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Opportunities for individual, household and community level climate change adaptation in Ireland

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Summary of key messages

- Individuals are already experiencing the impacts of climate change and as climate disruption deepens, this exposure to risk will become more heightened.
- Some impacts will be experienced 'in-place', at the scale of everyday life and home, leading to household and individual exposure to property damage, disruption to essential infrastructure and health and wellbeing impacts. Other impacts will result from wider global challenges, for example, as climate change disrupts global supply chains, food production and energy security, with potential cost of living implications.
- Critical in evaluating the potential impacts and exposure to risk, is to understand *social vulnerability* related to individual and household characteristics, including income, age, social networks, physical ability and so on. These same characteristics also impact on an individual or household's *capacity to adapt*.
- Drawing on behavioural approaches, various domains of individual adaptation can be identified, including: information-seeking and learning; preparative actions; protective actions; evacuations (short term) or migration (permanent); psychological coping; purchasing insurance; and political action and civic engagement.
- Individual capacity to adapt is also structured through social norms, institutions, property rights and other legal frameworks, and market conditions. Therefore, adaptation is not autonomous; instead, there is a hierarchical structure to adaptation, which can *constrain* or *enable* individual actions or responses.
- Capacity to act, however, does not necessarily lead to individual and household *adaptation actions*. Instead, understanding individual *motivation* to act is critical. Key explanations identified from the literature include: (1) perceptions of risk; (2) exposure to risk in the recent past; and (3) how the state is perceived in terms of protection (resources, effectiveness etc.).
- The report highlights opportunities for influencing or enabling individual, household and community level adaptation. These include the influence of the market (e.g. insurance) and market-based instruments (incentives/disincentives); regulation; voluntary methods; public engagement and participation; and through more direct forms of community and collective actions. Community action offers significant potential, but requires nurturing, capacity building and resources to ensure effective adaptation outcomes.
- Enabling actions or support for individual or community adaptation should minimise the potential to reinforce socio-spatial or short term maladaptation.

1. Introduction

> **"[A]daptation" means any adjustment to —**
>
> **(a) any system designed or operated by human beings, including an economic, agricultural or technological system, or**
>
> **(b) any naturally occurring system, including an ecosystem,**
>
> **that is intended to counteract the effects (whether actual or anticipated) of climatic stimuli, prevent or moderate environmental damage resulting from climate change or confer environmental benefits."**
> (Climate Action and Low Carbon Development Act 2015: 3)

As recognised by the Climate Change Advisory Council in its 2020 annual review report (CCAC, 2020), the literature on climate change adaptation tends to focus on the role of government and state action, with less attention given to the potential role of individuals, households and local communities in adapting to climate change risks. However, this lacuna overlooks the necessity of a 'whole-of-society' approach to adaptation to complement a whole-of-government response to reduce exposure to climate change risks and to cope with vulnerability to further impacts. Furthermore, individuals and households *may* act independently of any government steer, with potential for reinforcing pre-existing socio-spatial inequalities or risking maladaptation or the displacement of risks onto others. At the same time, individual actions are 'structured' or enabled through wider institutional processes or legal frameworks, such as regulatory structures and property rights, alongside the influence of social norms. Thus, there is a hierarchical structure to adaptation, which can *constrain or enable* individual actions or responses, while perceptions of state protection are often critical in shaping individual or household adaptation (Adger et al., 2013). In this paper, we aim to provide a review of individual and household level adaptation. This will address risk factors at a household scale and the socio-economic dimensions of climate change vulnerability. The following section provides a brief overview of climate change risks in an Irish context. We then examine the concept of resilience and how it relates to adaptation. Resilience has been conceptualised in policy and practice as both an approach to 'bounce back quickly' following a disruption or shock to a system or alternatively as a transformative agenda to reduce vulnerability. This has implications for how adaptation is conceived – as a reactive 'return to normal' or as anticipatory action to reduce vulnerability. In this context, we examine examples of household adaptation and maladaptation before considering motivations for taking adaptive action and perceptions of risk that underpin adaptative decisions. We then examine a portfolio of policy options for influencing individual adaptation, including collective responses based on community engagement and direct community action. However, firstly we locate the discussion by briefly examining concepts of resilience and adaptation.

2. Climate change related risks: Ireland

Climate change is one of the most challenging scientific and political issues of our time. From a scientific perspective, the evidence regarding human induced warming of the climate system is unequivocal (IPCC, 2014). For example, based on analysis of Global Climate Models undertaken by the IPCC, anticipated climate change not only means changes in global average temperatures, but also changes to the frequency and intensity of extreme weather and climate events such as severe flooding, high precipitation events and storms, droughts, and heat/cold waves, in addition to threats posed by sea level rises (DCCAE, 2018). While there is an overwhelming scientific consensus that human-induced climate change is happening, translating this knowledge into action remains an enduring challenge. While mitigating climate change and transitioning to a low or zero carbon society is paramount, policy-makers are increasingly promoting *adaptation* strategies as a means of coping with climate change risks, future uncertainties, and continuing high levels of carbon emissions. Indeed, even if emissions are stopped immediately, temperatures will remain elevated for centuries due to the effect of greenhouse gases from past human emissions already present in the atmosphere (Zickfeld et al., 2013). In this context, Ireland's National Adaptation Framework (NAF) defines adaptation as an "*approach for addressing the current and future risks posed by a changing climate. The aim of adaptation is to reduce the vulnerability of our environment, society and economy and increase resilience*" (Department of Communications, Climate Action & Environment, 2018: 9).

In an Irish context, the scale and rate of change observed are consistent with trends observed globally and regionally, and the Irish climate will continue to increasingly change into the future. Despite mitigation actions taken to limit climate change, even if all greenhouse gas (GHG) emissions immediately ceased, many drivers of change are 'locked-in' to the climate systems and the effects will be felt for many decades due to the 'inertia', or slow response time, of the system. In line with global trends, Ireland's temperatures have increased by nearly 1^{o}C (0.8 ^{o}C), increasing at a rate averaging 0.07 ^{o}C per decade since 1900. Both temperature and precipitation are predicted to increase gradually, and it is possible that there will also be abrupt shifts in climate behaviour due to reaching of unpredictable 'tipping points'.

