts.

The Venice of Africa

The experience of Makoko in Lagos, Nigeria provides a useful lens for understanding the complexity of coastal urbanization, climate change and precarity. In Africa, approximately 25 per cent of the population lives within 100km of the coast. Those living in these areas are often living in hazardous areas, vulnerable to storm surges and flooding – made worse by rising sea levels. Lagos is a low-lying delta city with a population of around 15 million. The city is fast-growing and, by 2100, some 60 to 100 million people are likely to call Lagos home (Hoornweg and Pope, 2017). Approximately two-thirds of the metropolitan population in Lagos live in informal settlements, which are often situated in environmental hazard areas (Ogunlesi, 2016).

Set along the shores of the Gulf of Guinea and Lagos Lagoon, much of the city already suffers from regular coastal flooding (Olajide and Lawanson, 2014). Makoko, a densely populated informal–coastal settlement whose residents work in fishing and boating industries, is one such area. The settlement is literally built on top of the Lagos Lagoon. Sometimes called the ‘Venice of Africa’, homes and structures for many of Makoko’s 100,000 people are built on stilts and residents move through the area on small boats and canoes. Infrastructure in Makoko is limited, with no access to public services such as sewage and potable water. As such, life in the area is precarious and can be difficult. Recently, Makoko has become known for its role at the centre of an urban renewal programme that has meant forced evictions and demolition of structures (Amakihe, 2017). These evictions are often justified in terms of public health and safety – removing people from vulnerable and hazardous living conditions (in addition to inadequate infrastructure, Makoko is below sea level and faces significant flood risk). However, many demolished areas have been redeveloped for private development and condominiums. While informal communities in Lagos suffer from inadequate infrastructure as well as state–led dislocation and violence, other areas of the city are being developed as high–end centres of finance and tourism. Typical of global city development models, these investment areas, built on infill and reclaimed land, have been prioritized for flood protection through a range of infrastructure projects including the ‘great wall of Lagos’ (an eight–mile embankment wall). Yet, it is not clear if even these priority areas can be sufficiently protected from future flooding, as some recent experience has shown. Moreover, some suggest that infrastructure like the great wall of Lagos will worsen conditions for areas further along the coast. Representative of many growing coastal cities of the global south, Lagos and Makoko highlight the complexity of coastal management and the unfortunate trend of displacement that often coincides with coastal redevelopment schemes.

Adapting to coastal change and sea level rise

There is a long history of managing the coast and our understanding of how to build and live with environmental change is advancing. However, for much of the 20th century, coastal planning was led by a modernist framing of human–nature relations which is often symbolized by control over nature through engineering. As such, much of the coastal infrastructure was designed explicitly to keep water out of cities. This infrastructure often centred on what are commonly called ‘hard engineering’ solutions, such as sea walls, levees and dams. London’s Thames Barrier is a good example of this kind of approach to flood management. The barrier, built in the 1980s, protects London from high tides and storm surges by closing a series of large

gates along the Thames River. Early on, the barrier was only used a couple times a year, if at all. Then, in the 2013–2014 flood season, a particularly wet year, it was closed 41 times. In a coastal setting, hard engineering generally describes those elements of infrastructure and infrastructural approaches that, like the Thames Barrier, are designed to deflect waves and tidal energy and keep water out of cities and communities. Yet these structures can also disrupt coastal processes and as such can have adverse and unintended consequences for surrounding shoreline conditions and coastal areas.

A few years ago, I was taken on a tour of a community in Bali, Indonesia where the houses along the coastal side of a small road had been destroyed by the sea. People I spoke to in the area claimed that the erosion and loss of homes coincided with construction of port infrastructure further down the coast. There were no public coastal defences here. Rather, homes and businesses were protected by individual investment and ad-hoc efforts. The one business remaining on the coastal side of the road was surrounded by tyres, sandbags and other bits of material that made up a bespoke, do-it-yourself sea wall. It seemed unlikely that this structure or the remaining homes and community on either side of the road would be able to survive for long without coordinated coastal planning. What the locals wanted was serious environmental review of the hard engineering and infrastructure projects that, they argued, were destroying their lives and leading to displacement of the entire community.

The flood experiences of New Orleans present another important example of the negative impacts of modernist infrastructural approaches to water management. The city itself is built on drained swamplands in low-lying areas of the Mississippi River delta. Have a look at a map of early New Orleans and you will see a small settlement nestled along the northern banks (in the crescent) of the Mississippi River. Surrounding the city are creeks, streams, lakes and wetland areas. Today's maps show how much of this area has been drained and urbanized, imprinting a sense of permanence upon what was previously an extremely dynamic waterscape and landscape. Moreover, what people did not realize (or perhaps ignored) was that these 'swamplands' were part of a critically important ecological system, which supported rich habitats for wildlife, biodiversity, water cleansing and carbon capture, as well as erosion and flood control. In the context of climate change, the wetlands at the mouth of the Mississippi River are particularly important for protecting the coast from storm surges and waves from large storms and hurricanes. Yet, they are under serious threat. The threat is not only from wetland draining and urbanization in New Orleans, but also by poor upstream river management (Blum and Roberts 2009). The Mississippi River flows for over 3,500km from Minnesota to the Gulf of Mexico. Like many other major rivers and watersheds, the Mississippi is prone to flooding, including the 1927 flood that inundated 70,000 square kilometres, leaving hundreds of thousands

homeless and killing over 500 people. Due to flooding events such as the 1927 flood, the US government's Army Corps of Engineers constructed numerous flood control structures, including levees, embankments, dams and channels to protect coastal communities. Indeed, over the past 100 years, the river has been engineered to support not only flood defence, but also commercial navigation, hydropower generation and development. However, recent studies have shown that the risk of flooding due to climate change, subsidence and river engineering is actually higher today than it has been in centuries (Munoz et al, 2018). Moreover, river engineering, including the construction of dams and other smaller structures, has hastened the rate of land and wetland loss in the Mississippi delta. Essentially, river management upstream has trapped sediments that would have been transported to the mouth of the river delta (Meade and Moody, 2010). As a result, there has been extensive degradation of the coastal wetlands around New Orleans. It is estimated that some 4,000 square kilometres of wetlands have been lost and converted to open water since 1956 (Twilley et al, 2016). In addition to the destruction of natural habitats, the loss of these wetlands has eliminated critically important flood defences for the city, southern Louisiana and the Gulf Coast more generally, and put additional pressure on strained flood infrastructure.

Without the protection from wetlands and other natural defensive features, hard engineering flood management has been the rule for New Orleans. Yet, following Hurricane Katrina, the city's flood protection scheme was exposed as inadequate, as the system failed to protect local communities, particularly low-lying poorer neighbourhoods (Wooten, 2012). Recognizing the extreme precarity of the city and its vulnerability to future hurricanes and storm surges, the US government funded a major coastal defence programme involving several new flood infrastructure projects. Most notable here are the 1.8-mile Lake Borgne Surge Barrier (cost: US\$1.3 billion) and the West Closure Complex (cost: US\$1 billion), both designed to defend New Orleans against a '100-year' flood (Schwartz and Schleifstein, 2018).

However, there are other approaches to coastal management. Elsewhere in Louisiana, and other parts of the world, communities are working to conserve, restore and construct some of the natural processes and environments used to provide coastal protection. For example, over the next 50 years, the Mississippi delta coastline will benefit from billions of dollars of investment in so-called 'soft' engineering solutions, including sediment diversions and dredging to support the establishment of sandbars and other natural flood protection features which have been lost due to dams and other restrictions to sediment flows. More generally, there has been a global trend towards *green infrastructure* (Sinnott et al, 2015) – a concept that recognizes the role of natural processes and features to provide important 'ecosystem services' to people, places and the natural environment (McClymont and Sinnott,

2021). It is a broad idea that can refer to natural areas such as wetlands and forests, but also to particular design measures and techniques such as green roofs, permeable surfaces and pavements, sustainable drainage systems, and rainwater harvesting. Framing features such as wetlands as infrastructure indicates the importance of natural ecosystems for human and non-human wellbeing. Most importantly, green infrastructure signals a networked approach to green spaces that builds a wider system of connectivity and benefits that reach beyond the sum of individual parts.

Techniques that support green infrastructure and more closely align with natural processes recognize the limitations of purely ‘defensive’ and ‘hard’ engineering approaches to coastal management. These techniques are generally based in a rounded or holistic approach to managing the coast and, as such, carefully consider the dynamism of coastal morphological processes (Reeve et al, 2018). Critically, these approaches are framed by a collaborative rather than top-down or controlling relationship between humans and water. This is nicely expressed by the many ‘living with water’ projects and ‘nature-based solutions’ which can be found across the globe.

As the limits of purely hard engineering approaches to coastal management are better understood, ‘keeping water out’ at all costs is no longer the only option. Recently, I visited Steart Marshes, a wetland, flood defence and nature reserve in Somerset, England. Steart is an excellent example of this new relationship with water and the environment (BBC, 2014; WWT, 2023). The marshes are located on what was previously agricultural land that was prone to flooding from the River Parrett. By converting almost 400 hectares of land into salt marshes, the surrounding communities now have improved flood protection and also benefit from the development of a beautiful nature reserve managed by the Wildfowl and Wetlands Trust. In conversations with the management team, I learned that numerous careful discussions and regular dialogue was held with area residents and stakeholders who were cautious about eliminating existing flood defences and breaching the sea wall. The design team listened to concerns, but also helped locals see the benefits associated with a more active or ‘natural’ coastal zone. The Steart Marshes project is an example of what many call *managed realignment* (Pontee and Serato, 2019). This phrase describes the process of rearranging the coastline (often inland) to produce more sustainable flood defences and habitat areas (interestingly, the word ‘realignment’ has taken the place of the more contentious word ‘retreat’ which was commonly used to describe similar projects). Managed realignment has become an important tool in the move from ‘hold-the-line’ coastal defence to more ‘natural’ coastal management processes (Esteves, 2013: 934). Yet, the Steart Peninsula is a rural, low-density area where there was space to construct new marshes without the need to relocate homes. In built-up urban areas, this is not normally the case and suggests that realignment efforts will be

a significant challenge and may not run as smoothly as the Steart Marshes project. Furthermore, as the New Orleans example shows, whether it is ‘soft’ or ‘hard’, an immense amount of infrastructure investment will be needed to maintain and protect coastal cities.

Unfortunately, much of the water infrastructure along the world’s urban coasts was designed and built prior to a sophisticated understanding of coastal processes, never mind an awareness of climate change and sea level rise. As a result, keeping water out of cities is likely to require Herculean efforts and the costs associated with these programmes will be in the billions of dollars. In the city of Miami alone, cost estimates range from US\$3–6 billion for sea walls and other forms of hard engineering flood protection ([Rhode-Barbarigos and Haus, 2021](#)). Miami is one of the cities that is expected to be particularly negatively impacted by sea level rise as it is located on porous limestone that means water flows under the city and comes up through the ground resulting in so-called ‘sunny day’ floods. To manage this situation, dams and other protective structures will have to reach down below the surface, as well as up, to keep water out of the city. Some landowners have decided to go further and have lifted their structures off the ground, a technique commonly used in beach locations. However, Miami and Miami Beach are even working to raise roads and sidewalks to prevent flooding ([Harris, 2022](#); [Robustelli and Vassigh, 2022](#)). These challenges mean that difficult decisions must be made about how to manage and protect coastal communities. In some cases, this will mean focusing infrastructure investment in areas where the economic benefits measure up to the costs. Indeed, it is no longer assured that all existing coastal defences will be maintained in the future and places that have seemed secure may soon find they too are on the front line of climate change.

What else can be done?

Living on the coast has always meant adapting to changing environmental conditions. Whether this has been through the construction of sea walls and embankments, wetland and dune rehabilitation, beach nourishment, or other forms of adaptation, humans have worked hard to maintain their place on the coast. Sometimes, however, adaptation means recognizing that it is not possible to stay ‘in situ’. According to the [Institute for Economics and Peace \(2020\)](#), over one billion people may be forced to move due to environmental change and related conflict. Those forced away from the coast due to climate change are commonly described as ‘climate refugees’ ([Luetz, 2019](#)). Use of this phrase signals the dire circumstances of those whose lives have been upended and brings to mind those people who have been displaced due to calamity, disaster or war. However, there has been some pushback to the use of this phrase as dystopian, apocalyptic and

depoliticizing (Bettini, 2013). Critically here, in the apocalyptic narrative, climate refugees are seen as impoverished victims who, through their migration, threaten the national security and wellbeing of other countries. Some argue that the alarmist framing does little to address the plight of those seriously impacted by climate change, and rather, results in negative stereotyping and xenophobia.

Further, in contrast to purely defensive, hold-the-line mindsets, many societies through history have embraced the environmental dynamism of coastal areas. For example, some Inuit communities were semi-nomadic, and moved along with changing conditions to follow food sources. In Chapter 5, I talk about Shishmaref, Alaska, where departure from nomadic practices has meant increased difficulty adapting to global warming. Indeed, migration due to changing climate and environmental conditions is not necessarily an unfortunate consequence. Rather, it is an adaptation tactic that has been practised by humans for thousands of years.

However, in much of the world, relocation is most often seen as a last resort. The flood defences of our cities are still dominated by hold-the-line philosophies which interpret moving away from the coast or ‘retreat’ as a failure. However, with expected sea level rise of up to one or even two metres by the end of the century, coastal societies must recognize relocation as a realistic adaptation solution to climate change. Of course, the challenges of relocation are significant. First, people have strong attachments to place and their communities which provide both mental and physical wellbeing. From the experience of New Orleans (and many other examples), we know that displacement can lead to many negative outcomes. Second, the costs of relocation are substantial, as getting people out of harm’s way may include costly efforts to buy out homes, support new developments, move residents, and remove abandoned infrastructure and structures. Third, relocation, in some instances, may mean the end of particular social and cultural forms. The value and potential loss of jazz and other cultural communities in New Orleans was wonderfully narrated in the HBO television show *Treme*. The show highlighted how people form special bonds to place through culture and what we lose when such places are devastated by disinvestment. The devastation of New Orleans was not only significant in terms of loss of life and economic impact, but also in terms of a unique cultural form and way of life.

In some cases, the impacts of climate change means that entire countries may no longer habitable. For example, the Marshall Islands, located in the north Pacific, is extremely vulnerable to flooding and any increases in sea level threaten the existence of many of its 1,500 islands (UH News, 2020; *The Guardian*, 2021; World Bank, 2021). Studies show that other atoll nations such as Kiribati, Maldives and Tuvalu are similarly threatened (Bryant-Tokalau, 2018; USGS, 2018; Voiland, 2021). In the Maldives,

Hulhumalé is a reclaimed, artificial island that is being constructed as a future development area and possible refuge from the rising sea (Brown et al, 2013; Brown et al, 2020). However, across the atolls, the loss of drinking water due to salt intrusion into groundwater systems is likely to impact liveability before the islands disappear (van der Geest et al, 2020). Quite simply, there are not enough resources to protect all coastal communities. Furthermore, it would be foolhardy and reckless to maintain hold-the-line policies at all costs. Unfortunately, the most vulnerable are those likely to be the most immediately and significantly impacted. It is clear that issues of inequality are likely to be exacerbated due to climate change.

Coastal erosion and management in Ban Khun Samut Chin

Take a look at a map of the upper gulf of Thailand and zoom in on the village of Ban Khun Samut Chin.¹ Zoom in close enough and you'll see something quite unusual. Jutting out from the coast near the mouth of the Cho Phraya River delta is a small bit of land, about 15,000 square metres – this is the Wat Khun Samut Taraward. The Wat (or temple) was once firmly surrounded by land. However, the image gives evidence to an active coastline that has been retreating for several decades. The Wat serves as a symbol of faith and is an important tourist and religious site for Buddhists. Indeed, several monks live there and maintain the site. In fact, several buildings were under construction on this small piece of 'land' when I visited. The Wat, however, is also a symbol of resilience and perseverance in the face of environmental change. Of course, it is a marker of what once was and what has been lost due to environmental change.