Global sea levels are projected to rise by 0.5m by the end of this century, along with expected increases in storminess and wave heights leading to sea/ocean surges (Desmond et al., 2017). Current rates of coastal erosion will be exacerbated. Ireland's coastal areas will be at serious risk from this

projected combination of rising sea level and storm height (Climate Ireland, n.d.). Sea level rise, ocean/sea surges and changes in patterns of precipitation can combine to form a significant threat. Sea level rise will enlarge estuaries, and tidal flow will penetrate further upstream in rivers. Noting the placement of Ireland's major settlements on the coast and/or by rivers, Climate Ireland state that both coastal and inland flooding are projected to significantly increase, potentially with serious social and economic consequences for Irish settlements, industry and critical infrastructure. A recent audit of coastal erosion in Ireland identifies approximately 800 properties at immediate risk, which will increase substantially over the next 50-100 years from projected sea level rise and storm surges (MaREI, 2019).

Over the last century there were increasing likelihoods of both extremely hot summers and extremely wet winters, and these likelihoods are projected to increase further. Murphy et al. (2019: 29-30) observe that the significant changes that have occurred in extreme seasonal temperatures and rainfall in the latter part of the 20th century would have been considered exceptional in the first half of the century, and that these increasing changes are "largely consistent with climate model projections of future Irish climate", and that "such events are likely to become less the exception and more the norm as further warming is experienced". Projections of increasing heat and decreasing precipitation in the warmer months indicate increased evapotranspiration, increased algal growth and low river flows (exacerbating water pollution); increasing precipitation in the winter will place flood-prone areas at increasing risk, as well as putting places not currently flood-prone at risk of flooding (Climate Ireland, n.d.). Climate risks are likely to have dramatic impacts across Irish society, profoundly impacting on food and energy security, biodiversity and natural capital, and health and wellbeing.

3. Understanding climate change resilience

At a conceptual level, *resilience* has been advanced in the climate policy literature as a means of understanding how a social-ecological system can cope with risk, complexity and uncertainty. In this section, we trace the emergence of resilience thinking and examine two contrasting approaches to conceptualising resilience in practice. The first approach, *equilibrium resilience*, emphasises the ability and speed of a system to 'bounce-back' following a shock or disturbance, while the second approach, *evolutionary resilience*, calls for greater attention to be given to 'transformation' of a system following a shock or disturbance. This distinction is critical in understanding the effectiveness and robustness of climate change adaptation. This is further discussed below and summarised in Table 1.

The term 'resilience' was first coined within systems ecology (e.g., Holling, 1973) to evaluate ecosystem functions based on assumptions of non-linear dynamics of change in complex, linked systems, whereby resilience describes the ability of a system to absorb or accommodate disturbances without experiencing changes to the system. Subsequently, resilience has also been applied to examine social-ecological systems, particularly how communities and societies cope or respond to environmental crisis and risk, such as climate change, flood risk, or ecosystem degradation (see Adger, 2000; Folke, 2006). Since the early 2000s, there has been a wave of interest in applying resilience thinking to a range of social science and policy disciplines, including disaster planning, economic geography, business and management studies, spatial planning, and community development. A rich body of work also emerged in the wake of the global financial crisis in 2008-2009, whereby commentators increasingly transferred resilience thinking to understand how local and regional economies coped with an economic crisis and instability (for an overview, see Martin et al., 2016). While this interest in resilience suggests a conceptual utility, its application across a range of social science disciplines (and its translation from ecology) also points to its emergence as a fuzzy or elastic concept (Faulkner et al., 2020), whereby the term's substantial meaning becomes diminished or becomes mobilised to support competing policy agendas. To unpack resilience further, we will now turn to two divergent conceptualisations of resilience in practice – the *equilibrium* approach and the *evolutionary* approach.

3.1 Equilibrium resilience

Often referred to as engineering resilience, this approach is defined as the ability of a system to absorb or accommodate shocks and disturbances without experiencing changes to the system (Holling, 1973). In this perspective, both the *resistance* to disturbances and the *speed* by which the system returns to equilibrium is the measure of resilience (Davoudi et al., 2013). This approach is particularly common within disaster management, in particular managing responses to geo-environmental hazards, terrorist threats, or disease outbreaks (Barr & Devine-Wright, 2012), whereby the ability to 'bounce-back' to a pre-disaster state in a rapid fashion is the preferred goal. However, a number of limitations can be identified in relation to equilibrium resilience. For example, Davidson (2010) questions whether an ability to absorb or accommodate disturbances without experiencing changes to the system should be the preferred option. In this regard the so-called 'normal system' may itself produce risks (e.g. construction on floodplains) or may be underpinned by socio-spatial inequities, as revealed by the Hurricane Katrina disaster in New Orleans whereby vulnerability to disaster was defined on the basis of class and race (Forester, 2008; Rumbach, 2008). Fundamentally, therefore, the equilibrium approach does not allow for reform and transformation as a response to crisis, largely ignoring

distributional and normative concerns in favour of aligning with or reinforcing existing power structures and relations. This suggests a potential bias within 'bounce back' conceptions of resilience to depoliticise, normalise or indeed naturalise environmental crises or so-called 'natural disasters' that are underpinned by human behaviour, institutions, rules and ideologies. A 'bounce back quickly' approach also raises questions relating to the resilience of *whom*, particularly in terms of transferring risk to the individual.