Asian mega-deltas and climate change

Coastal deltas are exceptionally dynamic landforms, shaped by movements in river sedimentation and coastal processes. They form in the spaces where rivers meet the sea and where sediments accumulate. Deltas are also incredibly diverse environments, rich in biodiversity and natural habitats. Through history, this has meant they have played important roles in the development of human life and civilizations. The richness of life associated with coastal deltas is, of course, directly impacted by human factors such as residential and commercial development, agriculture, dams, hydropower

¹ This case study reports on specific coastal management activities in the village of Ban Khun Samut Chin which were studied in 2018–2019 as part of a British Academy Knowledge Frontiers research initiative.

projects and other activities. As noted in New Orleans and with the Mississippi River, much of this activity results in lower flows and reduced sedimentation in delta areas as material is trapped further upstream. With a lower supply of sediment, coastal delta areas are more prone to erosion and other negative impacts. Another notable example, the Three Gorges Dam – the largest dam in the world – has been associated with several downstream impacts. These include a reduction in the amount of sediment transferred to the coast, destruction of wetlands, saltwater intrusion and a decline in biodiversity (Bianchi, 2016). Humans seem to thrive in river deltas, yet we also struggle to maintain a balance of life with those very features that sustain us.

Some of the largest and most populous deltas in the world are in Asia. These *mega-deltas* – such as the Mekong and Ganges – are dynamic and complicated ecosystems, home to large populations in growing cities that are centres of trade and business (Climate Policy Watcher 2023). Due to the rich soil qualities associated with these environments, Asia's deltas also play an important role in agriculture and food security. However, as noted earlier, infrastructure such as dams and other human activities such as mining and water extraction can impact river morphology by restricting or changing sediment deposit patterns and aggravating subsidence (many delta cities are actually sinking). Moreover, the impacts of climate change on Asia's deltas and delta communities are potentially catastrophic. Bangladesh, for example, is an Asian country particularly vulnerable to the impacts of global warming. A relatively flat and low-lying country located predominantly within a mega-delta formed by the Ganges, Brahmaputra and Meghna rivers, Bangladesh regularly experiences water-based disasters and challenges including flooding from monsoon rains and storms, as well as droughts, water shortages and salinization of freshwater supplies. Water security in Bangladesh is complicated by high population density, poverty and limited infrastructure (for example, for water drainage), as well as by sea level rise and more extreme and erratic rainfall patterns associated with climate change. According to Germanwatch's 2021 Climate Risk Index, Bangladesh is one of the most climate-vulnerable countries in the world as water-related disasters could mean the displacement of hundreds of millions of people (Jacob, 2021).

The Chao Phraya River basin, located in Thailand, is one of the most important and most threatened of Asia's mega-deltas. The basin covers 30 per cent of the country and is home to over 20 million people. Like other Asian delta environments, the delta is experiencing flooding, salinization, subsidence and erosion (Hogendoorn et al, 2018; Bidorn et al, 2021). Within the delta, about 25km north of where the Chao Phraya River spills into the Upper Gulf of Thailand, sits the city of Bangkok. Bangkok is a vibrant, growing city of over 10 million people. It is the business

and political centre of Thailand and, as the principal city, it is critically important to the country's economic wellbeing. The city has breathtaking architecture, rich culture and historical sites, numerous Buddhist temples, an active street life and a dynamic nightlife, contributing to its status as a major tourist centre. However, Bangkok is at risk (Philip, 2011). Like New Orleans, the city is low-lying, with parts of the city below sea level and much of it located on land areas that were drained for agriculture and development. The city's close relationship with water can be seen through its canals, used both for transport and irrigation for centuries and leading many through history to call it the 'Venice of the East'. Use of the canals declined during the 20th century due to urbanization, landfill and a move to modern irrigation methods (Davivongs et al, 2012). However, it is still possible to experience traditional life and culture on the water, including the famous Damnoen Saduak water market, located outside of the city. Bangkok also experiences an intense rainy season associated with the South Asian monsoon from late May until about October or November.

Bangkok's climate, location and development patterns mean it is prone to regular flooding and at risk of extreme inundation. Some have argued that, without serious mitigation, the city will need to be abandoned or relocated (Weather Channel, 2015). The flooding challenges facing Bangkok were particularly visible in 2011 when much of the country was flooded by a combination of monsoon rains and Tropical Storm Nock-ten. At least 800 people were killed due to the storm and flooding, along with almost US\$46 billion in damages (World Bank, 2011). Flood conditions and vulnerability in the Bangkok metropolitan area are exaggerated by a combination of climate, poor infrastructure and subsidence (Marks and Elinoff, 2020). The Chao Phraya River delta is experiencing some of the world's most significant rates of subsidence which is magnifying the effects of sea level rise (Bidorn et al, 2021).

Shoreline retreat in this delta has been estimated at an average range of seven metres per year over the last 6 decades (Charoenlerkthawin et al, 2021). Coastal areas at the mouth of the Chao Phraya River are under particularly severe erosion pressures, as is clearly visible in the case of Ban Khun Samut Chin. One of the most visible changes to the delta has been the loss of mangrove forests. Mangroves are generally understood to be important coastal 'stabilizers' by trapping sediments. They also support biodiversity by providing organic material and habitats for diverse species including shrimp and other crustaceans, fish and birds (Winterwerp et al, 2005). Over the last several decades, many of the mangrove forests in the Chao Phraya River delta have been eliminated for development, aquaculture and the production of charcoal. By some accounts, somewhere between 80 and 90 per cent of the region's mangrove coverage has been lost since the 1950s

(Bidorn et al, 2021). As a result of these conditions, large areas of coast can be eroded quite quickly.

In Ban Khun Samut Chin, flooding, often associated with large storms including Tropical Storm Harriet (1962), Typhoon Gay (1989) and Tropical Storm Linda (1997), has forced villagers to relocate their homes several times while habitats and ecological systems have further deteriorated. During a recent visit, talking with villagers, I learned that all had moved their homes due to coastal erosion. One older resident told me he had moved three times, first in 1962, then in the 1980s and again in the 1990s. Each time, flooding associated with tropical storms damaged his homes to the point they were no longer habitable. These sites are now fully under water.

Coastal management in the Chao Phraya delta

There is no overarching or coherent approach to manage the entire river delta (Hogendoorn et al, 2018). Rather, coastal issues are addressed in piecemeal fashion by municipalities, communities and individuals directly impacted by environmental change. However, coastal processes are interdependent and systemic and do not stop at administrative boundaries. Moreover, the coastal protection and management efforts in one area will likely result in impacts elsewhere along the coast. Unfortunately, coastal management in the Upper Gulf of Thailand does not show the coordination required for addressing the complex environmental change happening in the area. Of course, this is a challenge in river deltas across the world. Their dynamic form belies the rigid approach to land use planning and resource management typical of contemporary government systems and coastal management regimes. Yet, coastal planning in the Upper Gulf is largely structured by fragmented administrative boundaries. During my visit, this fragmented approach was particularly evident as the city of Bangkok was presenting a sea wall project that would defend some of the city's administrative frontage on the gulf. However, neighbouring areas would not receive the same protection and would likely be negatively impacted by construction and the disruption of coastal sedimentation processes.

Absent coordinated coastal protection or financial aid from government sources, villagers in many areas have undertaken a variety of ad-hoc adaptation measures including mangrove reforestation to stabilize the coastline. Yet, the lack of a coordinated coastal policy or funding for villages such as Ban Khun Samut Chin means that these areas are likely to continue to feel adverse effects from environmental change. Nevertheless, while Ban Khun Samut Chin and the upper gulf show the complexity of issues associated with coastal change and the difficulty of addressing these issues in piecemeal fashion, their actions signal the role for local knowledge and engagement in coastal planning.

Water security against the tide

Ban Khun Samut Chin is a small fishing community with limited resources for coastal protection. As noted, the area has experienced decades of coastal erosion. This slow onset disaster, destroying homes, schools and livelihoods, is leading to out-migration and threatening the existence of the village. However, the village remains. You can even spend the night in one of Ban Khun Samut Chin's homestays, which sit defiantly over open water. I visited the village in 2017 along with a team of academics and students from Chulalongkorn University in Bangkok. We were involved in a project that sought to understand shoreline changes in the region, including how local people were dealing with coastal erosion. The village could only be reached through the labyrinthine canals and waterways of the river delta. Noisy boats and water taxis shuttled residents and visitors up and down the mouth of the river. The journey provided a fascinating vista into coastal life in the Upper Gulf. Small villages and homes dot the 'waterscape', many sitting cheerfully, often brightly painted. Homes in this area are literally in the water. The boundary between what is land and what is water seems fickle, almost non-existent. After you arrive at the village dock, it is a 20-minute walk along narrow paths flanked on both sides by aquaculture activities. The village itself sits linearly along these narrow strips of land, framed by the rectangular shapes of shrimp and blood cockle farms.

The area has not been prioritized for protection by government agencies and, as such, most funding and support has been volunteer-based, philanthropic or supported from tourism activities. When we arrived, we met with Mr Wisanu Khengsamut, the village headman. Mr Khengsamut took us to a warehouse filled with reports, images, documents and artefacts detailing the village's history and fight against coastal erosion. The most powerful and poignant piece of evidence is a series of aerial photographs of the local Wat taken over four decades (1974, 1991 and 2009). The first image shows the Wat surrounded by land, well-inland from the shoreline. By the second image in 1991, the Wat is directly on the water's edge. And finally, in 2009, it is set out into the water – off the coast by about half a kilometre. The images are striking. While the Wat has been protected, now reached by a narrow causeway, all other structures from the first image are gone – destroyed or completely submerged. Due to the high rate of shoreline erosion, villagers have had to relocate inland several times (we were told that some have moved their homes five times over 30 years). While the Wat has received donations and support, the village itself has not been so lucky and is continually threatened by coastal erosion. Mr Khengsamut showed us a series of correspondences with international stakeholders, including former US Vice President Al Gore who has been active with climate change advocacy and awareness. Unfortunately, the response for the global community was

underwhelming, characterized by a response from Mr Gore's representative thanking the people of Ban Khun Samut Chin for their hard work, but offering no further support.

Recognizing the difficulty of securing their future, in some ways, the village has partially embraced its tragic situation. As a visitor and tourist, you're welcome to spend the night in the village in one of the local homestays. These small cabins are set out in a small pond adjacent to the village where you can experience life at the boundary between land and water. To outsiders, the structures have the look and feel of precarity and vulnerability. Of course, they are perfectly safe and inland from major erosion areas. Yet, the homestays along with the local museum help narrate the village's history and experiences with coastal change and provide some income and economic activity. They also provide a sense of agency and hope that there might be a future in Ban Khun Samut Chin and that the community and individuals might be able to rebuild their lives and even flourish in these extreme conditions (Teamvan, 2017).

During our discussions, the village headman highlighted a number of goals for the future. At the centre of these is a desire to protect the village and maintain it for future generations. To make this possible, the village is working to stabilize the coast and even reclaim sunken lands. Villagers have tried a number of techniques, experimenting with various forms of wave dissipators and sea walls made of bamboo, rocks and other material.

In recent years, mangrove reforestation has been an important part of coastal management in Ban Khun Samut Chin. Villagers have been working to protect the coast by experimenting with a diversity of techniques and tools. Some have become experts, developing specific knowledge about coastal management including understanding about mangrove species, care for newly planted mangroves, and general coastal processes and the impacts of environmental change on lives and livelihoods in the area.

During my visit, I met with the village's mangrove steward. He noted that planting mangroves has not always been successful, as juvenile trees are often drowned and cannot withstand the wave energy of the upper gulf (further, only certain species of mangroves have been shown to survive). Bamboo fences and wave dissipators have been shown to provide protection for young mangroves. Accessing philanthropic donations, villagers constructed a mix of rock and bamboo fences near the shore to protect newly planted mangrove trees. Villagers noted that rock revetments were more effective than bamboo in protecting the mangroves. After several years of coastal management work, villagers' work in mangrove reforestation has begun to pay off. We visited an area of the village that had been flooded and lost erosion processes. Today, the 1.25-acre site is home to a small forest of mature mangroves, reclaiming the formerly sunken area and forming a new line of defence for the community. In this way, local knowledge is being deployed

by people living directly within the coastal zone. They work as stewards and caretakers of these sunken lands – even bringing them back to serve as flood protection infrastructure for the community. The local approach to coastal management demonstrates perseverance and an almost stubbornness in the face of environmental change. For example, we were told by villagers that government agencies had planned to plant new mangroves and reforest coastal areas that the villagers were using for shrimp farming. However, this was rejected as the locals argued that the plan would negatively impact village economic activity, essentially destroying the local economy and economic aquaculture activity. Overall, in my research and visits to the area, I witnessed a great deal of creativity and resilience among the people of Ban Khun Samut Chin. They are clearly knowledgeable and motivated to manage and care for the coast. Yet, the lack of resources and coordinated planning will likely and unfortunately lead to further land loss and displacement.

Planning for uncertain futures in Fairbourne, Wales

This section examines recent climate change adaptation efforts in Fairbourne, Wales (United Kingdom).² The village, located in the estuary of the River Mawddach and on the coast of the Irish Sea is facing the long-term prospect of flooding and inundation due to the impacts of climate change and sea level rise. A Shoreline Management Plan for the area recommended realignment of the coast and eventual decommissioning or abandonment of Fairbourne. In other words, the people of Fairbourne are expected to be some of Britain's first climate refugees.

There are 12,400km of coast in the United Kingdom, significant areas of which are under environmental stress (Pontee and Parsons, 2010). Of the 4,500km of English coast, 1,800km is said to be vulnerable to coastal erosion (EA, 2011). The Environment Agency estimates that even with shoreline management protections in place, in England, over 700 properties could be lost to coastal erosion by 2030 and over 2,000 by the year 2060 (EA, 2015: 6). In Wales, it is estimated that over 2,000 properties could be at risk of coastal erosion over the next 100 years (Wales Audit Office, 2016). While flooding and coastal erosion have long been identified as critical issues facing the United Kingdom (Thorne, 2014), major flooding events have increased awareness and stimulated the development of new policies (for example, OST, 2004; Defra, 2006a; 2006b; Pitt, 2008; Flood and Water

² Material in this section was originally published in Buser, M., 2020. Coastal adaptation planning in Fairbourne, Wales: lessons for climate change adaptation. *Planning Practice & Research*, 35(2): 127–147, reprinted by permission of the publisher (Taylor & Francis Ltd, <http://www.tandfonline.com>).

Management Act, 2010; Defra, 2011; 2012; EA, 2011; Defra 2018). The winter storms of 2013–2014 and 2015 brought added attention and media spotlight to flooding in England and Wales (BBC, 2014c; 2015; Dodds, 2014; NRW, 2014a; 2014b; Kendon and McCarthy, 2015; Sibley et al, 2015). Within the context of climate change, erosion and flooding due to rising sea levels, severe storms and storm surges are expected to adversely impact infrastructure, communities and homes in coastal areas in the coming years (OST, 2004; EA, 2011; Wales Audit Office, 2016).

Currently, much of the UK coast is protected by hard engineering and defensive structures (Thorne, 2014; Ballinger and Dodds, 2017). Yet, as Ballinger and Dodds (2020) point out, defensive structures have, at times, contributed to worsening flood scenarios by producing a false sense of security and/or facilitating development in vulnerable areas. Moreover, in recent years coastal planning in the United Kingdom has shifted away from traditional models of ‘holding back the sea’ (for example, protecting all existing coastal settlements, infrastructure and resources through defensive structures) towards flood risk management strategies associated with Defra’s *Making Space for Water* (Defra, 2005; Johnson and Priest, 2008). As such, the conventional *hold-the-line* approach to coastal defence is slowly being supplemented by an integrated set of strategies which seek more *sustainable* coastal management based on a holistic, strategic risk management process and a stronger knowledge of natural coastal processes (Johnson and Priest, 2008; Pontee and Parsons, 2010). This is reflected in the UK government’s approach to coastal management where ‘natural’ or non-structural forms of flood defence are deployed, which may include a variety of hard and soft engineering measures.