3.2 Evolutionary resilience

In contrast to equilibrium-based approaches, evolutionary resilience rejects the notion of single-state equilibrium or a 'return to normal', instead highlighting ongoing evolutionary change processes and emphasising *adaptive behaviour* and *adaptability*. These themes have been particularly explored within the evolutionary economic geography literature (e.g., see Bristow & Healy, 2020). As outlined by Pike et al. (2010: 62), an evolutionary analysis emphasises the "path dependent unfolding of trajectories of change, shaped by historically inherited formal and informal institutions". Therefore, a key departure point in this analysis is that development does not proceed along a single path, but along multiple pathways (some of which may be suboptimal). By embracing the inevitability of evolution, resilience thinking from this perspective emphasises the role of *adaptation* as a response to shocks and disturbances, enabling a more optimistic and potentially more transformative notion of resilience. In summary, 'bouncing back' to a perceived normal state following a shock need not be the only response. Instead, evolutionary resilience places significance on *transformation*, whereby social systems (through individual or collective agency) can adapt or search for and develop alternative development trajectories.

Drawing on Pike et al. (2010) and Hudson (2010), the key advantages of an evolutionary perspective is its potential to reveal:

- The importance of both exogenous and endogenous shocks intertwined with "the unfolding of broader, longer-run and slow burn processes" (Pike et al., 2010: 63), including long term socio-spatial and economic restructuring processes. In relation to household adaptation, this suggests not only examining 'shock' events, such as widespread flooding in a city, but incremental 'slow burn' processes of change, such as coastal erosion, incremental temperature rises in cities, or long term regulatory maladaptation;
- The importance of path dependencies in shaping resilience, adaptation and adaptability, which may be weakened by entrenched path dependencies. For example, this may relate to inherited

political institutions (and institutional norms or ways of working) or may relate to past urban development (such as building on flood plains or other vulnerable areas);

- The potential of 'lock-in' development paths to compromise household resilience, whereby formal and informal institutional culture and relationships may inhibit adaptive behaviour and capacity. Similarly, the process of 'de-locking' may be central in 'path creation' towards a more sustainable future.

Table 1: Key features of equilibrium and evolutionary approaches to resilience (adapted from Scott, 2013)

Equilibrium resilience	**Evolutionary resilience**
'Bounce-back' resilience	'Bounce-forward' resilience
The ability of a system to accommodate disturbances without experiencing changes to the system.	The ability of a system to respond to shocks and disturbances by adaptation and adaptability
Emphasises a return to a steady-state after disturbance – 'business as usual'.	Emphasises transformation or path creation in response to disturbances – 'do something different'.
Short-term response to shocks and disturbances.	Long-term response, emphasising adaptive capacity.
Prominent in the literature surrounding disaster management, managing geo-environmental hazards	Prominent in the literature surrounding climate policy, spatial planning
Conservative approach, naturalising man-made crises and depoliticising responses.	Recognises the politics of resilience, involving normative and value judgements.
A reactionary tool, reinforcing existing power structures	A critical tool, enabling reform
Example: intervention *following* a flooding event	Example: *anticipatory* and risk-based intervention *before* any flooding to reduce vulnerability

4. Understanding Adaptation

A key component of evolutionary resilience is *adaptation* – i.e. how a system responds and transforms in the face of a crisis or exposure to a new vulnerability. This includes the capacity of response, based on pre-existing attributes such as good governance or financial resources, and adaptive capacity i.e. the response of a place contributing to its ability to recover from the impact of shock or disruption (Faulkner et al., 2019). The essence of adaptive capacity is that it embodies positive change, irrespective of whether that change is short-term or long-term (Havko et al., 2017). In relation to capacity of response, significant barriers to developing effective adaptation strategies at a household

level may include a lack of knowledge or motivation, long term cost recovery of actions causing inertia, or lack of financial resources.

To build resilience, adaptation and mitigation are adopted as complementary policies. The aims of mitigation are to eliminate (or reduce as far as possible) GHG emissions and consolidate and increase carbon sinks, thereby reaching 'net zero', a balance of emissions and removals of GHG by the middle of this century (O'Dwyer et al. 2018). Without mitigation, the effects of climate change will be greater, so requiring increased measures and levels of adaptation. The IPCC 2018 Report (2018: 51) states that "[a]daptation is more likely to contribute to sustainable development when policies align with mitigation and poverty eradication goals". In an Irish context, Dekker and Torney (2020: 28) observe that "[t]he 2019 Climate Action Plan … has a single chapter on adaptation, which is treated as separate of mitigation. However, adaptation and mitigation actions overlap and can have multiple benefits". Murphy et al. (2019: 1) further state that:

> 'Too often mitigation and adaptation are treated as independent strategies; in reality, even if we could somehow stop all greenhouse gas emissions right now, some degree of warming will still result. Additionally, even at 1.5°C and 2°C warming, impacts will still be felt. Therefore, it is critical that society adapts to future impacts of climate change'.

The IPCC 2018 Report defines adaptation as follows:

"Climate adaptation refers to the actions taken to manage impacts of climate change by reducing vulnerability and exposure to its harmful effects and exploiting any potential benefits. Adaptation takes place at international, national and local levels" (p.51).

Adaptation means "anticipating and planning for the effects of climate change and taking appropriate actions to offset or minimise the adverse impacts of these changes while taking advantage of any opportunities that they might bring" (O'Dwyer et al., 2018: ix). Dekker and Torney (2020: 3) further add that "[a]daptation involves the changes humans make to the system such that the system is optimized to meet their needs", and note that the changes depend upon the type of threat, and that ultimately those changes enable the system to continue in its function to support human beings. Spanning long-term temporal and spatial scales, adaptation "facilitates planning through learning by doing" (Kopke et al. 2018: 1), indicating the need for adaptive *capacity*, defined by the IPCC (2014) as the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

4.1 Adaptation: whose responsibility?

Effective adaptation requires action that is multi-scalar and multi-actor in approach. For example, the NAF recognises that adaptation not only requires a whole-of-government approach but also a *whole-of-society response*. This includes a range of actors comprising international agreements and institutions; government and the state (central, regional and local government); firms and market actors; NGOs, civil society and the voluntary sector (e.g. community groups); and households and individuals. In this sense, adaptation actions are rarely autonomous (Adger et al., 2005) with actors or individuals constrained by institutional processes or legal frameworks, such as regulatory structures, property rights and social norms associated with rules-in-use. Thus, there is a hierarchical structure to adaptation, which can *constrain or enable* individual actions or responses (ibid.).

The literature on adaptation tends to focus on the role of the state (at various spatial scales) as a key actor in institutionalising, regulating, and financing climate adaptation and also in terms of information brokerage and 'steering' change through policy design and resource allocation. In contrast, the literature on household adaptation is less extensive and tends to be dominated by accounts associated with: (1) household vulnerability and adaptive behaviours in a global south context (e.g. Shah et al., 2013; Rumbach and Shirgaokar, 2017), reflecting climate change vulnerability and limited government resources and institutional capacity to take action; and (2) farm household adaptation, reflecting the link between household behaviour and farm-based livelihoods (e.g. Below et al., 2012; Naqvi et al., 2020; van Zonneveld et al., 2020). However, a growing body of literature is exploring adaptation at the household scale in terms of behaviours, motivations and actions, explored in the following section.

5. Household adaptation to climate change

Climate change impacts are increasingly affecting individual lives, exposing households to a range of climate related risks. In this context, it is useful to consider the vulnerability of households to risk and how household characteristics intersect with place-based exposure to risk. The concept of *vulnerability* provides an important framework for understanding how individuals and communities respond and adapt to environmental change (Adger, 2006; Wilson, 2012a). Vulnerability has been widely utilised in ecology (alongside resilience) and has been increasingly applied to examine the social-ecological interface associated with impacts resulting from or adapting to environmental risks (Gallopin, 2006). For Wilson (2012b) vulnerability represents the 'flip-side' of resilience, suggesting that notions of resilience and vulnerability can be conceptualised as opposite ends on a unilinear

spectrum. Thus, vulnerability is usually framed in negative terms as the susceptibility of a system to be harmed: i.e. the degree to which a system is susceptible and unable to cope with adverse effects (for example, from climate change related risks) (Adger, 2006). For Adger, the concept of vulnerability provides a key analytical tool for:

> '… describing states of susceptibility to harm, powerlessness, and marginality of both physical and social systems, and for guiding normative analysis of actions to enhance well-being through reduction of risk' (2006: 268).

In this paper we focus on vulnerability to exogenous climate change impacts (both shocks and slow burn processes) at the household scale, addressing a significant gap in the policy literature.

While there is a paucity of holistic studies examining household vulnerability as a result of anticipated climate change risks, a more extensive literature exists that examines household vulnerability within a global south context (e.g. Gaiha and Imal, 2004; Guillaumont, 2009; Naude et al., 2009). Within these studies, vulnerability at the household level has often been examined in terms of the impacts of hazards external to the household (exogenous shocks) and how these relate to household characteristics (e.g. income, resources, networks). A key feature of this work is a focus on risk and vulnerability as a dynamic process, rather than simply household vulnerability following a disruptive event (e.g. an extreme weather event). Therefore, by focusing on risk, household vulnerability studies can identify not just transient impacts, but also the probability of remaining at risk or the exposure to external shocks that may further impact on households; in other words, it attempts to capture household trajectories. Furthermore, as Naude et al. (2009) outline, vulnerability relates to an undesirable outcome (e.g. vulnerability *to* climate change) and that such vulnerability is due to exposure to risks. Following Adger (2006), this opens up possibilities of attempting to identify the key parameters of household vulnerability to the stresses to which a household is exposed, household sensitivity and adaptive capacity. This will include identifying household or place-bounded assets that may assist in a time of crisis (e.g. support of friends and family) or act as a liability (e.g. diminishing local services).

In Table 2 below, we highlight illustrative risk factors associated with climate change at the household level comprising four critical domains: (1) property related risks, (2) health and wellbeing risks, (3) cost of living risks, and (4) risks to critical infrastructure essential to household functioning.

Table 2: Illustrative risk factors for household vulnerability to climate change (source: authors)

Types of risk	**Illustrative examples**
Property related risks	At the *building scale*, climate change risks relate to following factors (Sanders and Phillipson, 2003; Hertin et al., 2003; Chalmers, 2014; Kovats et al., 2021): • *Increases in precipitation*: with risks associated with winter ingress in building fabric after heavy rainfall events, increased risk of water penetration of vertical walls in dwellings, and increased indoor moisture and mould growth detrimental to health of occupants (with requirements for increased ventilation); • *Subsidence*: due to increasingly variable water content levels in soil, due to warmer summers and evaporation effects and transpiration of moisture from vegetation, leading to soil shrinkage and swelling; • *Freeze thaw cycles*: repeating freeze thaw cycles between day and night in Ireland can have a significant impact on construction materials. For example, if concrete blocks become saturated in the outer leaf and are subsequently subjected to repeated freezing and thawing, the contained water would expand in the blocks as it froze and have a tendency to disaggregate the blocks (Expert Panel on Concrete Blocks, 2017). Repeated freeze thaw cycles (e.g. during a cold spell with fluctuating day/night temperatures) could be expected to result in concrete blocks deterioration; • *Wind impact*: wind action on buildings (from increased storminess) causes dynamic structural loading by pressure forces. This leads to structural damage from individual roof tiles being removed through to uplift of flat roofs. Risks from chimney stacks or trees collapsing on to buildings also increases, causing structural damage, suggesting the need for increasing safety features to cope with 50 year events; • *Driving rain*: exposure to high levels of driving rain generally leads to more weathering and higher maintenance requirements to ensure that buildings remain weather tight throughout their expected life. The maintenance of render systems, pointing of masonry and maintenance of sealants around openings all require more frequent attention in severe exposure to reduce the risk of loss of property value; • *Air quality and thermal comfort within buildings*: high temperatures within buildings in the summer affect the comfort of the occupants, particularly within domestic buildings and night-time discomfort. Higher internal humidity increases the chance mould growth, which is associated with health issues e.g. asthma;