In Wales, the National Strategy for Flood and Coastal Erosion Risk Management indicated that while traditional ‘drainage and defence’ solutions will remain critical to flood protection, other options are likely to be needed, including ‘making more use of the natural environment, like wetlands or salt marshes’ and ‘deploying sustainable drainage systems much more widely’ (Welsh Government, 2011: 4–5). One implication of this shift away from hard defensive structures is less certainty regarding the future shape of the UK shoreline. As such, coastal planning is likely to become significantly more contentious as defensive flood protections are re-evaluated based on flood risk management approaches (Blunkell, 2017). Moreover, across the United Kingdom there is evidence of a move away from central or state-led models of flood risk management (Johnson and Priest, 2008: 515; Butler and Pidgeon, 2011; Thaler and Priest, 2014). This represents a governance shift to partnership working and cross-sector collaboration. Within the contemporary coastal planning process, this has meant wider involvement of stakeholders such as the Wildfowl and Wetlands Trust, the National Trust and Network Rail who own or manage property and assets along the

coast, as well as local communities who are being encouraged to adapt their properties and livelihoods to flood risk (National Trust, 2015). These shifts within flood management are consistent with wider trends of devolution and the localization of responsibility for service delivery (Johnson and Priest, 2008; Thaler and Priest, 2014). As such, coastal planning could be seen as a frame through which to facilitate local voices and involvement in adaptation planning and to build local ownership and buy-in to climate change adaptation strategies.

Adapting to climate change, decommissioning Fairbourne

Fairbourne is a Welsh community of approximately 1,700 people in South Gwynedd at the mouth of the River Mawddach. The coastal area is surrounded by mountainous terrain and sits at the edge of the Snowdonia National Park. Fairbourne developed in the late 1800s as a holiday resort following the construction of a railway line (Gwynedd Council, 1998: 210). The village faces Cardigan Bay and is recognized as flood prone in planning documents. The community includes a mix of caravans and one- and two-storey detached homes and small businesses and is protected from the sea by a shingle beach and an embankment of concrete defensive structures.

A shoreline plan for this area (SMP1) was completed in 2002 and recommended the policy of ‘hold the line’ for Fairbourne. The 2012 shoreline plan (SMP2) conducted further study of coastal processes, and took various models of sea level rise into consideration and reflects a shift in focus to the impacts of climate change (PCC, 2012). In addition, the plan’s analyses and policies are set across a 100-year timeframe (increased from 50 years). This reflects an ambitious future orientation and desire to match planning to the long-term impacts of climate change impact (Wilson, 2006; Wilson and Piper, 2010)). The climate scenarios are based on an anticipated 0.36m sea level rise over the next 50 years, at which point, the plan notes that the village’s defences would be regularly overtopped and the entire area would flood on a 1:10 year basis (PCC, 2011a).

The village is situated in a particularly vulnerable position as it is threatened by coastal erosion and flooding from the sea as well as from the River Mawddach. Moreover, there are limited prospects for moving away from the coast via managed realignment as Fairbourne abuts steep slopes of the Cadair Idris ridge and Snowdonia National Park. According to the SMP2, without further defensive interventions, as a result of sea level rise associated with climate change, the village would be subject to regular tidal inundation and eventually would be lost to the sea. The plan indicates that while the precise timeline is unknown (due to the uncertainties regarding sea level rise), the coastal area is extremely vulnerable. Based on an assessment of these scenarios and risks, the plan recommended a shift away from the

previous ‘hold the line’ policy from SMP1 across the three plan epochs. Specific policy recommendations for the Fairbourne Embankment and the Ro Wen Coast (populated areas of Fairbourne) from the SMP2 (PCC, 2011a: 4D112) by epoch are:

- Epoch 1, up to 2025: Hold the Line (HTL);
- Epoch 2, up to 2055: Managed Realignment (MR); and
- Epoch 3, up to 2105: No Active Intervention (NAI).

The implication of these policies is a commitment to maintain existing defences through 2055 followed by eventual decommissioning of the village and realignment of this area of coast.

Public response

Adopted in 2012, the West of Wales SMP2 did not result in significant public attention or controversy in Fairbourne until a 2014 BBC television report highlighted the possible loss of coastal communities in Wales. Statements by the BBC (2014a; 2014b) suggested that Fairbourne was under immediate flooding threat and would be lost in ten years. At the outset of the story, the television host asks the audience to ‘imagine discovering that in just over a decade your village, your whole community would be abandoned, left to the mercy of rising seas. The people of Fairbourne on the coast of west Wales have just found out this may be what lies in store’ (BBC, 2014a).

According to council staff, the coverage and its dramatic portrayal of Fairbourne about to be ‘left to the elements’ and ‘lost to climate change’ (BBC, 2014a) contributed to anxiety and anger. Moreover, in the months and years following the BBC broadcast the village remained in focus through a number of additional local and national news stories about coastal flooding. Much of this reporting sensationalized the issue, with headlines such as ‘Village of the dammed’ (Spillett, 2016) and ‘Welsh villagers trapped in “zero value” homes’ (Sky News, 2016). According to the local authority project manager, these events negatively impacted housing values and caused a local crisis: “[It was a] social emergency state, people wanted to sell their house and move out but couldn’t” (interview with project manager, 2 November 2017).

The BBC and other media outlets were criticized for sensationalist reporting. Alun Davies (MP for the area at the time) condemned the BBC, saying: ‘[I]t is enormously irresponsible to report these draft plans as facts. No decisions have been taken’ (FFC, 2014b: 2). Nevertheless, while this reporting dramatized and at times misrepresented the details of the coastal planning process, it was significant in generating awareness and local involvement in shoreline planning and the large climate adaptation process. For example,

soon after the BBC report, a community action group, Fairbourne Facing Change (FFC), was established to:

galvanise the community to actively challenge the inaccuracies of the reporting and coverage of the SMP2 and to focus on influencing the ‘direction of travel’ for the various policies within it. Our objectives are to inform, engage and involve the people whose lives have been deeply affected by the situation, which could have been considerably lessened, had we been consulted and engaged at the time stated in the Council’s timeline. (FFC, 2014a)

Since its inception, FFC resisted the main policies set out in the SMP2 and hired a barrister to mount a legal challenge (FFC, 2016a; 2016b). At issue here were the baseline figures upon which sea level rise has been estimated in the SMP2. According to FFC, the assumption of one metre of sea level rise over 100 years was overly aggressive and a figure of 50 centimetres should have been used (FFC, 2016a). The resistance effort demonstrates the difficulty of long-term planning for climate change adaptation. It is perhaps not surprising that a group of local residents challenged the policies that would allow for inundation of their homes and decommissioning of their village. However, from the context of planned adaptation, critical questions here relate to how these tensions and contestations might have been managed or brought to light at earlier stages of the consultation process.

Fairbourne Moving Forward

Following the increased media attention and challenges by local residents, in 2014 Gwynedd Council established Fairbourne Moving Forward (FMF), a multi-agency group set up to help manage coastal planning and adaptation in Fairbourne. The agency was set up to include representation from a variety of stakeholders including FFC as well as the council, Natural Resources Wales (NRW), the Welsh government, Royal Haskoning (consulting engineers) and others with a stake in the coastal area (for example, Network Rail, NRW). Gwynedd Council has also established a full-time FMF project manager to facilitate community relations and to lead on implementation of the SMP2. However, this is seen to be an extremely novel and challenging planning context: ‘There is no precedent to follow in implementing the Shoreline Management Plan. No process, no best practice and no lessons to learn from other areas’ (FMF, 2017: 4).

Of critical concern to the organization are the relations between increasing flood risk and a decline in economic and social wellbeing. According to the recent annual report (FMF, 2017), over the next several decades the risk of inundation will likely contribute to a decline in property values, economic

blight of the community, and a decline in the health and welfare of local residents. This decline is associated with the combined factors of expected sea level rise and the SMP2 policy of managed realignment (epoch 2) and no active intervention (epoch 3).

FMF has initiated several projects and programmes intending to mitigate some of the immediate impacts of the SMP2 policy (for example, decline in property values) as well as the longer-term health and wellbeing of residents. In the short term, FMF has worked with NRW to establish flood preparation and early warning systems (for example, Flood Warden Group) where residents take an active role in preparing for flood events and ensuring flood warning messages are understood. In addition, NRW has made repairs to the coastal structures at Friog Corner – an area of the village flooded during the severe storms of 2013 and 2014 – and further studies have been conducted to examine the opportunities for improved defences at this location which is particularly susceptible to flood risk (NRW, 2017). For people concerned with property values and who desire to sell their homes, FMF is supporting the development of a Community Interest Company as a means to run a buy-to-let scheme to enable residents to sell now and remain in place or move away (Community Interest Companies are limited companies which are intended to provide direct benefits to the community in which they are located). Several other projects are underway, including, for example, a climate change education programme, systematic monitoring of groundwater resources and coastal erosion, and a counselling service to help residents manage the process of decommissioning and the effects it may have on their mental wellbeing.

Looking towards the longer term is development of a Fairbourne Master Plan. The document is intended to be the central mechanism through which to implement the SMP2, including ‘decommissioning of the village and relocation of its residents’ (FMF, 2017: 23). It is expected that the plan will include further studies of sea level rise, groundwater levels and the general impacts of coastal change on the village’s built and natural environment as well as social and economic assets. A critical challenge for this process is to maintain as productive and viable a community as possible during an extended period of planned abandonment.

Implications for the coast and planned adaptation to climate change

Fairbourne is one of the first UK residential communities to initiate processes of decommissioning directly as a result of climate change and sea level rise. The planning process demonstrates that communities are likely to be surprised and angered by coastal adaptation policies that do not ‘hold the line’ on existing defences. In a previous paper on Fairbourne (Buser, 2020), I discussed how these processes could be understood and evaluated in terms

of local ownership, collective action and fairness. In this discussion, I reflect on how we might interpret these events through the lens of care.

During my research and in my discussions with planners, engineers and council officers involved in this work, I found a strong sense of concern for the people of Fairbourne. I sincerely believe that the efforts to understand and adapt to climate change in this area were motivated (at least at the individual level) by a concern for the wellbeing of people living in a potentially disastrous flood zone. Nevertheless, the language of care is largely absent from most of the planning work conducted in this context. Rather than engage with people's fears and concerns, and perhaps in an effort to appear purely objective and evidence based, shoreline planning was conducted in a most dispassionate and uncaring way. Drawing on my earlier experience as a planner and observation of planning consultations in the United Kingdom and United States, I do not find this surprising. Urban planning has, at times, struggled to establish its identity as something 'scientific'. The evidence-based rhetoric that makes up so many consultations and the resultant zoning and land use strategies appeals to these mindsets. This kind of posturing and the entire lexicon of urban planning is at odds with the way people experience place. To take emotions, attachments and love out of our experience of home (or hometown) is to disavow our human experience. In Fairbourne, climate change and sea level rise are reduced to a 'pure' science based in a modern interpretation of rationality. Yet, we know that science does not exist outside of the social (Latour, 2007). This is not to challenge our objective reality. Rather, it is to recognize that culture, and indeed politics, inform what we study, how we study it and how we make sense of any phenomena (including the policies we make based on scientific study). Yes, it is likely that sea level rise will make living in Fairbourne untenable. However, the entire process of thinking through these challenges was conducted in such an uncaring and unsympathetic way that no future effort to involve the local community in discussions about the eventual decommissioning will likely make up for this. It is as if we expect the science and data to speak for itself without reflecting on the lives that will be impacted or the ways in which people will resolutely protect their homes. As a result, the very basis and foundation of the planners' arguments are continually questioned, including the data on sea level rise and its impacts on Fairbourne.

I also suggest that the Fairbourne case highlights an important problem related to how we understand places threatened by climate change. Earlier in this book I spoke to the notions of vulnerability and fragility. Fairbourne, for all intents and purposes, has been described as a place vulnerable to climate change due to its unique circumstances – it is a coastal town, situated on a sandbar, hemmed in by sea, river and mountains in an area where sea level is rising and coastal infrastructure is ageing. Yet, this is not dramatically different from many coastal communities and cities across the world. Rather

than demonstrating a unique vulnerability, Fairbourne is an expression of the fragility of our communities, our homes and ourselves. Set out in the language of vulnerability, one might more easily blame those living in the village for purchasing a home in such a location. Some might say ‘they should have known the area would flood’ (indeed, I’ve heard and read this statement in media comment sections many times). However, when we see Fairbourne in terms of fragility, as part of a fragile ecosystem, I think that something shifts. We more easily recognize that we are all fragile beings; this fragility includes our physical selves as well as our mental and emotional selves. To look at the coast (and Fairbourne) as part of a fragile ecology of care means we can see ourselves in the experiences of others.

It is worth highlighting another troubling aspect of the planning in Fairbourne. Elsewhere, I have noted that the ability of local communities to engage with and respond to coastal planning challenges will be uneven (Buser, 2020). Climate change impacts the entire UK coast. Yet, the adaptation ‘outcomes will depend significantly on the types of capacities available to these communities’ (Begg et al, 2015: 695). What this means is that to be resilient, to adapt to climate change, is going to be extremely unequal. To state the obvious, it is most likely that the more affluent cities, communities and families will find climate resilience and adaptability easier to come by.

Coastal planning at Fairbourne is innovative in that planners, engineers and policy makers are incorporating the impacts of climate change and sea level rise in an effort to avoid potentially catastrophic conditions. With few financially viable alternatives available, such as new infrastructure, the recommendations are for eventual abandonment of defensive structures and transition away from the coast. It is likely that this scenario will be repeated elsewhere in the United Kingdom as the impacts of climate change become more evident and embedded into planning and decision-making. Difficult decisions must be made regarding how best to protect livelihoods. As such, the Fairbourne case provides a useful heuristic towards understanding and examining how we might face the challenges of living with climate change. Looking to the future, I suggest that a great deal of work is needed to interrogate the policies, discourses and engagement practices surrounding adaptation and the extent to which these processes might contribute to socially and environmentally just outcomes. This is relevant not only for coasts (in the United Kingdom and internationally), but also for climate adaptation programmes in other geographies and environmental contexts.

Further thoughts on coasts and climate change

The coast is an area of dynamic environmental change where huge populations live, work and play. For the largest and wealthiest cities,

large-scale defensive infrastructure serves to protect communities, residences, businesses and industry. Sea walls, barrages and other structures enable people to live in coastal cities across the world. While this infrastructure may not always be visible, it is part of an ecology that supports water security and, as such, plays an important role in the production of flourishing lives. Perhaps cities have come to over-rely on this type of defensive physical infrastructure for flood protection. The costs of maintaining ageing hard infrastructure will certainly make future protection more difficult. New ways of managing the coast are being implemented that resemble natural forms of flood protection. Yet, these can be difficult to implement in built-up urban areas. Climate change is putting pressure on coasts and the way we manage these areas. In the cases I've looked here at and my wider research, I have found that coastal management is often limited due to administrative and organizational structures. By this I mean that while the coast is flexible, dynamic and constantly in motion, our management systems and structures often are not. Moreover, the devolution of responsibility to local scales can hinder coordination and worsen inequality across communities. Further, when large-scale coordination does take place, conventional cost-benefit rationality seems to dominate decision-making, which can negatively impact areas that are already marginalized. A care-oriented approach to the coast might make the interdependencies and connections more obvious. Further, it might enable people to see alternative ways of living within coastal zones and adapting to climate change.

In Lands of Snow and Ice

In love with the cryosphere

One of my strongest and fondest memories of growing up on Long Island was playing ice hockey on the Setauket Millpond. I recall having so much fun skating on natural ice. As a family, we didn't spend a lot of time at indoor rinks. Rather, my brothers and I developed our love for ice and hockey through the annual ritual of carefully stepping out onto the pond, tentatively feeling for movement and cracks. Once the 'all clear' was given, it was onto the ice with reckless abandon. That the ice did not freeze often, or stay frozen for very long, made these days into very magical, special events. I can still visualize my 'between the legs' pass to help score our team's winning goal as pools of water formed on the ice in the bright winter sun. These glorious days certainly embedded in me a love of snow and winter sports (I've always been a Winter Olympics guy!).