	• *Coastal erosion, landslides and 'bogslides'*: risks to building integrity due to land instability and shifting weather patterns; • *Wildfires*: risks to buildings from uncontrolled fires (forest, vegetation, peat) during dry periods with impacts ranging from smoke damage to structural failure and total destruction.
Health and wellbeing risks	As reported by Munro et al. (2020), the effects on health are cumulative and include direct and indirect impacts. Health impacts are likely to overlap with and consolidate existing health inequalities. Examples include: • Changing exposure to heat and increased risks of heat stress (extreme discomfort, increased morbidity and mortality rates), particularly impactful on vulnerable groups e.g. older people; • Increased exposure to UV radiation, air pollution, pollen and emerging infections; • Direct risks to life and limb associated with extreme weather (e.g. storms) or flooding events (e.g. falling debris, trees etc); • Health risks associated with diminished air quality (outdoor and indoor), as above; • Vegetation (e.g. gorse) fires and wildfires have become an increasingly visible phenomenon in Ireland in recent years (Nugent et al., 2020). Most fires in Ireland can be attributed to human causes, whether deliberate or unintentional; however, the prevalence of summer droughts lead to increased risk of uncontrolled fires and more extensive wildfires. If peat becomes sufficiently dry, subsurface bog fires, which release carbon from the peat, may also occur (ibid.). Health risks can result from increased frequency of wildfires with particulate matter a direct cause for respiratory hospitalisations (Aguilera et al., 2021); • Change in labour capacity during hotter summer months as rising temperatures affect people's ability to work in discomfort (Watts et al, 2019), particularly for sectors involved in outdoor work e.g. construction sector, agricultural sector or amongst vulnerable groups such as elderly people in the workforce or pregnant women (Lundgren et al., 2013); • Exposure to floods has been systematically associated with mental health problems (Fernandez et al., 2015; Lamond et al., 2015; Munro et al, 2017); • Mental health impacts related to perceptions of risk, environmental or related financial stressors, and related strains on interpersonal relationships. These impacts can lead to stress, anxiety, recovery fatigue, or a sense of

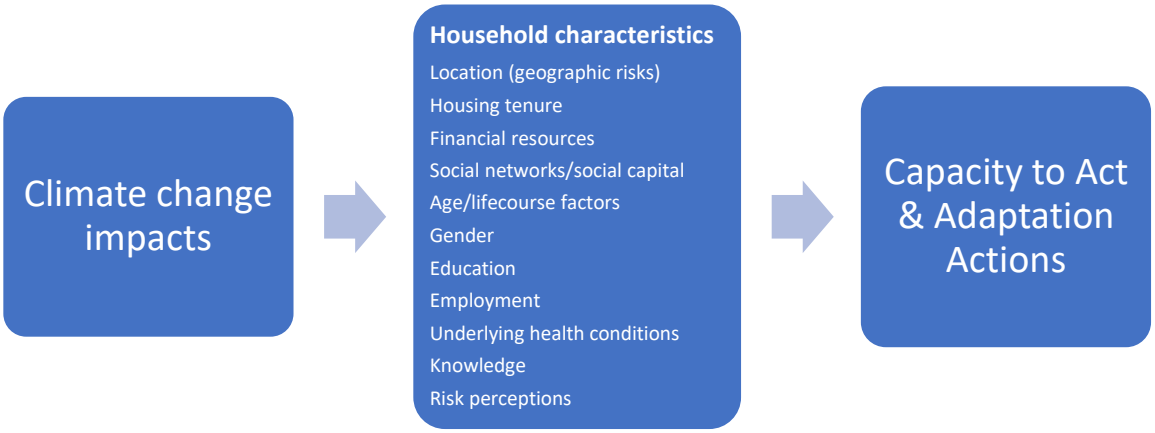
	loss/grief leading to an erosion of emotional resilience and psychosocial wellbeing (Hayes et al., 2018); • Increased risk of contaminated private groundwater and waterborne infection following increased frequency of flooding events (Musacchio et al., 2021; Andrade et al., 2020)
Costs of living risks	• Financial losses due to property damage (from risks outlined above); • Increased building insurance costs for property at risk (e.g. from flooding), insurance incentives for mitigating risk at household level or withdrawal of insurance cover and the increased transfer of risk from insurance companies to households (Hudson et al., 2019); • Increased food costs due to food supply issues and disruption to food supply chains (Munro et al., 2020) (impacts of climate change on food producing regions and cheap food imports from regions at risk). This also has implications for dietary health (Lake et al., 2012); • Household costs associated with mitigation actions e.g. carbon taxes, mobility costs, conversion to heat pumps; • Fuel poverty increases.
Risks to critical infrastructure essential to household functioning	• Disruption to household water supply during warmer summer months. Projections indicate an overall decrease in levels of precipitation during the summer months and this will lead to significant decreases in annual effective runoff and the availability of water supply including domestic supply. Furthermore, as outlined by *Climate Ireland*, for the areas where demand is currently greatest, e.g. the Dublin region, the greatest decreases are expected and this may make the provision of potable (safe to drink) water problematic, during the summer months in particular. These issues are heightened by a lack of investment in Ireland's water infrastructure, causing water loss (see https://www.climateireland.ie/#!/tools/hazardTool/hazardscopingWaterScarcity). • Energy insecurity during an era of energy transition; • Increased food insecurity due to global supply chain issues and increased disruption to food producing regions; • Disruption to key services (e.g. health, essential retail) following an extreme weather event (Scott et al, 2020); • Disruption to transportation infrastructure from extreme weather events (flooding, prolonged freeze or snow events) (Scott, 2013).

However, as widely recognised in the literature (e.g., Rumbach and Kudva, 2011), climate change impacts on households and individuals are uneven and are experienced very differently across different places and across household characteristics, summarised in Fig. 1 below. Households or individuals living in different places or geographic locations can be affected with different set of risks in terms of exposure or sensitivity to risks, for example households occupying a riverside property at risk from flooding or a coastal property at risk from coastal erosion. Household *characteristics* have the potential to build or erode resilience to climate change risks and shape potential adaptation pathways, which may be further mediated by social norms, cultural values, or place attachment. For example, the risks outlined in table 1 in relation to property damage have potential to cause potential harm to occupant health and wellbeing and create financial burdens of additional repair costs for property owners. These vulnerabilities may overlap or reinforce wider socio-economic inequalities: for example, low income groups are less likely to have adequate home insurance, or renters may have less influence on timely building repairs (Scott et al., 2021). Therefore, households with different characteristics living in the same area and in similar dwellings, may have different levels of exposure and variable capacity to act.

The influence of household characteristics on coping with a crisis has been very evident in relation to the current Covid-19 pandemic, whereby the health crisis overlapped pre-existing inequalities and spatial inequities across cities, regions and rural places, with uneven impacts across race, class, gender, age and geography (Scott, 2020) leaving many households unable to cope with the crisis. There are critical lessons for climate adaptation from individual experiences of the pandemic (Reckien, 2021). Consider, for example, the different experience of a service sector employee, with the ability to work from home, compared to someone working in essential retail or construction, potentially exposed to greater health risks through work travel and workplace interactions. During climate change induced urban heatwaves, these individuals would also experience similar differences, with the service sector employee able to work comfortably from home or from an air-conditioned office, avoiding heat stress and discomfort, with the construction worker exposed to potential heat stress risks. Similarly, research from the UK (Gallent and Hamiduddin, 2021; Gallent and Madeddu, 2021) illustrates how affluent households responded to the pandemic through increased use of pre-existing second home properties in rural locations (to avoid high density locations with increased risk of infection) or have increasingly sought expensive rural properties to take advantage of new working from home opportunities. These types of adaptive or coping behaviours were not available to households with less financial resources, first time buyers, renters, or older households reliant on nearby family or friends for care. This suggests that pre-existing financial resources will be a key determinant in

providing an opportunity to adapt, raising concerns with 'just adaptation'. Box 1 below highlights the need for further research in this area drawing on previous studies of household vulnerability in Ireland.

Fig. 1: Household characteristics that influence vulnerability or capacity to act



Box 1: Developing a Household Climate Change Vulnerability Index

Limited research has been undertaken in an Irish context to capture the potential influence of household characteristics in shaping adaptation actions. One potential approach would be to develop a Household Climate Change Vulnerability Index to capture the influence of household characteristics. For example, Murphy and Scott (2014) devised and applied a Household Vulnerability Index to identify households vulnerable to financial risks in the wake of the financial crisis and property crash of 2009 and subsequent austerity policies. This study was based on customised survey data and a series of indicators in relation to both *objective* measures of vulnerability (e.g. employment status, income) and *subjective* measures and individual perceptions (e.g. self-reported wellbeing, perceived job insecurity). Data was collected across six domains: employment, income/finances, mortgages/rents, the housing market, stress/support, and life satisfaction. In this way, the study was able to identify households vulnerable to risk and those households who were able to mobilise household resources (for example, savings, or social networks to manage mental health impacts) to cope with the crisis, maintain wellbeing and take adaptive action. A similar approach to capture household vulnerability to climate change risks and capacity to take adaptive action would provide a dynamic assessment of household adaptation capacity nationally.

An additional dimension to understanding household vulnerability relates to the *systemic* nature of the challenge. An illustrative example is in relation to household property. The housing sector remains central to the overall shaping of opportunity structures in societies in terms of family formation, mobility and asset accumulation (Forest and Hirayama, 2009). Property (for home owners)

represents a critical household asset in terms of wealth accumulation, intergenerational transfer, or as a resource for elderly care provision. Due to changing temperatures, changing patterns of precipitation, an increase in 'extreme weather events' and sea level rise, the property sector is expected to be profoundly affected by climate change (Desmond et al, 2017; Scott et al., 2021). Environmental hazards related to current and future climate change have the potential to cause enormous damage to housing, imposing significant social and financial costs. Across Europe, climate change has led to detectable changes in weather patterns (e.g. heatwaves, intense precipitation), increasing exposure of people and property to climate disruption (*disaster damages*) leading to an observed increase in economic losses (*disaster losses*) (EEA, 2017). A report by the European Environment Agency over a decade ago (EEA, 2010) highlights that extreme temperature events across Europe between 1998-2009 caused over 77,000 fatalities while flooding and storm events were the most costly hazards accounting for €96 billion in losses (primarily damage to property and critical infrastructure). Reflecting such dynamics, the European Environment Agency (EEA, 2016: 16) notes that "climate change is not isolated; it is strongly intertwined with socio-economic factors that make it a systemic challenge". In relation to the hazardousness of place, this includes real estate markets, property rights, residential consumer choices and mobilities, and management and regulation of land-use, construction and urbanization. In other words, vulnerability in Europe to sea-level rise, fluvial and pluvial flooding, heat stress and storms, increase not only through a changing climate but also through continued urban development in inappropriate locations (such as on flood plains) or the design of our cities (e.g. through the intensification of urban heat island effects) - i.e. development patterns increasingly interact with a changing climate to erode resilience and to increase household and individual vulnerabilities to risk. At the same time, past and current development patterns will establish *path dependencies* for future decision-taking regarding climate change adaption, such as construction on flood plains or incremental development along coastlines that are vulnerable to erosion.