However, even back in the 1980s, I knew something had changed about Long Island winters. While the ice froze occasionally, it didn't seem like winter was as cold or snowy as it had been in the past. My evidence of this consisted of a set of murals in my elementary school painted by local artist Vance Locke. Locke was commissioned by Ward Melville to produce images of the area's history in 1952 (Sanzel, 2020). Of course, there is some nostalgic reimagining of Long Island's past going on here. However, I was always struck by the mural of locals cutting out large ice blocks from the millpond. At some point in the town's history, at least according to Locke's representation, there was so much ice that it could be harvested to keep perishable foods from spoiling. I couldn't imagine the pond could freeze like this – it seemed unfair that we only got the ice for a few short weeks a year.

It turns out that a lot of ice hockey players feel the same way I do. Sadly, informal gatherings of hockey players and ice skaters on natural ice are in decline, and not only on Long Island (Spillane, 2016; Haven Pell, 2020). Indeed, in Canada (the birthplace of ice hockey), there is a long history of 'backyard rinks' where youngsters can practice their skating day and night,

right outside their door. I recently read about Ian Williams, a Canadian ‘hockey dad’ outside of Toronto who builds a rink in his backyard every year for his kids to enjoy. However, shorter, warmer winters have meant that the rink doesn’t stay frozen for long and often turns into a ‘birdbath’ rather than a hockey rink – even in the middle of winter (Schwartz, 2018). Ian’s experience reflects the shrinking skating season in Toronto where it is expected that by 2090, the number of outdoor skating days will decrease by some 35 per cent (Schwartz, 2018). At some point in the not-too-distant future, if climate change continues its current course, Toronto’s backyard ice rinks may be gone forever (Robertson et al, 2015).

The ski and snowboard industry has been similarly impacted by climate change. As a winter enthusiast, I have also spent a lot of time at ski resorts. While not the grandest of mountain ranges, the northeast United States has some great and quite popular resorts. Some of my best winter days were spent at places like Killington, Mount Snow, Okemo and Stratton – all located in Vermont’s Green Mountains. Indeed, snowboarding was basically invented by Jake Burton Carpenter at Stratton Mountain. Since the 1980s, snowboarding has gone from a niche activity to a major Winter Olympics draw (I’m in awe of the snowboarders sailing up to eight metres (some 26 feet) at the half pipe competition). Yet a recent report notes that places like Stratton are less likely to have snow and the winter ski season could be reduced by up to a month by 2080 (Vaugh, 2021). Moreover, I was shocked to read that by 2100 all but one of the previous Winter Olympic sites will not have enough snow to host the event (Craven, 2023).

The loss of these leisure activities is a consequence of global warming that brings climate change into view of the general public. It also has been used as a means to raise awareness and attention in places like the United States, Canada and Europe. If we can see how climate change is changing culture, perhaps we can motivate action. Indeed, many resorts are directly involved in mitigating climate change (sustainable skiing, and so on). Although, the growth of indoor snow resorts seems drastically out of step with concern for environmental change and our understanding of sustainability.

Winter – with its characteristic cold temperatures, snow and ice – has always been an important part of my life. I cherish the change of seasons and the sight of darkened leaves falling to the ground. The first snow fall fills me with joy and anticipation. Yet, global warming is producing a new climate where, at least in Long Island (where I grew up) and Bristol (the place I now live), snow is less prevalent. To lament this and quote the great Marillion song ‘Seasons End’: ‘snowflakes in a new-born fist, sledging on a hill. Are these things we’ll never see in England’. In the following sections, I discuss the role of snow and ice in the global hydrological cycle and explore the experience of living and adapting to climate change through two case examples.

The cryosphere

The snow and ice that I love so much make up part of what is known as the cryosphere. Holding almost 70 per cent of the world's freshwater, the cryosphere is essential to life on Earth and is part of an interconnected hydrological system of climate, land, wildlife and plant habitats, and human settlements (Stephens et al, 2020). It has significant atmospheric influences on precipitation, contributes to surface water systems, and regulates the amount of global freshwater available for humans and animals. The cryosphere generally includes all the Earth's frozen water in the form of snow, ice, permafrost and glaciers. The word cryosphere comes from the Greek word – *kryos* – for cold. It is the frozen part of the hydrosphere (all of Earth's water) and part of the hydrological cycle that circulates water through the environment.

The frozen Earth also plays a key role in maintaining the global climate. For example, snow and ice have a high level of reflectivity. In climate science, this reflectivity is known as albedo. As most urban inhabitants know, cities, with high levels of asphalt and building coverage, often experience something called the urban heat island effect. This is due, in part, to predominance of dark surfaces which absorb sunlight, thus increasing local heat. The impact of this low level of albedo (reflectivity) can be significant – meaning an urban area can be as much as 10°C higher than surrounding rural areas (Meteo Blue, 2013; Climate Central, 2021). Ice and snow have a high level of albedo and therefore reflect significant portions of the sun's rays out of the climate system. For climate change, this is significant as melting snow and ice results in less reflectivity, contributing to a type of negative feedback loop (lowering albedo), further warming the planet.

As noted, snow is an important part of the hydrological cycle, contributing to precipitation and circulation of water through the atmosphere. Moreover, it serves as a type of seasonal water storage system, providing water through the spring – when it is most useful for agricultural purposes – as the climate warms and snow melts. Snow also provides an insulating cover for the earth. Interestingly, ground without snow is colder than with snow and can freeze deeper. These insulating characteristics provide a protective shield for soils as well as the plants and animals that ride out winters in the area below the frost line (Soils Matter, 2017).

The world's glaciers are also major stores of freshwater. While only about 2 or 3 per cent of the Earth's water is found within glaciers, this represents some 75 per cent of the total freshwater (USGS, 2023). Glaciers are critically important to global water security, providing water for drinking, irrigation and agriculture for hundreds of millions of people (Schaner et al, 2012 in Rasul et al, 2020). Like melting snow, as glaciers melt, they provide water for

human, plant and animal communities. While melting glaciers may not have an immediate negative impact on drinking water supplies, as they retreat, the amount of runoff is reduced (this happens after something called ‘peak meltwater’ which is the high point of glacial runoff). The loss of glaciers will likely have disastrous consequences for water security in much of Asia and other parts of the global south. Finally, the cryosphere holds significant amount of greenhouse gases, particularly methane, which has been stored and frozen for centuries. Thawing of the cryosphere and release of these gases is expected to further exacerbate global warming.

Climate change and the cryosphere

Across the world, the cryosphere is in decline (Rasul et al, 2020). Indeed, the continuing loss of glaciers, snow cover, sea ice and permafrost severely threatens the Earth’s climate system. Not only are these habitats under threat, but the loss of snow, ice and glaciers across the world will further amplify climate change and the negative impacts of global warming. In this section, I discuss some of the major trends related to climate change and the cryosphere including the major ice sheets, glaciers and permafrost regions.

Ice sheets

Much of what we experience in terms of climate change will depend on what happens to the large glacial ice sheets in Greenland and Antarctica. Research shows that these vast ice sheets are melting and will likely continue to lose mass at an accelerated rate far into the future (Pilkey and Pilkey, 2011). A recent study suggested that melting of the Greenland Ice Sheet is accelerating and much of the sheet is threatened (Boers and Rypdal, 2021). One study indicated that the Greenland Ice Sheet has lost some 3,902 billion tons of ice since 1992, increasing the sea level by almost 11 millimetres (IMBIE, 2020). If all this ice was lost, the sea level could rise by over seven metres. Moreover, the infusion of freshwater into the oceans could weaken the Atlantic Meridional Overturning Circulation – the ocean system that regulates weather across the North Atlantic and Europe by bringing warm water north and colder water to the south (Harvey, 2021). Some have argued that significant weakening or failure of this circulation system could result in major freezing events and global weather disruptions. At the other pole, the Antarctic Ice Sheet is losing about 150 billion tons of ice annually. Yet, while the ice sheet is losing mass, the overall trends for the Antarctic are less obvious and quite ‘messy’ (as the National Oceanic and Atmospheric Administration says), with sea ice changes trending flat over the last four decades (Scott, 2023).

Alpine glaciers

Some of the most visible evidence of climate change can be seen in the glaciers of the Alps, Himalaya and Andes. Almost all mountainous and alpine glaciers are melting and losing mass which can impact sea level rise. However, perhaps more critical will be the impact on water security and the availability of clean drinking water in parts of Asia, Europe and South America. In the Himalaya, for example, glaciers contribute to rivers that flow through major population centres in China, India, Nepal, Bangladesh and other countries in South Asia. The Ganges, Yellow River, Indus and Yangtze are all glacier-fed rivers that provide water resources for huge populations. In South America, melting glaciers threaten the water security of La Paz, Bolivia and Santiago, Chile (and many other cities). Peruvian glaciers have lost approximately one-third of their area since 2016 (Moens, 2020) while all the 26,000 glaciers in Chile are receding (CGTN, 2022). Sadly, the Ernest Hemingway story ‘The snows of Kilimanjaro’ will eventually refer to conditions that no longer exist in Tanzania. Indeed, the glacier at Kilimanjaro has lost approximately 85 per cent of its area and is likely to be completely melted by 2060 (Rasul and Molden, 2019). Meanwhile in Europe, it is estimated that over 50 per cent of the mountain ice has disappeared since 1850. By the end of this century, less than 10 per cent of this ice is expected to remain (Rasul et al, 2020). Yet another study detailing the loss of ice in the glaciers of New Zealand found that they are shrinking at such an accelerated rate that many will be gone by the mid-2030s (Corlette, 2022; McClure, 2023).

Recently, I had a chance to witness these trends first-hand when I travelled with my family for a snowboarding holiday in the Austrian Alps. The resort – Stubai – is located south of Innsbruck at an elevation of almost 3,500 metres. So, even though there was no snow in Innsbruck in late December, the mountain was well covered with glorious snow. Further, Stubai sits on the Schaufelferner and Daunkogelferner glaciers (some of the lifts are built directly into the glacial ice). The resort’s high elevation and glaciers meant that, in the past, enthusiasts were able to enjoy year-round skiing. I was told that during the ‘summer ski season’, the resort would churn up ice from the glaciers to create skiable terrain (clearly not the best tactic for maintaining the longevity of this precious resource). Today, there is a better understanding of the challenges facing alpine glaciers and significantly more careful management of the ice (Salim et al, 2021). There is no longer summer skiing at Stubai. Moreover, the resort deploys a range of ice protection tactics, including covering parts of the glaciers with geotextiles that reflect radiation from the sun (that would normally melt the ice) back to the atmosphere. One study showed that the use of geotextiles could decrease the loss of snow and ice by approximately 60 per cent (Olefs and Fischer, 2008). However, the process is so expensive that it is not considered

to be a long-term strategy for climate change adaptation. One estimate put the cost to cover all global glaciers at over US\$1 trillion (Amos-Landgraf, 2021). In any event, the outlook for the world's glaciers is not promising, with another report suggesting that by the end of this century – even if warming is limited to 1.5°C – over half of the glaciers on Earth will be gone (Rounce et al, 2023).

In addition to tourism impacts, the rapid melting and loss of alpine glaciers can result in significant consequences for mountain and downstream communities and there will likely be an increase in glacier-related disasters (see Rasul and Molden, 2019). In some cases, glacial melt can produce huge lakes and surface water within the glaciers that can burst. Known as Glacial Lake Outburst Floods, these events can have devastating effects on the lives of people, agriculture and wildlife habitats. Moreover, receding glaciers can disrupt landforms and destabilize slopes, resulting in landslides and other related hazards (Haeberli and Weingartner, 2020).

Melting glaciers will also negatively impact the availability of water for agriculture, irrigation and drinking. For example, in parts of Nepal, some two-thirds of the water supply for mountain communities comes from snow and ice meltwater during the dry season. As there are limited water storage resources (for example, groundwater aquifers or large reservoirs) in these areas, it is the glaciers themselves which provide water security in times of low precipitation. As these recede and disappear (following a short-term trend of increased water availability), it is expected that water scarcity will become more common (Wood et al, 2020). Moreover, as glaciers melt, the quality of water will be negatively impacted. For example, it is possible that chemicals such as DDT (no longer in use due to their adverse effects on humans and wildlife), mercury or minerals such as iron that are trapped within the ice will be released and go on to contaminate important water sources (Zhang et al, 2017). Of course, water is crucial for irrigation and agriculture. The loss of glaciers is likely to seriously impact food security and force communities to abandon farms and traditional growing practices.

Permafrost

Some of the most significant impacts of global warming will be on areas of permafrost. Permafrost – these parts of the earth and ground that are perennially frozen – covers some 20 to 25 per cent of the Earth (Pilkey and Pilkey, 2011). It can be found in areas of Tibet, Siberia, Canada, Alaska, Greenland, the Andes and other spots around the world where the subsurface ground is essentially permanently frozen. In the permafrost, the upper or surface level, around a metre deep, can sometimes melt in summer (it is described as active) while the perennially frozen areas can be hundreds of metres thick.

Critically for climate change, melting permafrost releases methane and carbon dioxide into the atmosphere. As these areas warm, matter and material that has been frozen will begin to decompose (releasing greenhouse gasses) and further add to climate change. The processes will then lead to further melting of permafrost areas (and further release of methane and amplification of climate change). It is not completely known to what extent this type of negative feedback loop might contribute to future global warming. However, much of the recent research suggests that the impacts could last centuries (Biskaborn et al, 2019). The release of methane from permafrost is what most concerns climate change scientists. When compared to carbon dioxide, methane has a relatively short shelf life, lasting about nine years in the atmosphere before it dissipates (CO₂ lasts anywhere from 100 to thousands of years). However, while it is there in the atmosphere, methane has much stronger heat-trapping properties. This means that even small changes in the amounts of methane emitted can have significant short-term impacts on global warming. Methane is also emitted from agriculture and much of the focus has been on burping and farting cows. My son does not eat meat, partly for this reason. And, recently, I have turned to a mostly vegan diet for similarly environmentally motivated factors. Yet, the melting permafrost cannot be saved by plant-based diets alone and will require coordinated and significant reduction in carbon emissions.

The potential impacts of the loss of permafrost areas are significant. In addition to the carbon release discussed previously, warming of these areas is damaging fragile ecosystems and habitats. Many plants and animals that are attuned to the permafrost environment will be negatively impacted by these trends. For example, thawing permafrost can release nutrients that increase the growth of algae and harm stream and water ecosystems including fish and their food sources (O'Donnell et al, 2017). Further, larger shrubs are now growing in areas formerly dominated by lichens, grasses and other small plants. Growth of larger vegetation will accelerate permafrost thawing which will then go on to release additional polluting emissions and worsen climate change (Struzik, 2020).

Melting permafrost will also likely contribute to the loss of land via storms and other processes related to coastal erosion. Indeed, coastal areas in Arctic zones are particularly susceptible to erosion. This is due to the relations between warming climates and the sensitivity of permafrost to changes in temperature. Following other similar trends, rates of erosion in Arctic coasts are expected to increase. This could have catastrophic consequences for people living in these areas with some communities experiencing erosion rates of more than 20m per year (Jones et al, 2020).

These processes will also disturb infrastructure and the built environment. For example, permafrost melting can destabilize the ground through processes of contraction and expansion associated with melting and refreezing (Bykova,

2020). One study found that some 70 per cent of Arctic infrastructure – buildings, pipelines and roads – is at risk of damage or destruction (Hjort et al, 2022). In Russia, entire cities hosting large populations are built in permafrost areas. As these areas thaw and soils shift, the potential impacts to societies will be significant. Indeed, many structures in cities such as Vorkuta show major degradation and deformations due to a decline or reduction in permafrost. In another Russian example, an oil storage tank in Norilsk collapsed due to thawing of the permafrost and associated subsidence. The spill polluted two rivers and a lake with over 20,000 tons of diesel oil. This will not be a rare occurrence in the future. Indeed, the predicted cost to Russian infrastructure due to melting permafrost is likely to be more than US\$80 billion (Schrieber, 2020).

Adapting to change in the cryosphere

Perhaps, the story so far is somewhat dire. The impacts of global warming on the cryosphere threaten societies directly and indirectly across the world. Moreover, melting glaciers are not a distant threat. Rather, the interconnectedness of the Earth's hydrological cycle means many of us are already impacted by these processes and eventually we will all know and experience the consequences. The cryosphere is a critical part of the global climate ecosystem and major changes are taking place here that will dramatically impact life on Earth. Even if we took radical steps to reduce carbon emissions, the cryosphere will be forever changed by human behaviour. This means that people will have no choice but to adapt to a new environment and new climate. I have already talked about efforts to cover glaciers with geotextiles that reflect sunlight and radiation back into the atmosphere. There are many other forms of adaptation worth noting and I will discuss some of these in the following case studies. These can be both proactive and reactive. There is a critical need to think through the way we will feed societies under climate change, particularly in cryosphere areas. For example, in such areas, changes in agricultural practices might include switching crops and plant varieties, altering planting patterns, or initiating new irrigation and water conservation techniques that reflect new water needs and circumstances (Hock et al, 2019). Many villages in the Indian Himalaya are creating artificial glaciers and ice stupas to fill a water security need in the early spring. I will talk about some of these in Ladakh, India later in this chapter. Melting permafrost can also lead to increased flooding and other hazards such as avalanches and landslides. As a consequence, communities are developing more robust approaches to disaster risk reduction and management that include monitoring and modelling of the permafrost (and hazard risks), early warning communication systems, and citizen-based risk mapping – to name just a few efforts (Pradhan, 2022).

Unfortunately, adaptive strategies tend to be driven primarily by local factors and conditions and can be narrowly focused, short-term and generally inadequate at fully adapting to a changing planet (Rasul et al, 2020). Clearly, we are dealing with a global challenge that is not restricted to local, state or national borders. Nor is it limited to any individual sector. As such, adaptation to climate change will require innovative cross-border, multi-institutional responses. Indeed, the challenges to the cryosphere will have multiple forms of impacts across all manner of interconnected systems, including natural habitats, water and food security, infrastructure and the built environment, tourism and leisure, human health and wellbeing, and economic security and livelihoods, and so much more. It is likely that connected and integrated forms of adaptation that engage with this diversity of themes and contexts will be needed to ensure and support flourishing lives in the cryosphere.

This introductory section has provided a brief overview of the cryosphere and some of the evident trends related to climate change. In the following sections, I review two cases of climate change and adaptation in the cryosphere. The first looks at the village of Shishmaref in Alaska (United States), home to an indigenous community that has witnessed decades of coastal erosion due to disruptions to sea ice, storms and wave action, and melting of permafrost. The extent of disruption has been so extensive that the village has twice voted to relocate. The second narrates the challenges and adaptation practices of people living in Ladakh (India), also known as the ‘land of high passes’. Making up part of the Himalayan mountain chain, most of Ladakh is at an altitude of over 3,000m and, at times, can be quite inaccessible. Climate change, development, tourism and geopolitical conflict interconnect in Ladakh and threaten ways of life that have been in place for centuries. Both cases demonstrate the interconnections between the cryosphere and human culture. They also highlight how those on the front line of environmental change tend to be the most vulnerable and under-resourced communities. Yet, the way in which people work to maintain these ways of life – integrated within ecologies of reciprocal care – are inspirational and world leading. In the following examples, I take a closer look at these activities and how life is changing in two cryosphere communities.

Life on ice in Shishmaref, Alaska

Shishmaref is a small village located on Sarichef Island, part of Alaska’s Seward Peninsula. The peninsula is a remnant of the land bridge that once connected North America and Siberia – an important historical route for human migration. Today, this part of Alaska is home to several indigenous communities known as the Iñupiat. Traditionally, the Iñupiat lived subsistence lifestyles – hunting seal and walrus and living off the resources of the land. In this context, sea ice was a critical infrastructural resource as it connected

communities and served as a stage and hunting ground to access resources and harvesting areas. Even today, local knowledge of the sea ice, handed down over generations, is crucial to life and survival in this coastal area of the Arctic. Yet, as the climate warms, the sea ice is becoming more unpredictable and threatening the long-standing understandings and adaptive practices associated with survival in this rugged part of the world. Shishmaref has been identified as at risk for over two decades now, with some estimating that the island would be uninhabitable in the very near future ([Angnatok and Laing, 2023](#)).

Adaptation to environment and land has always been a way of life for the Iñupiat. Through their history, many Iñupiat communities were nomadic, moving across the region, following resources, and fitting themselves into the landscape. Nomadism enables the ability to move along with environmental conditions. Nomadic pastoralists can take herds of cattle or other animals across large territories as they provide for community needs. Iñupiat nomadism was largely curtailed during the mid-20th century as indigenous areas of the newly formed state of Alaska came under American regulatory control.

The Iñupiat and their ‘challenge’

Today, at the Iñupiat community of Shishmaref, fewer than 600 people live in some 150 structures on Sarichef Island. They are known as the ‘Kigiqtaamiut’ or ‘people of the island’ and have lived in this region for thousands of years ([Marino and Lazrus, 2015](#)). As with other Iñupiat people, traditionally they lived a nomadic lifestyle, migrating along with changing environmental conditions and the availability of food. Nomadism is, of course, an adaptive strategy that enables people to follow reliable and predictable patterns, commonly associated with the changing seasons.

Today, the impacts of climate change, including more volatile and extreme weather, is putting pressure on the livelihood of nomadic people across the world ([Pascotti, 2017](#)). In Shishmaref, deterioration of the nomadic lifestyle began in the 20th century with programmes designed to ‘civilize’ native people through integration into western lifestyles ([Marino, 2015](#): 13). On Sarichef Island, this meant the construction of urban-style infrastructure, a school building, a post office, the introduction of modern and petrol-powered vehicles such as All-Terrain Vehicles and snowmobiles. In other words, the establishment of a ‘permanent’ settlement on the island with all the comforts associated with modern life ([Soikkeli, 2021](#): 46). In addition to modern technologies, particular long-standing ‘worldviews’ have been threatened. For example, as Susan [Fair \(1997\)](#) notes, the Kigiqtaamiut people traditionally saw themselves as stewards of the land, to maintain it in honour of the past and future. There is an obvious care ethic here that positions

people in a role of looking after and maintaining the life-sustaining qualities of the environment in which they live. Care, in this way, is an alternative to the concerns of private land ownership. Recognizing the value of land as something that is shared with the past and future changes the way it is managed and how people fit themselves into the landscape. The erosion of traditional, non-western worldviews can be associated with the deterioration of care and caring practices. I highlight this later in Norberg-Hodge's account of transformation in Ladakh. It seems that similar processes are underway in Shishmaref.

Yet, not all traditional practices have vanished. Indeed, today, the village is still sustained by subsistence economies. For example, residents hunt seal, they fish, and they gather berries and other local vegetation. They depend on the land and sea for their livelihood and work within the seasonal balances of freezing and thawing ice. Yet, a good portion, some 50 per cent, of the workforce are involved in the waged economy with jobs at the medical centre, school and other government agencies, as well as in hunting or fishing supply (Marino, 2015). This hybridity contributes to particular adaptation challenges as the community can no longer migrate with the relative ease of their ancestors. Indeed, the introduction of modern technology, institutions, and social and economic structures has, in some ways, limited adaptation options.

Most non-Arctic people seem to know about Shishmaref as a place impacted by climate change. Going back to about 2002, stories of the community on this topic have been published in the *New York Times*, the *Los Angeles Times*, the *Guardian*, and many other international, national, and local news and media sources. Typically, the stories highlight the destruction of life and culture, the suffering endured by residents, and of course, the impending doom of Shishmaref as a kind of real-world Atlantis. Time and again, the villain in these stories is climate change – responsible for melting ice, volatile weather and rising seas. Truly, climate change and recent weather patterns have drastically impacted life on Sarichef Island. The most visible impacts of these changes in Shishmaref – the images that make for powerful representations of climate change – are everywhere. Do a quick image search on Shishmaref. At the top of the search findings are photographs of homes and structures dangling on cliff edges, literally crumbling into the sea. Right behind these in the visual narrative of Shishmaref are those photos that combine destitution and poverty alongside activities of self-sufficiency and resilience (for example, hunting and preparing seal or salmon). In many of these images you will see a mix of traditional (for example, hunting seal or ice fishing) and modern ways of life (riding All-Terrain Vehicles or watching TV). Here, the Iñupiat's cultural hybridity is on display – caught in the middle of 'the traditional' and 'the modern'.

The story of Shishmaref is as compelling as the images suggest. For decades now, it has been well known that the island is facing destruction due to coastal flooding and erosion. The entire developed area is under threat of erosion, which generally coincides with large storm events. Moreover, inundation of the island with sea water can infiltrate water infrastructure and contaminate the supply. As a result of these and other environmental factors, life in Shishmaref is at risk. The seriousness of this risk has been punctuated several times by the destruction of homes and structures due to storm events followed by successful votes – in 2002, 2012 and 2016 – to relocate the community. It seems that nomadism is not long forgotten.

Relocation of Shishmaref is a complicated endeavour (Gregg, 2021). It is clearly a challenge to support the migration of people from the places they have lived for generations, even when there is the threat of inundation and destruction. Indeed, cities and countries across the world are struggling to manage this process. Of course, there are massive financial challenges involved with relocating coastal communities. Otherwise known as managed retreat, these are processes through which home and communities are moved away from flood-prone areas which are then either returned to a pre-development state or employed as a form of flood defence, for example. In New York, in the aftermath of Hurricane Sandy, over 500 coastal homes were purchased and then demolished in Staten Island. The cost of the programme was over US\$200 million which only resulted in piecemeal protection and relocation. Indeed, the buyouts in the area have been unevenly implemented due to the voluntary nature of the programme (Misdary, 2022). The New York example begins to demonstrate the massive costs involved with moving even a small number of residents. Further, it is evident from this example and experience around the world that there are significant cultural and emotional implications associated with relocation. Home is perhaps the most important way we make connections to place. It forms the basis of community and how we see ourselves ‘fitting in’ (*or not*). Many of those New Yorkers who moved through the relocation and buyout programme felt displaced and struggled to get over the sadness of leaving their former neighbourhood.

The relocation of whole communities can mean that particular cultural forms and practices are lost. This was one of the messages of the powerful and very enjoyable and entertaining television show called *Treme*, which I mentioned earlier (especially if you appreciate jazz, bounce or zydeco music styles). Set in New Orleans, *Treme* narrated fictionalized stories of post-Katrina loss and resilience in a realistic style that the show’s creators had developed in earlier gritty dramas such as *The Wire*. *Treme* focused on how Hurricane Katrina exposed long-standing racial and social inequalities in America. These were the same inequalities that made the aftermath of the hurricane so catastrophic and gut-wrenching (almost 1400 deaths). In addition to the loss of human lives and the billions in infrastructure and

material damage, the show exposed Katrina's devastating impact on culture. As most who have visited the city can attest, New Orleans is a unique place – a carnival hotspot that draws on Spanish, French and African cultures and people to produce an astounding mix of influential musical styles, food and art. Some suggest that the city will be uninhabitable in the not-too-distant future (Harmon et al, 2021). The devastation of New Orleans through sea level rise, intense storms and volatile climate will leave a hole in the cultural diversity of America. This is a hole that simply cannot be replicated through relocation. Culture is not something that can be picked up and moved wholesale without change. Rather, our lives and cultures are 'placed' and developed via an ecology that includes the environment. Cultures and people both fit into and are moulded by their physical world. It is an amazing feedback loop that contributes to the diversity of societies and cultures across the world.

The people of Shishmaref have formed their culture in concert with an environment that has always changed. For generations, they have been moving along with seasons and environmental change. Their nomadic lifestyle enabled adaptation. Yet, bound by modern conceptions of land value and ownership and their own integration into Western lifestyles, today these adaptive strategies are less feasible if not outright impossible. In Shishmaref, there has already been small-scale relocation as some homes (at least 22) and structures have been demolished and residents have been moving further inland and to higher elevations (Marino and Lazrus, 2015). The formal process of managing the possible relocation of Shishmaref has been going on now for some 30 years (at least). Indeed, the village has voted three times to relocate. Yet, relocation in the near future seems unlikely. Unfortunately, plans to move such as these signalled to state infrastructure funding bodies that the area was not one worth investment and, as such, money for infrastructure and housing has evaporated (Marino and Lazrus, 2015). This has meant that the quality of life on Sarichef Island has been worsening.

There have been ongoing efforts to protect Shishmaref. In particular, the US Army Corps of Engineers have worked for decades to protect the island. This has included the use of sandbags, the installation of revetments, sea walls, rock and boulder revetments, walls, and gabions (Mason et al, 2012). Most of this has been only of limited success or only designed for relatively short-term protection. Unfortunately, longer-term protections have been more difficult to fund, in part due to the community's decision to relocate. Nevertheless, in 2022, the USDA Natural Resources Conservation Service announced funding for the community to improve its water supply which was in dire need of updating (USDA, 2022). What I found particularly inspiring from the Shishmaref case was the ability of the residents to get international attention. This small community of about 600 people is regularly reported

on in the international media and residents have spoken to the US Congress in Washington, DC (DeMarban, 2014). The stories of people living at the edge – Shishmaref is only 100 miles from Russia – can be so powerful. For example, Esau Sinnok, an Arctic Youth Ambassador, talks about how climate change is compounding the island’s problems and making life there untenable. He says: ‘It really hurts knowing that your only home is going to be gone, and you won’t hunt, fish and carry on traditions the way that your people have done for centuries. It is more than a loss of place, it is a loss of identity’ (Sinnok, 2015; 2016: np). I find these expressions, and in particular, the awareness that time is limited in Shishmaref, particularly moving. More than the physical reality of loss, it is the cultural impact that cannot be replaced.

Unfortunately, Shishmaref is not unique in Alaska. A significant number of communities along the coast, with people living on barrier islands and sand dunes, are threatened by coastal erosion. Melting ice means these areas are more vulnerable to significant storm events and the destruction of homes and communities. It has been suggested that the increase in autumn storms is likely associated with the delayed formation of sea ice which has customarily safeguarded coastal areas from storm surges and flooding (Shen and Ristroph, 2020). Like Shishmaref, many of these areas have limited resources for coastal protection or relocation. There are no easy answers to the challenges facing cryosphere communities in the Arctic. Yet, one crucial step here, as suggested by Elizabeth Marino and many others, is to legally recognize the indigenous right to territory and the ability to practice subsistence lifestyles.

The land of high passes

Ladakh is a high elevation, cold desert located in the mountainous part of northeast India. It is a sparsely populated, rural area of about 300,000 people (30,000 of whom live in Leh, the capital and main city of Ladakh). Ladakh, sometimes called the ‘land of high passes’, is known for its high altitude, extreme temperatures and breath-taking views. Winters are cold, with an average January temperature of about -7°C . However, it is not unheard of for the temperature to drop to -20 or even -40°C . The average July temperature is about 18°C . Yet, there has been a warming trend, particularly since the 1990s (Chevuturi et al, 2018). Moreover, Ladakh sits in the rain shadow of the Himalayan mountains and has desert-like conditions. The precipitation that does fall (about 100mm per year) generally occurs during the June to August monsoon season. In these conditions, surface meltwater is the primary source for human and animal use, including irrigation and agriculture. This is the water that comes from glacial ice and snowfields as they melt with the onset of the spring season.

Ladakh is part of the ‘third pole’, the area of Asia that includes the Himalaya, Hindu Kush and Karakoram ranges. It is often called the third pole (after the Antarctic and Arctic polar regions) due to the vast amount of frozen water stored in these mountains. However, as noted earlier, glaciers in the third pole are melting and retreating at a high rate (Press Trust of India, 2021). In 2002, there were more than 18,000 glaciers inventoried in the central Ladakh range (Schmidt and Nüsser, 2017). They are generally quite small and notable for their high altitudes (above 5,200m) and northwest–northeast facing positions (Soheb et al, 2022). As noted, the people living in Ladakh rely on glacial meltwater for crop farming (during the short growing season) and animal husbandry with livestock consisting of yak, goats, cattle and other animals attuned to the arid mountain conditions (Dame and Nüsser, 2011; Schmidt and Nüsser, 2017). The Himalayan glaciers feed into the Indus, Ganges and Brahmaputra rivers and are part of a system that contributes to the water security of over one billion South Asian people. Yet, these glaciers, including those in Ladakh, are retreating at a worrying rate (Azam et al, 2021). My interest in Ladakh is based in a desire to understand how climate change is altering these water systems, the ways in which these processes are influencing society and culture in the region, and the relations to care and care practices associated with water security.