At the urban scale, vulnerability to flooding, coastal erosion and heat stress will increase due to anticipated climate change combined with current development patterns. For example, Bertilsson et al. (2019: 970) state that floods are aggravated by increasing amounts of impermeable surface in the built environment which modifies flow paths, noting that "[f]loods are part of a natural process, but when they occur in urban watersheds, they produce negative consequences for the people inhabiting these areas, both in terms of damage to properties and threat to human health (and lives, in the extreme situation)". As flood risk increases, properties will have to be adapted to cope with flooding in order to ensure that households can recover quickly after flooding, that people can continue to

travel freely and safely, and that our economy continues to function (Hamin et al., 2018). More than 50% of Ireland's population reside in coastal environments, the majority in urban centres of varying size. Ireland's largest towns and cities, Cork, Galway, Limerick and Dublin, are all coastally located, and are all situated on rivers with associated estuaries. Many important urban centres are already vulnerable to flooding. Changes in precipitation patterns and the frequency of severe weather events increase this risk, which is further increased by other parameters like land use and urban fabric (Desmond et al., 2017). In relation to heat stress, Hamdy et al. (2017) state that "[d]uring the sweltering summer of 2003, which was the hottest summer in the last 500 years, over 35,000 people died across Europe from heat-related causes" (p.307). Although overheating has not always been associated with the Irish climate, observed data indicates that the annual average surface air temperature in Ireland has increased by approximately 0.9°C over the last 120 years, with a rise in temperatures being observed in all seasons. This compares with a global average temperature estimated to be 1.1°C above pre-industrial levels, with fifteen of the top 20 warmest years on record in Ireland having occurred since 1990 (Cámaro García and Dwyer, 2021). As the climate progressively warms there will be a rise in heat related mortality as incidences of heatwaves increase. During the summer of 2003, for example, climate change increased the risk of mortality due to excessive heat by 20% in London, which was estimated to cause 315 deaths; mortality risk in central Paris increased by c.70%, and there were an estimated 735 resulting deaths (Desmond et al., 2017).

Therefore, exposure to risk and the ability to take adaptive action for property owners are mediated, structured or constrained by institutions, the regulatory control of land-use, property rights, insurance costs, market signals (e.g. increases or decreases in property prices), and influenced by path dependencies (e.g. past urban investment), cultural values (e.g. property ownership) and place-attachment (e.g. resistance to move, importance of local social networks), further explored below.

6. Household adaptation (and maladaptation)

A useful stating point in understanding household adaptation is a recent paper by Carman and Zint (2020) that attempts to classify personal and household climate change adaptive actions. In defining household adaptation, the authors are highly critical of household adaptation definitions that focus narrowly on individual/household benefits derived from action. These individual benefits may focus simply on actions taken that contribute to beneficial outcomes for individuals exposed to the effects of climate change, such as preventing damage to one's property from climate change risks, protecting one's personal health or through creating financial savings. Carman and Zint argue that such

definitions of household adaptation are unhelpful as they rarely consider systemic effects: in other words, adaptive actions can have short term benefits for those engaging in them, but the same actions can develop negative impacts on other people or lead to further environmental damage. These definitions that focused on individual benefits also diverge from the IPCC's approach, which emphasises the prevention of harm *and* exploiting beneficial opportunities, and moreover recognises systemic risk factors. Therefore, identifying who and what is affected by the outcomes of adaptation should be explicit. To address this deficit, Carman and Zint consider household adaptation as having personal, social, and environmental co-benefits and therefore generate positive social and environmental outcomes.

This broader approach is critical to avoid examples of *maladaptation*. In other words, successful short term adaptation may be less successful in the longer term. As Adger et al. (2005) highlight, while actions can be successful for adaptive agents, these actions may produce negative externalities and spatial spillovers, potentially increasing impacts on others or reducing their capacity to adapt, or lead to further environmental damage. The most widely cited example is the potential for individuals to adapt to hotter summers through increased use of air-conditioning to cool homes, which in turn leads to a surge in energy demand and increased carbon emissions. The short term benefits are offset through higher household energy costs and the environmental impacts of increased energy usage. A further example might relate to adaptive actions to prevent flood damage at an individual property scale that may simply displace the problem onto neighbouring properties or create downstream risks. A third example may relate to adaptive actions to warmer summers exacerbated in cities through the urban heat island effect. Affluent households could adapt to these effects through purchasing a rural second home or moving long term to a rural location with lower temperatures. However, these short and long term migratory actions have social, economic and environmental consequences in terms of increasing demand for new rural housing construction, creating new market demands that increase local house prices (with potential to displace locals), and increased dependence on car mobility through dispersed living models. As evidenced by the response to the current Covid pandemic, the demand for rural housing in coastal locations increased significantly with higher house price increases in these localities than in urban areas (Scott and Heaphy, 2021). Therefore, household adaptation should also take into account efficiency, effectiveness, equity, legitimacy and robustness (Adger et al., 2005).

In relation to specific adaptation actions, various approaches to classifying actions can be identified in the literature. For example, in a review of the UK literature, Porter et al. (2014) categorise household

responses to climate change into two main types. Firstly, they identify *coping responses*, which are intuitive, inexpensive and accessible. Porter et al. note that coping responses are typically associated with actions related to shifting weather conditions as currently experienced, particularly warmer summers and increased heatwaves and colder winters. In relation to heat stress management, coping responses included changing clothes, dietary intake, and keeping windows open, but rarely more complex solutions such as introducing shading to home gardens. Secondly, Porter identifies *adaptations*, which are more complex, costly and more anticipatory than reactive coping responses. These were more commonly associated with household flood risk management, requiring more technical and costly actions. These included interior modifications (e.g. replacing ground floor carpets with tiles, moving electrical fixtures higher up walls, external modifications (e.g. reinstating porous surfaces), or purchasing specialised insurance.

An alternative approach to categorising adaptation action is advanced by van Valkengoed and Steg (2019), who identify six domains of individual adaptation outlined below in Box 2.

Box 2: Domains of individual adaptation (adapted from Valkengoed and Steg, 2019)

- *Information-seeking*: gaining information about risks and potential actions to perform (e.g. flood risks to property);
- *Preparative actions*: actions to protect one's household *before* an adverse event (e.g. adapting house interior to better cope with flooding, such as moving electrical points higher up walls);
- *Protective actions*: actions to protect one's household *during* an adverse event (e.g. protecting property through temporary sandbags);
- *Evacuations*: either temporarily or permanently leaving an area to avoid a climate related hazard;
- *Purchasing insurance*: such as ensuring household insurance cover includes climate related damages to property (which may involve additional premiums); and,
- *Political action*: supporting or advocating for adaptation-related action. This can range from shifting voter behaviour, lobbying politicians or public officials, direct protest, or joining/forming residents' groups to take direct action.