Culture, politics and development in Ladakh

Bordering Tibet, Ladakh is home to a large Buddhist population and Buddhism has been part of Ladakhi culture for some 2,000 years. The importance of Buddhism is evident in the landscape and built form, including the numerous stupas or ‘chortens’ (and stupa engravings), rock carvings, stelae (stone slabs with carved inscriptions), monasteries and other structures (Luczantits, 2015). Buddhist culture still thrives in Ladakh (sometimes called ‘little Tibet’) and can be witnessed at these sites as well as festivals, the prayer flags adorning spiritual locations, prayer wheels, dress and, of course, the presence of Buddhist monks who reside in local monasteries.

Ladakh is also well-known for its position on the caravan trade route that historically joined it to the Silk Road. For centuries the region was a central crossroads between Central and South Asia and closely connected to China, Lhasa and other important social, economic and cultural cities (Rowold et al, 2016). This connectivity was severed following independence and the creation of new borders with Pakistan and China, much of which remains disputed. Ladakh, and its main city of Leh, became part of the Indian state of Jammu and Kashmir in 1947. The borders isolated the area and cut it off from the trans-Himalayan trade. This level of extreme isolation lasted until the 1970s when travel restrictions to Ladakh were lifted and the Indian

army began constructing roads and other infrastructure. Today, the Indian government is actively modernizing this boarder region through extensive highway building, investment in education and universities, and delivery of water and sanitation improvements through the Jal Jeevan Mission. This programme is working to the objective of bringing drinking water to all households (essentially at the doorstep) across rural India.

Nevertheless, in this part of the world, geopolitical contestations and disputes are as ripe as ever. For example, in the northern corner of Ladakh, at the confluence of borders between China, India and Pakistan, sits the Siachen Glacier. The glacier is in an area of Ladakh that is generally understood to be un-demarcated and contested. At some 5,400m, it is one of the most inhospitable places on Earth. It has also been the site of military battles and skirmishes between Pakistani and Indian forces (Siachen Glacier is sometimes called the highest battleground on Earth). Yet, rather than bullets, it is the climate and hostile environmental conditions that have produced the most casualties. Both armies maintain military bases at extreme altitudes which has contributed to significant loss of life. One study suggested that less than 5 per cent of casualties suffered by Indian forces have been a result of enemy fire (Khan, 2012). Siachen is not the only flashpoint in Ladakh. More recently, injuries and deaths were reported after conflicts between Indian and Chinese forces at the Pangong Lake and the Galwan Valley on the disputed border between the two nations.

These skirmishes reflect just some of the long-standing geopolitical instability of the area and the ongoing militarization of Ladakh and surrounding regions. This includes the Union Territory of Jammu and Kashmir, which has been the site of dispute between India and Pakistan since independence in 1947. Instability has been on the rise in recent years, particularly after abrogation of Article 307 of the Indian Constitution in 2019, which had enabled Kashmiris some level of autonomy from the Indian government. The national government also severed off Ladakh from Jammu and Kashmir into its own administrative unit. There remains, however, internal discord within Ladakh that partly reflects the area's unique demographic characteristics and situation. According to the 2011 Census, the region includes a mix of people with mostly Muslim (around 130,000) and Buddhist (just over 100,000) religious backgrounds while Hindu people made up around 10 per cent of the population (approximately 30,000). The majority of Muslim people reside in the northern area of Kargil while Buddhists dominate the areas around Leh. There are also some 1,200 nomads who migrate across pasturelands with livestock such as goats and sheep (Dollfus, 2013). Today, the city of Leh serves as a jumping off point for Himalayan tourism and adventures but also as an employment centre and gateway to opportunities in other parts of India and beyond. Reflecting its regional importance, over the last three decades, the city has grown at a

significant pace (sometimes as high as 30 per cent), largely due to rural to urban migration.

While the area is experiencing rapid growth, much of Ladakh was undisturbed by forces of globalization well into the later stages of the 20th century. Indeed, there was almost no formal road system well into the 1960s (Demenge, 2015) and the area was only opened to national and foreign visitors in 1970s. In her classic book, *Ancient Futures: Learning from Ladakh*, Helena Norberg-Hodge narrated the ways in which western style development, consumerism and integration to the wider global world was impacting the Ladakhi people. Her book is based on years of anthropological research and is extremely thoughtful and rich in detail. During her time there, Norberg-Hodge witnessed how this relatively isolated, homogeneous culture, hitherto closed off from modern development, experienced processes of globalization. Her assessment was grim. For example, she found that the onset of westernization eroded long-standing social and cultural practices, including intergenerational care and networks of social capital. Moreover, by the end of her work there, she found that the 'modern' Ladakhis were less happy than earlier generations, and even less happy than the people she originally met in the 1970s.

Considered from the perspective of care, westernization and developmentalism obscured and damaged the interconnectedness of life that had previously been central to Ladakhi people. Not only were connections between people being severed, but links to the natural world were also less obvious. As Norberg-Hodge wrote, reflecting on the traditional integration of human-natural life in Ladakh, 'everything has been done with care: fields have been carved out of the mountainside and layered in immaculate terraces ... the crops are thick and strong and form such patterns that an artist might have sown their seeds. Around each house, vegetables and fruit trees are protected ... by a stone wall' (Norberg-Hodge, 2000: 10). Her book details the sustainable qualities of the Ladakhi people – making things by hand, using local and communal labour, reusing and recycling extensively and thoroughly enjoying life. Critical here is the role of leisure and Norberg-Hodge devotes a chapter to the Ladakhi *joie de vivre*. Interestingly, she attributed a great deal of this happiness to the Ladakhi connectedness to the land, their knowledge of the seasons, the environment, and their connection to other people. This kind of interdependence, she argued, included emotional support and a contentedness with their lives and situations.

On a recent trip, I was able to witness some of the beauty of traditional life in Ladakh and how this is moving towards a more progressive future. The village of Damkhar sits on the Indus River about 120km north of Leh. Here, we were able to talk to two generations of organic farmers. They noted how the weather had changed significantly during their lifetimes and how there was less water availability in the village than in previous decades.

They also talked about an organic agricultural future that was sensitively incorporated into the environment through sustainable land use practices. Fascinatingly, we also witnessed some of the close-knit intergenerational bonds that, at least in this village, were still on display. Sonam Angchuk, our colleague and guide, brought us to his grandfather's house that was built by hand over 100 years ago. We sat in the kitchen (the centre part of the home) and shared food, drink and friendly conversation. The care and love between generations was plainly evident as family members sat and talked together and discussed their experiences living with the land and supporting each other.

For Norberg-Hodge many of these positive qualities of traditional village life were being eroded due to the opening of Ladakh to western-style development and global connectivity. She noted how out-migration to Ladakh's main city of Leh as well as Delhi and other parts of India were pulling people out of the villages and eroding traditional life and values. This was not to discount the value of education and improved economic opportunity that was available outside the villages. However, for Norberg-Hodge, the impacts of these processes were negative both for the city of Leh and the rural areas of Ladakh. Increasingly, Leh was seen as a big city with big city problems such as crime, traffic and pollution. Meanwhile, the villages were being hollowed out and becoming increasingly negatively impacted by tourism and western value systems.

These trends have not abated in the years since the publication of *Ancient Wisdom*. In many of the villages I visited, people seemed to accept that the young generation would study in Leh, Delhi or further afield and seek opportunities beyond rural Ladakh. I was regularly told that it is quite difficult for young people to stay in the villages and that it was important for them to explore the world beyond. Moreover, the city of Leh is still expanding and aching with growing pains; like other Indian cities, it has high levels of (sometimes unregulated) development, traffic congestion and transport deficiencies, as well as water and sanitation challenges (there is no public sewage treatment system in this city of 30,000). Yet, through all of this, I have always been taken by the prologue to *Ancient Wisdom*, written by the Dalai Lama, where he notes: '[N]o matter how attractive a traditional rural society may seem, its people cannot be denied the opportunity to enjoy the benefits of modern development.' However, he continues that, among the people of Ladakh, there is 'an inner development, a sense of warm-heartedness and contentment, that we would all do well to emulate' (Norberg-Hodge, 2000: x). For me, this quote (and *Ancient Futures* more broadly) draws attention to the importance of decolonizing research and engagement in the global south. In Ladakh, I am in awe of the uniqueness and beauty of this place, its culture and its people. Yet, simultaneously, I am aware of the potential to romanticize the traditional. Further, I understand

that this place, like all places on Earth, is changing and will continue to change. None of this means that we cannot celebrate what is special or unique and learn from those who live in this rugged and culturally rich place.

Conversations about water, care and culture

Over the past few years, I have been lucky enough to learn from Ladakh, working with a group of artists, water experts, glaciologists, paleoclimatologists and communities there to explore the impacts of climate change on water security in the region. Part of our work has involved gathering as much information as we can find about water and glaciers in Ladakh. But also, and I would argue more importantly, we have been meeting with Ladakhis across the territory to hear their stories and to understand how their lives have been impacted by environmental change. This has been led by the ambitious and talented team at the Ladakh Arts and Media Organisation (LAMO), a charitable, non-governmental organization, established in 1996, that promotes and supports artists and the creative heritage of the region through the arts.

In their work with villages in Ladakh, LAMO explores local knowledge and practices through the arts. During these events, they spend several days with village partners, listening to stories and songs about water, participating in rituals, and investigating water resources and infrastructures. These workshops often involve schools and students interested in exploring water themes as well as elders and local water resource experts. Even with the erosion of traditional cultures and social capital, this kind of intergenerational sharing is still an important part of Ladakhi life. We have noticed that this kind of listening exercise is critically important for understanding the interdependencies between culture, society, environmental change and water security. Moreover, by listening-first and working through the arts we are better able to facilitate discussions and understanding about local values and bring local knowledge into the public domain.

During one recent workshop in Gya, students spent a day walking in the areas surrounding the village to explore water infrastructure, streams and irrigation systems. With the help of water experts and artists, they studied the water systems (quality and quantity), discussed management best practices, and produced resource maps that highlighted the village's hydrological systems. Somewhat surprising to me, I was told that this kind of hands-on learning that draws on and explores local surroundings is not particularly common in Ladakhi schools. In the workshops with LAMO, we have worked to introduce creativity into pedagogy. This has included bringing artists along on field trips, but also looking at water through activities such as drawing, performance and singing. In Ladakh, music is culturally important and can often provide insights into the connections

between people and the environment. Recently, students at one of our workshops sang songs from *Singing Ice: Ladakhi Folk Songs about Mountains, Glaciers, Rivers, and Streams*. In *The High Mountains*, the children sang: ‘If the glacier does not form, in the lowlands, why should the turquoise lake form.’ The lyrics throughout the song make connections between mountains, glaciers, streams and lakes, plants and animals, and human flourishing. This type of interdependency and the framing of humans as only part of a larger ecosystem is a common theme in Ladakhi culture. It is also something that we feel deserves celebration. The work by groups like LAMO helps signal that Ladakhi culture and way of life is special and worth protecting.

As Norberg-Hodge noted years earlier, I found evidence of a generational gap and a disconnection between the rich Ladakhi cultural history and young people. Yet, I also found a fascination with the past and traditional ways of life. For example, at our workshops, we regularly facilitate intergenerational dialogue between students and elders. At these sessions, the children are always full of enthusiasm and questions. At a recent event, an elder talked about his years living as a nomad, before he settled permanently in the village of Chumathang. He told the audience of his experience living on the land, moving with the seasons and *really* knowing the environment. Nomadism in Ladakh is no longer practised to the extent it was in the previous generation. Yet, these kinds of knowledges, now passed down mostly through stories and songs, provide clues into ways of life that still have value and the potential to inspire. In the following section, I will highlight some of these knowledges and how they relate to water security in Ladakh.

Water security issues and care through climate change adaptation practices

Ladakh is an arid and cold mountain region where glaciers (known as *kangs-ri* in Ladakhi) provide people with water for agriculture, drinking and economic development. Due to the area’s environmental conditions, there is often a shortage of water, particularly at the end of the winter season before the glacial meltwater becomes available. Life in this area has always meant adapting to challenging environmental conditions and doing a lot with very little. As with other parts of India (for example, Rajasthan, which I talked about earlier), there is a rich history of community-based water conservation and management in Ladakh. These are often quite simple, yet ingenious, forms of engineering that work with, rather than against, the natural environment.

Indeed, Ladakhi people use many of the rainwater harvesting practices and infrastructures found in other dry parts of India. For example, some communities have installed small tanks or ponds, locally known as *zings*, that collect glacial meltwater (Tundup et al, 2017). The *zings* are at the

end of an interconnected set of channels, often cut into the mountain slopes, that allow the water to flow directly into the storage area. In addition, several tactics are used to simply hold water in the area. These include the creation of ponds through stone impoundments, but also snow ridging and the construction of snow barrier bands (Tundup et al, 2017). These techniques help to collect snow on fields along ridges, which traps drifting snow and enables subsequent use and groundwater recharge. As community-based water systems, these infrastructures are commonly collectively organized and managed. In some cases, a *churpon* (a water manager or overseer) is selected by villagers to ensure fair and equitable distribution of water resources (Angchok and Singh, 2006). Yet, it is common for an entire village to participate in water infrastructure projects which might include design, physical labour, procurement of materials or donation of funds to support the work. In my discussions in Ladakh, I found a strong sense of community collaboration and volunteering around water infrastructure. For example, annual maintenance work or urgent repairs are often done collectively, with people notified of projects by door-to-door visits or through messaging applications. This kind of maintenance work is, in my view, all about care. As Norberg-Hodge noted, Ladakhis see themselves as part of something larger than themselves. They are aware of their relational position in the world (to use the contemporary geographical way of explaining this). This understanding of relationality and interdependence supports caring practices – for those around you, the environment, and the infrastructure that facilitates water security and flourishing lives.

Artificial glaciers and ice stupas

Ladakh is an important centre for the experimentation of artificial glaciers and ice reservoirs. Much of the artificial glacier activity is intended to address the water ‘gap’ that often occurs in the early spring before the meltwater from larger glaciers becomes accessible. Essentially, these are reservoirs of ice that, unlike naturally occurring glaciers, typically only last for a few months. Some of these are simple stream impoundments that freeze, forming a temporary frozen reservoir (in the summer, these are often completely dry). The most famous of these Ladakhi ice reservoir practices is, without a doubt, the construction of ice stupas (Giaimo, 2016; Ice Stupa, 2023). Several news and popular media sources have caught onto these towers of ice as creative and ingenious adaptive responses to climate change. A few individuals, such as Mr Sonam Wangchuk, have received a great deal of attention for their water security work in Ladakh. Mr Wangchuk is an engineer who has long been involved in addressing water challenges. He is well known across the world for water security innovations, including the

creation of artificial glaciers called ice stupas. His work has been reported in many major global news outlets including the BBC and *Guardian* (Kohok, 2017; Safi, 2017).

The ice stupas are made by pumping water into the air which then freezes into stalagmite-shaped ice structures (EarthSky, 2022). Their name reflects the way that the ice structures resemble the cone or funnel shape of traditional Buddhist stupas (usually considered to be holy sites or monuments). They have been celebrated as an indigenous and small-scale response to current and future water security challenges in the Himalaya and elsewhere. However, while many local benefits for water security have been identified, their role as a practical, valuable and long-term climate change adaptation strategy is uncertain. Of particular concern here is the potential for future climate variability as well as the extent to which these ice harvesting structures are fully integrated into local community water management regimes and practices (Nüsser et al, 2019; see also Clouse, 2016; Gagné, 2016; Sharma, 2017). During a recent visit, I was able to meet another climate hero – Mr Chewang Norphel – a former engineer known as the ‘ice man’ of Ladakh (Aggarwal, 2021). Mr Norphel, now almost 90 years old, has worked in Ladakh most of his life. He often speaks of the challenges associated with living in the Himalaya and how he originated the idea of creating artificial glaciers back in the 1990s when water security was emerging as a significant issue for local villages (Shaheen, 2016). The work of Mr Norphel and Mr Wangchuk continues to provide inspiration to young Ladakhis and climate advocates across the world.

In 2019, a competition was initiated to promote more interest in ice stupas, providing a cash award to the structures that conserved the most water. The competition led to the construction of the structures across the region and widespread reporting and coverage of receding glaciers and water security in Ladakh. In 2021, the two winning ice stupas each conserved 12 million litres of water (HIAL, 2022). Unfortunately, the enthusiasm for ice stupas seems to have somewhat diminished. When I visited the region in 2023, it was difficult to find any ice stupas (even though I was visiting at a time when they would still be frozen). During the trip, I travelled to an area north of Leh where some had been constructed. The ice stupas were gone (although there were indications in the ground where they had been located in previous years). While Leh seems to have given up on ice stupas, the city now constructs another kind of artificial glacier – the ‘ice wall’. The wall is a sheet of ice draped over the surface of a northern facing hillside. In addition to the water security benefits, the wall is the source of increased tourism due to its attractiveness for ice climbing. Indeed, competitions are now held annually and regularly draw over 100 international climbers and enthusiasts to test their abilities against Leh’s wall of ice.

Care, ice and Ladakhi culture

Ladakh is an area experiencing significant change. It is going through environmental, political, social and cultural transformation. With increased development and tourism, people in Ladakh are probably (overall) more comfortable than they were in previous generations. There are better roads, more food options, more employment prospects, better education opportunities, and so on. Yet, as Norberg-Hodge noted 30 years ago, this has come at a cost. For some, the cost may be the loss of nomadic lifestyles that used to characterize Ladakhi culture. For others, it will mean children go to Leh or Delhi to study for jobs that will possibly take them even further afield. Yet, in my experiences there, I saw that there is a notable sense of joy among the Ladakhi people. I agree with Norberg-Hodge that a lot of this joy comes from a feeling of connectedness. It is being in touch with people, the environment and spirituality. Water security in Ladakh is accomplished in this way – through relations between multiple forms of knowing that are not always ‘objective’ or easily framed in modern understandings of the world. As forms of being, rituals, prayers, collective and communal work enable people to live in the rugged land of high passes and to find a sense of contentment and joy that is easy to envy but difficult to replicate.

A postcolonial cryosphere

This chapter reviewed some of the climate change issues and challenges surrounding cryosphere communities. Certainly, the legacy of colonialism continues to impact life in the cryosphere. Culture is not static, and we should take pause before celebrating the unique characteristics of a particular people. No human characteristic emerges in isolation. Rather, we are relational and formed through interactions with other people and environments both near and far. This makes all cultures hybrid in nature. In the people of Shishmaref the evidence of hybridity is easy to see. The mix of modern and traditional technologies and practices contributes to a somewhat ambiguous reality. Clearly, modern development in Shishmaref and Ladakh has contributed to improvements in some aspects of wellbeing such as increased access to education, economic opportunity, healthcare and connectivity to the wider world. Yet, this has come at a cost. Primarily, we see this in the loss of traditional ways of life that, in many ways, are more sustainable than modern practices.

Indeed, there is growing attention to the limits of globalization and western-style development and enthusiasm for alternative understandings of sustainability. One of the most prominent and well publicized of these is *sumak kawsay* or *buen vivir* (in Spanish). The concept comes from Bolivia and Ecuador where Quechua and Aymara indigenous framings of wellbeing have

infiltrated both the public consciousness and public policy. Translated into English, *buen vivir* means *the good life* or *living well*. Elements of this worldview are now part of the Ecuadorian and Bolivian constitutions. Yet, more than a political device, *sumak kawsay* has wider, more spiritual connotations that signal both communal attitudes around work and life as well as a harmonious connection to nature. A *sumak kawsay* worldview generally rejects mind–body and human–nature dualisms and modern framings of humans as superior or destined to control nature or somehow situated outside of ‘the environment’. However, it is pluriversal, meaning that there are multiple ways of framing our position in the world and no singular, privileged position. This way of seeing the world is rhizomatic (Deleuze and Guattari, 1987); a relational ontology that destabilizes modernist ontological nature–culture divisions (Escobar, 2011). It is, thus, a non-linear (as opposed to developmentalist), non-dualist worldview situated in community, solidarity, and a biocentric relationship with nature where all living things have intrinsic value (Coral-Guerrero et al, 2021). This indigenous, non-western framing has been recognized globally in academia and public policy (Altmann, 2017; Coral-Guerrero et al, 2021) and is emerging, along with a suite of other non-developmental concepts (for example, *ubuntu* in southern Africa) as a way to resist hegemonic, neoliberal and individualist discourse and growth-at-any-costs policies.

Sumak kawsay articulates much of the interconnectedness that is present in Shishmaref and Ladakh. In Ladakh, these harmonious framings are commonly situated in Buddhist spirituality where humans and the environment are not adversarial (as is common in modern western societies). Rather, Buddhists recognize the interdependence of all beings and position themselves in harmony with nature. I see significant connections between these southern framings of the good life and care. Care means recognizing the interconnectedness of our lives. These are the multitude of connections with other people, places, environments, technologies, and so on. In much of the western world, it seems that we have only peripheral or minor connections to the cryosphere. Perhaps we read about melting glaciers or reflect on changing seasonal patterns to warmer winters. Yet, we know that the cryosphere is a critical part of the wider global hydrological cycle. Moreover, our actions are having direct impact on the communities that live in these areas. People in Shishmaref and Ladakh both tend to see humans as centrally situated in nature. I have found this to be a recurring theme in much of my research outside of the global north. It seems that the time is ripe for a shift in thinking to more southern perspectives informed by alternative ways of seeing human–nature relations.

Ecologies of Care

This chapter summarizes and compares the cases and further develops the concept of ecological care. The chapter includes a brief introduction followed by a summary of the case examples and key themes. Drawing on this material, I make a theoretical contribution which joins together diverse positions and perspectives from urban studies, geography, water security studies and feminist theory. The intent is to build a foundation for future climate change adaptation. This starts with recognizing the potentially catastrophic consequences of global warming and the ways in which these impacts will be locally and unevenly experienced. Moving from this point and away from conventional, or status quo, responses for building resource and asset bases, I argue for a shift in understanding the practices which make up adaptation and wellbeing more generally. This is a shift that sees human lives as always invested in ecologies of care.

A note on international work, travel and climate impact

Recently, I read an article critical of Rishi Sunak's (British prime minister in 2023) travel practices (Stacey, 2023). The prime minister had travelled from London to Leeds by jet, reducing the journey from two or three hours by train to 36 minutes. I suspect that there was a good reason for speeding up the journey. Yet, it does seem plainly inconsistent with the UK government's pledges to reduce carbon emission and achieve net zero by 2050. Aviation is one of the most polluting industries and contributes something like 2.5 per cent of the total global carbon emissions. While this is a relatively small figure, only a small people globally are regular (annual) or frequent flyers (Carrington, 2020). Indeed, one piece of research noted that only 1 per cent of the global population contributes about half of the carbon emissions related to air travel (Gössling and Humpe, 2020). So, it is a big impact from very few people. One of the most significant changes we can make in our personal efforts to mitigate global warming is to reduce the

number of flights we take. Returning to the UK prime minister's journey, surely the job involves meeting with other politicians, policy makers and businesspeople, and constituents outside London. Yet, something about these kinds of journeys that could so easily be conducted via less polluting transport modes regularly opens politicians to critique.

For most of us, improvements in internet connectivity mean travel can be avoided and replaced by virtual meetings. And many argue that we should be working virtually, rather than flying. Yet, as a place-oriented scholar, I always approach these critiques with a cautious eye. Years of working as an urban planner tell me that there is something unsatisfying and less authentic when communication is exclusively online. Being in a physical place is important. Indeed, many planners have been criticized for not spending enough time in the communities where they are working. How can they possibly make recommendations or even begin to understand the needs and challenges facing a community without ever visiting it? There clearly is something important about *being there*, in person.

If we accept there is some importance to showing up and witnessing experiences directly, but that there is a carbon cost to this, how do we make decisions about global travel? When is it 'worth it' to travel internationally? As far as I can tell, these decisions are being played out in both the market (through the pricing of airfares) and in the individualization of climate responsibility. I wrestle with these questions constantly and do not, as of yet, have a singular or all-encompassing rule or edict. Generally, in my academic work, I have tried to make the most use out of digital forms of connectivity to minimize travel until there is a pressing and specific need.

I often describe my research as internationally situated, action-oriented, community-based and arts-led. Within this context, I am motivated by a desire to bring all the academic resources I can muster to places in need. This has meant developing UK-funded action research projects in places like India and Thailand. Furthermore, my work seeks to address, in a small way, the imbalance between the global north and south scholarship and the legacy of colonialism and the persistence of colonialist attitudes. I manage both of these almost every day as I try to shift academic responsibility and expertise to partners in the global south. As such, my projects do not generally require that I be 'on site'. Rather, I coordinate, manage, facilitate and support partners to do work that they find meaningful. In arts language, I am a producer. Unfortunately, within academia, there is an organizational and financial regime that, while speaking the language of co-design and collaboration, falls woefully short of anything like a fair exchange or equality. Nevertheless, I have been able to build relations with partners who, I'm often told, are happy with the projects we have conducted and have found the collaborative ethos refreshing. Furthermore, a great deal of this work has been conducted virtually through online meetings, emails and (more often)

instant messaging software. During this time, my travel rule has been to only fly when it is considered absolutely necessary for a project. I generally interpret this as only when the partners request my direct involvement and feel that it would benefit activities and progress of the work. However, I have also noticed that new partnerships can struggle to gain traction without an in-person meeting or visit. I try to avoid these types of development visits as much as possible. Yet, when I do travel for project development reasons, I try to bundle activities including research design, grant writing, site visits, seminar and conference talks, and so on. Perhaps all of this is a long-winded form of an excuse. Nevertheless, however much guilt I feel for airline travel, the feedback I have received from partners and funders has been very positive and I know that there have been specific benefits in these places. For now, at this stage of living with climate change, this is how I frame and justify my international research activities. It is worth thinking through these issues as, I suggest, there are key issues of care at play here. For example, I can conduct care work in support of the wellbeing of people in fragile water security settings at a distance. This could involve developing projects, supporting funding programmes and raising awareness to the challenges facing these communities, among many other activities. I can also become physically involved in the way communities manage water security and adapt to climate change. This diversity suggests that within academia, we can contribute to the wellbeing of people and communities in multiple ways, but we should be flexible and creative in the design of international collaborations and consider our role not only as outsiders, but also as contributors to global warming.

Global hydrological challenges

At this point, I would like to restate some of the key issues and challenges related to water security and climate change. At the start of this book, I outlined several global trends and issues associated with climate change and water security. First and foremost, is recognizing that water is the key mechanism through which climate change activates. The global hydrological cycle joins the entire planet through interconnected weather systems. Moreover, our experience of climate change is most often situated in a water context through, for example, droughts, floods, intense storms, melting glaciers, and so on. Second, this book has focused on climate adaptation, not mitigation. Communities where I work and study are commonly concerned about reducing carbon footprints and limiting global environmental change. Yet, the issues explored here have been about managing change that is already happening and, it seems, worsening. Within this context, we know that climate and environmental adaptation is unequal territory. Adaptation draws heavily on locally available knowledge and resources. These elements

are not equally distributed across cities and neighbourhoods, never mind the planet. Third, in the opening chapter, I introduced the idea of fragility as a possible alternative to the disempowering understandings of vulnerability. I do not think it is the individual word as much as the associations we attach. The core idea here is to recognize that we all require care. There is no life without care, which permeates thoroughly and perpetually. This life, of course, relates to the Earth itself. All life on Earth is fragile, interconnected and interdependent. As such, our hydrological selves are always and forever situated within an ecology of care.

Care as a way to explore our watery interactions in and with the world

In the second chapter, I explored the concept of care and some of the research that has brought attention to the challenges and inequalities generally associated with care and care work. Conventionally, care has been associated with the practices involved in looking after others. These practices may be provided to family members, the elderly, those who are unwell or frail, or other vulnerable individuals that require some form of support. Care work is often intimate, emotional labour, that is disproportionately conducted by women. It is often un- or under-paid and is commonly associated with vulnerability within the private or domestic sphere. As such, the practices, benefits and inequalities of care work can be hidden from public view. Of course, we all receive care – as children, adults and in old age. Yet, while care is so critical to flourishing lives, it remains undervalued and is often pushed to the margins.

In part, I argue that a distaste for being labelled vulnerable or fragile drives care underground. We like to imagine ourselves as resilient, strong and capable. If someone called me fragile, I would probably take this as a criticism of my strength and determination. Yet, we are all fragile. Our lives, homes, communities and the planet are all fragile. It is an inherent human condition to be fragile. As much as we push this aside or pretend that we are invincible; we are not. And, it is care and care work that manages fragility. Yet, so much of the care work that is conducted to support human lives is hidden. I am not only thinking about the care practices commonly associated with the home and emotional labour. I am also referring to all that is done to enable flourishing lives in the public sphere, including water distribution and management systems, flood protection programmes and other forms of water infrastructure. Often, water management is dominated by a masculinist discourse that rejects affiliations with care. Water managers, I have noticed, are not conventionally seen as care workers, but rather are most commonly situated in a context of modernist rationality and consumerist self-interest. To draw out an alternative, at the end of [Chapter 2](#), I drew inspiration from

Dobson's thinking around ecological citizenship. Particularly helpful here for me is the way Dobson sets citizenship and responsibilities as transcending national borders and the blurred boundaries between public and private actions and spheres.

In the middle chapters of the book, I presented several place-based examples related to the impacts of climate change, adaptation and water security. These examples crossed three main thematic areas of drinking water ([Chapter 3](#)), coastal change ([Chapter 4](#)) and the cryosphere ([Chapter 5](#)). The case studies provide some insights into the dynamic nature of environmental adaptation. Critically, they show that climate change is only one factor in the production of water insecurity. The impacts of climate change intersect with other locally relevant characteristics such as demographics, socio-economic status, land rights and tenure, and prevailing land development policies and practices, among other factors. As such, adaptation to climate change involves an affiliation with other forms of getting by. In other words, it is not something done in isolation but, rather, is inexorably caught up in daily life. What is more, these adaptive activities are framed by and supported through ecologies of care. These are the often-unrecognized assemblages that make it possible to build resilience and adapt to changing conditions. They have always been a part of flourishing human lives. What I have tried to do here is point to the multitude of component parts and machines that make up these assemblages.

The context of drinking water

Civilizations rise and fall with the availability of clean and secure drinking water. [Chapter 3](#) explored water distribution and management efforts and some of the associated infrastructural challenges. In the main part of the chapter, I narrated two quite distinct contemporary examples. One was based in Rajasthan (India) and the other in Flint, Michigan (United States). The intent was to explore some of the social and cultural characteristics of water distribution while drawing out the role of care.

In Rajasthan, one can see many of the same challenges that are present in other parts of India with respect to water security. These include, for example, the failure to provide fully accessible drinking water through modern systems, the weather-related impacts of climate change (for example, erratic monsoon patterns), water inequalities and pollution. Further, the promotion of modern water infrastructure and modern lifestyles has negatively impacted traditional water conservation practices and knowledge base. It is only in the last couple of decades that these locally situated solutions have been brought back into policy discussions as legitimate approaches to water security.

Care is one of the central features of traditional water management in Rajasthan and is visible across a range of contexts. For example, many

traditional water practices are part of a care collective. In other words, they transcend the individual. To participate in traditional water management often means to buy in to something larger, such as a community of shared interests that resolves to work together to support health and wellbeing. This ethos is often at odds with modern, self-centred and market-oriented atomization policies. Collective care, in this sense, brings people together to solve critical challenges related to their wellbeing. The renewed interest in traditional water management practices in Rajasthan seeks to rebuild the collective approach to water security. In my research, I have seen this through shared ownership and distributed management models (for example, community ownership and stewardship of water tanks) where decision-making as well as maintenance are spread across local stakeholders and water beneficiaries. I also found this collective care in the way people told stories about water. Our work with people in the village of Jhakhoda, Rajasthan explored how people narrated water security. We found a rich ecology of stories ranging from the mundane to the mythological. For me, these expressions draw attention to the importance of seeing flourishing lives beyond exclusively technical framings. Water security is thus environmental, social and cultural. Furthermore, these stories helped me to see how there is no singular model of ‘the traditional’ or ‘the modern’. Rather, in places like Rajasthan, one can see unique expressions of hybridity and a mix of conventional, traditional and even radical ways of being with water.

In Flint, the persistence of structural racism, combined with austerity policies and the demographic and fiscal challenges associated with shrinking cities have led to worsening urban conditions. The water security story of Flint is disheartening and suggests that many American cities are likely to face serious water management problems in the near future. Shrinking cities are not only associated with declining populations and tax revenues, but also with deteriorating and declining infrastructure. Clearly these issues contributed to the water contamination issues in Flint. However, austerity policies that included cutting costs and raising fees for, and ultimately switching to the Flint River for, drinking water resulted in lead poisoning and an outbreak of Legionnaires’ disease. While all of this was a failure of public policy, the experience of the crisis was very much private and domestic (Pauli, 2019). Again, we see how the water work of engineers and policy makers is framed in techno-managerial language while the work of caring for vulnerable and sick family becomes the gendered work of mothers. I suggest, however, that the Flint Water Crisis was a failure of care in the most public ways. It is my contention that water suppliers, managers and policy makers making decisions about water must be seen as care workers. Recognition of the caring characteristics of this work – in particular the way these systems and individuals enable flourishing, healthy lives – might help challenge decisions justified primarily by financial concerns. Here in

Flint and in the wider context of environmental change, I feel this change in perspective and framing is critical. Public decisions about managing water systems that ignore care characteristics and impacts are, in my view, likely to result in unequal outcomes, particularly along gendered lines. It is time to put care squarely into the world of public water supply.

The Flint Water Crisis also highlights the complex, more-than-human nature of water distribution. Water supply is always an accomplishment realized in caring collaboration with physical infrastructure and ‘things’. Ever since I became aware of this tragedy, the role of orthophosphates as care agents has always fascinated me. I recall watching an explanatory video that showed these substances working their way through the water to attach themselves to the pipes, forming a protective barrier and ensuring the pipes did not corrode and lead would not infiltrate the drinking water. I want to repeat and emphasize one part of that sentence: *forming a protective barrier*. Orthophosphates, in this way, make up part of a caring assemblage that keeps people healthy; they are our protectors; they are heroes. Of course, the technical failures of water managers meant the orthophosphates could not do their work. As such, we can clearly see the results of ignoring the human and non-human caring interdependencies that make up water distribution systems. Care is more than emotional. It is something done and this doing always happens via more-than-human assemblages.

Climate change and coasts

The coast is a dynamic area of incessant environmental change. In [Chapter 4](#), I discussed a range of challenges associated with coastal processes. The impacts of global warming are clearly evident in these areas. This includes rising sea levels as well as stronger storms and other factors leading to coastal erosion and change. We know that these are immensely urgent issues as huge populations live within the coastal zone. I explored the impacts and adaptive practices in two central case studies – Ban Khun Samut Chin (Thailand) and the village of Fairbourne (Wales, United Kingdom). Ban Khun Samut Chin provides an example of fragmented coastal planning where individual communities are largely left to themselves to adapt to environmental change. For many, adaptation has meant retreat from the shoreline – often moving their homes more than once. The lack of coordinated planning has left it up to individual communities to learn about and make decisions about various forms of erosion protections. In Ban Khun Samut Chin, it has also stimulated a range of care practices associated with looking after the coast, the temple (or ‘Wat’), mangrove forests, and reaching out to others for help and assistance. Here on display, defying the odds, is the oft-valued quality of resilience. Surely, we can say that people overcoming almost continuous disruption from environmental change with inadequate public support are

demonstrating resilience. While I am amazed at the ability of people in Ban Khun Samut Chin to manage these challenges, this resilience narrative has always left me flat. It reminds me of some research I read on the experience of young people in Haiti (Derivois et al, 2018). At the national level, the research noted how people who had experienced disasters in Haiti had higher psychological resilience scores than people in other, mostly wealthier countries who had also experienced disaster. Further, among Haitian school-age children, kids living on the street and not regularly attending school were found to be more resilient than those who had lived in a home and attended school. Imagine this – those who are the least well off and living the most precarious lives are the ones who are scoring high on resilience measures. Further, the authors note that there is very little positive or transformative learning associated with this form of resilience. These young people do not come out stronger or find new ways of coping. Rather, they have seemingly simply accepted disasters as part of life. How tragic. Moreover, others have suggested that resilience narratives can reinforce austerity, neoliberal and neo-colonial structures of inequality (Diprose, 2015). Here, resilience provides a justification for bootstrap policies and the elimination of state responsibility for the wellbeing and welfare of society. In this context, one might be less celebratory of the resilience of people in Ban Khun Samut Chin (or Haiti) but, rather, look deeper at the forces of oppression that contribute to insecurity.

The village of Fairbourne is, perhaps, at the other end of the spectrum of state responsibility. In this case, formal planning mechanisms have been put in place to counter the threat of rising sea levels over the next 30 to 50 years. For villagers, this means the eventual decommissioning (abandonment) of their community, a place many have come to in their retirement. Public response to these plans was fierce and many joined up to challenge not only the decision, but also the science and data behind sea level rise estimates. The plans, nonetheless, are unchanged. In Fairbourne, unlike the Thai case, adaptation to environmental change was largely removed from the local community – they had little involvement or even awareness of the original planning process where these decisions were made. Indeed, presented in highly technical evidence, the entire process was expressed in an unpolitical, matter-of-fact way. Of course, the decision to abandon a community is highly political and likely to be very emotional. Such discourse ignores so many aspects of care, including the way people feel about their community and neighbours, the role the village plays in their physical and mental health and wellbeing. I suggest that an alternative way of working in the coast would centre around the idea of fragility. Yes, the village is exposed to future flooding due to sea level rise and worsening storms. However, there are other forms of fragility that could be involved in discussions and decision-making about the village's future. Front and centre here should be

how any adaptation measure might influence and impact the whole person. Moreover, rather than centring on disempowering evidence, residents could be brought together as collaborators whose voice has meaning and whose knowledge and skills might be brought to bear on living in this dynamic coastal setting.

The cryosphere

The final empirical chapter looked at the relations between climate change and the cryosphere. The cryosphere is all that snow, ice and permafrost and holds the vast majority of the world's freshwater resources. Changes in the cryosphere can be easily seen in melting glaciers as well as diminishing annual snowfall and shorter winter periods. These changes are already impacting global environments through, for example, sea level rise and flooding. One might say that cryosphere communities are at the front line of climate change adaptation. The cases in this chapter – Shishmaref, Alaska (United States) and Ladakh (India) – point to a rapidly changing environment that threatens the continuation of human life in these areas. At Shishmaref, vanishing sea ice is leading to stronger storms and increased rates of coastal erosion. Eventually, the island community will no longer be a place people can call home. Ladakh is similarly impacted by climate change. Yet, here, it is receding glaciers that have disrupted long-standing ways of life. Water resources in Ladakh are part of a massive watershed area that sustains life across Asia and the glaciers here provide drinking water to some of the largest, most populated mega-cities on Earth. Within Ladakh, a harsh, dry, mountainous region in northern India, glaciers are recognized as life-sustaining and as such are given a special, spiritual role in societies there.

Both cryosphere cases draw attention to how the impacts of global warming are directly impacting those communities that often have relatively small carbon footprints (particularly when compared to cities in the global north). It also highlights a few conceptual challenges related to the shift from traditional to modern lifestyles. All people deserve the right to the benefits of modern development in terms of improved healthcare, wellbeing, communication, opportunities for leisure, and so on. Yet, we often describe traditional lifestyles in nostalgic, celebratory tones. None of the people I met in the so-called developing world wanted to go back to pre-modern life. My friends and colleagues in Ladakh, for example, enjoy the conveniences of modern communication, transport, electricity and water distribution systems. Yet, they simultaneously lament some of the social and cultural shifts that have gone alongside the introduction of these features. Much of this was documented by Helena Norberg-Hodge in her book *Ancient Futures*. This included, centrally, the loss of intergenerational bonding and the diminished forms of reciprocal care associated with extended family

interactions. Communities, dispersed and fragmented by the promise of modern life, no longer support these caring practices. I am told that children in Ladakh often leave their villages quite young to study in Leh or even Delhi where the primary schools afford the potential for a better education and future. Again, it is not ethical to restrict a family's desire to improve life for younger generations. Yet, these decisions clearly come at a cost. Modernism and western-style development brought opportunity, but it also brought pollution, shattered traditions and produced a society that is now less happy and more anxious. While *Ancient Futures* was written 30 years ago, you can still see these processes taking place in in Ladakh.

Nevertheless, today's care networks in Ladakh as well as in Shishmaref are sustained by a complex mix of traditional and modern practices and technologies. This mix is present in the adaptive practices of both cases. For example, in both places, adaptation involves a fusion of modern and traditional water management systems. This includes the way people in Ladakh and Shishmaref draw on their beliefs to forge connections to their environment (for example, worshipping and performing rituals for mountain and glacial deities) while simultaneously constructing modern water distribution infrastructures. In my view, this kind of hybridity, which values the non-technical through stories and practices, could be one way to bring care more visibly into public infrastructure contexts.

Ecologies of care

Care and care practices are relational. By this I mean that they are always conducted in a context. This context is the assemblage of people, places, things, bureaucracies and regulations, and so much more that makes up our lives. Ecologies of care is a more-than-human framing of the way care works and joins all this together. There is no care in isolation. The practice of care is work that is always done in collaboration. This sense of collaboration is at the heart of an ecological understanding of care. It means that when some form of water security is accomplished, this is always done together. An ecology of care approach understands that water security works in and through people who look after water infrastructures and the wellbeing of others. And, it recognizes that this is so pervasive – it is literally right in front of our eyes – that it is easily missed or taken for granted.

Of course, all practices are not caring practices. Yet, it is my contention that one does not need a caring attitude or disposition to provide care. Rather, care practices are those activities that contribute to living well in the world. Here, I want repeat Tronto's often-cited definition of care as 'everything that we do to maintain, continue and repair our world so that we can live in it as well as possible ... that world includes our bodies, ourselves and our environment, all of which we seek to interweave in a complex, life-sustaining

web' (Tronto, 1993: 103). Care practices are the ways in which we support ourselves and others. Unfortunately, so much water security activity is not recognized as care. I have argued in this book that the rejection of fragility as a fundamental feature of human existence helps to occlude the role of care in our lives. If we see ourselves as inherently fragile – *in need* – then water security is always wrapped up in care. In this sense, the maintenance and repair of water infrastructure as well as the management of these systems must be seen as care practices. What change might we see if we saw the technical work of fixing water pipes or building reservoirs as care work? In the last several years, I have witnessed so much 'formal' work around water security – coastal planning to address sea level rise and flooding; maintaining and repairing distribution networks and reservoirs for drinking water; constructing artificial glaciers to combat climate change – and not once did anyone I spoke with describe this work as care. Most often, these activities are expressed as engineering works, technical endeavours or even just 'jobs'. Yet, the care work involved in protecting and supporting fragile human lives is right there. I suggest that by framing water security in techno-rational language, water managers can avoid the care connections and the messiness that goes along with it. This rational discourse facilitates neoliberal, market-oriented and cost-benefit decision-making such as was plainly evident in the Flint Water Crisis. Expressing public policy for water security as care destabilizes and maybe even destroys this reasoning. While ecologies of care seem more visible in the context of crisis, they are always there.

An ecology of care approach also sees the agency in the non-human world. Things and materials – whether they are pipes, orthophosphates, wells, dams, coastal revetments or other forms of water infrastructure – contribute to water security. They are part of the water security care assemblage. When we recognize the caring properties of things, our caring world is dramatically expanded and enriched. With things, we have more collaborators and allies. The work of water security becomes easier. There may be some resistance to seeing non-humans as caring agents or even as care workers. Yet, things are always part of any caring assemblage. Parents, for example, care for children in concert with all sorts of technological devices and materiality. I remember the books I used to read to my son with heart-warming fondness. These short stories of balloons, moons and strange animals, written in comforting language and illustrated through warm, simple graphics and drawings were my caring partners. They helped me make loving connection. They brought us closer and helped form a bond that I still feel long after the bedtime ritual has ended (I am now sound asleep before my teenage son heads up to bed). This is only one simple example of how things (in this case, stories and books) support people in care work. If you think about any time you looked after another, take a moment to reflect on the non-human collaborators and how they made this work possible. Moreover, as my vignette suggests,

care ecologies include discourse and non-material machines. This includes the stories, mythologies, beliefs and the language that helps us express all of this. Stories help us make meaning and see ourselves in the world. They help put all that materiality into our emotional selves. When we tell water stories, we can bring materiality to life, drawing out our care connections.

Conclusion

In this book, I explored water security and climate adaptation through the framing of care. I looked at several cases of adaptation to challenging environmental change and water insecurity. This work is always ongoing. Water security is not a given and is not static. Rather, it is an accomplishment that must be nurtured and maintained. I am guilty of taking my own water security for granted. I only became aware of this when I began working in parts of the world where water was an active part of daily life and where people had to expend energy for, what I considered to be, the simplest of needs: clean, readily available water. I also saw how uncertainty regarding environmental change produced both physical and emotional displacement. Water security, climate change and climate adaptation will continue to be critical points for human welfare and wellbeing. I have argued that when we see the ecologies of care that flow through these contexts, we will have a better understanding of how to manage these challenges.

I am optimistic that a shift in water management and water security is possible. I am encouraged by programmes and efforts to empower communities and facilitate local knowledge and practices. I hope these will be expanded. Yet, more research is needed to understand how *real* empowerment happens in water security. People should have meaningful roles in water security decision-making. This role should include an attention to local knowledge, experiences and practices, and beliefs. I signal out this idea of belief because it is not commonly part of water security discourse. Yet, if we are to engage people in a meaningful way, we must take this seriously. Our beliefs help us frame our position in the world. I do not think this can be ignored just because we are looking at something considered 'technical' or rational such as water distribution and management.

Further, we need to enable more south to north learning and exchanges. Too often this is a one-way exchange. My own experience suggests that even in the best-intentioned north-south collaborations, it is difficult to overcome prevailing mindsets and institutional inertia in which *north knows best*. Legacies of colonialism and persistent racism still influence the world. These need to be recognized more obviously and countered through specific administrative techniques and practices (not only through the discourse of equality and fair exchange). In this area, I am heartened by some of the exchanges that have come from South America. In particular, the Andean concept of *sumak*

kawsay (or *buen vivir* in Spanish), mentioned in the previous chapter, which has not only influenced the Ecuadorian and Bolivian political arenas, but is becoming a global influence for anti-developmental activism (Altmann, 2017; Hernández and Laats, 2020). In *sumak kawsay*, I see a fundamental ethic of care around harmony, collectivism and wellbeing – an opposition to the individualism which characterizes much of western society.

I argue that we must recognize the ecologies of care that make up our world. This means not only identifying the networks of care, but also making them visible and celebrating their role in wellbeing. Here, I return to the notion of fragility, which I argue is embedded in care, care work and care practices. Take a moment to think of your own fragility. Think about how it is managed and the people and things you depend on. This is not a fault or deficiency; it is a condition of existence. I need care. My life depends on it. My wellbeing is caught up in an ecology of care so vast that it is, sometimes, overwhelming. Unfortunately, in common discourse and public policy, most of this is hidden, out of sight or even disparaged as frivolous. Yet, life, so precious, flourishes only through and with ecologies of care.

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