In a similar approach, Carman and Zint (2020: 6) undertake a meta-analysis of the literature on household and individual adaptation focusing on *behavioural responses*, and identify eight primary categories of adaptive behaviour at the individual and household scale, outlined in Box 3 below.

Box 3: Behavioural responses to adaptation at the individual/household scale (adapted from Carman and Zint, 2020)

- *Civic engagement*: acting alone or with other people to support climate change adaptation policies, social and environmental change or other community adaptation goals e.g. policy support, joining a community group;
- *Consumption*: actions to adapt to climate-induced global supply chain disruptions, based around product purchase and use decisions e.g. replacing preference for cheap food imports with locally produced and available products;
- *Psychological coping*: mental management if stress associated with the impacts of climate change e.g. seeking support from friends, family and networks, or adjusting expectations;
- *Household protection*: physical actions to proactively protect one's family members, house and/or possessions from climate change impacts e.g. moving possessions to upper floors, insurance, placement of temporary sandbags in a flooding event;
- *Learning*: building new understanding about adaptation e.g. information-seeking or sharing, changes in knowledge;
- *Lifestyle change in place*: making long term changes to one's way of living e.g. growing own food, financial saving to take longer term actions;
- *Migration*: permanently leaving one's original home in response to climate change e.g. changing housing type or location within the same region/city or moving to a new city, region or country;
- *Self-protection*: personal physical actions, planned or unplanned e.g. during a heatwave, drinking more water, wearing lighter clothes, changing work patterns, or temporary evacuation during flooding.

These categories and the behavioural perspective adopted by Carman and Zint reflects a wider *behavioural turn* in risk management. As outlined by Kuhlicke et al. (2019), this approach is based on three core premises. Firstly, it suggests that impacts can be reduced by individual actions, and thus places some degree of responsibility for adaptation on individuals. Secondly, it suggests that motivations for adaptation can be understood and can therefore be targeted by policy-makers (e.g. through incentives/disincentives, regulation). Thirdly, it assumes that individuals have the capacities and resources to take adaptive actions, raising potential issues for social vulnerability and environmental justice.

Moreover, notably, adaptation is not isolated from other household decisions, but takes place in the context of demographic, cultural and economic changes along with governance and technological transformations (Adger et al., 2005). Therefore, from an analytical perspective, it can be difficult to disentangle adaptation actions from actions stimulated by other social and economic drivers, or the influence of specific events. Furthermore, Adger et al. (2005) suggest that adaptation actions can also

arise from non-climate related socio-economic changes. For example, a household relocating from an area vulnerable to flooding may not be motivated by climate change considerations but influenced by other factors such as labour mobility. Therefore, adaptation can be purposeful or unintentional.

A further individual response to climate change (and a reactive form of adaptation) relates to the growing literature on climate litigation, following recognition of addressing loss and damage due to climate change within the Paris Agreement in 2015. Toussaint (2020) observes that there is growing evidence of litigation and legal action at international, regional and domestic levels along with an expanding literature that explores how climate change relates to human rights, particularly the state's role in protecting its citizens. This includes a growing number of legal cases challenging various government's lack of ambition related to mitigation or adaptation efforts, or cases that seek to assign responsibility where failures to adapt to climate change result in harm. As Toussaint outlines, these cases may set out to achieve a range of objectives, including: (1) seeking compensation; (2) cases aimed at increasing mitigation ambition or funding adaptation measures; and (3) a growing body of court cases that grapple with questions of responsibility, attribution and ultimately some form of remedy. Toussaint notes, however, these actions face significant obstacles, such as proving causality or attributing harm to decision-makers or polluters. This is currently an under-researched area but may grow as a potential avenue for individual citizens or for communities to respond to climate change impacts, particularly as the evidence base improves regarding climate vulnerability and the extent that risk is assessed by decision-makers, for example, before approving new residential development in vulnerable areas.

7. Household motivation

Earlier in this paper, we discuss how household characteristics overlap with place-based risk factors to determine household or individual vulnerability to climate change. In a similar vein, it might be reasonable to assume that households with the capacity to act (e.g. through knowledge, social networks, skills, health or financial resources) will therefore take action to adapt to climate change. However, the literature presents a more complex picture underpinned by various explanations of motivation in framing adaptive behaviour. Before proceeding further, it is useful to first briefly examine some of the formative theories/models advanced in the literature to explain motivation. These models often draw on earlier studies that examined pro-environmental behaviour change and health protection. Originally these were first developed around a linear progressive 'information deficit' model of understanding how failure to achieve desirable action was attributable to a lack of

awareness and poor knowledge. Hence, it was believed that provision of information should generate increased awareness and so influence attitudes and bring about behaviour change (Kollmuss and Agyeman, 2002). These early models have been criticised for being simplistic, as a gap often persists between individuals possessing environmental knowledge and taking action (Blake, 1999; Kollmuss and Agyeman, 2002; Steg and Vlek, 2009). A variety of models have since been developed that recognise social norms, and how people's perceptions of threats and their own perceived capacity to control or cope are central in the formulation of an intention or motivation to take action. Some formative theories are illustrated in Table 3 below.

Table 3: Illustrative Behaviour Change Models

Theory / Model	Key factors	Source
Social Cognitive Theory	Emphasis on social learning with cognition playing a significant role in people performing behaviours. Here, human behaviour is mutually influenced by three sets of factors: personal, behavioural, and environmental influences.	Bandura, A. 1986. Social Foundations of Thought and Action. Englewood Cliffs, New Jersey: Prentice-Hall
Health Belief Model	The HBM is explained by the relationship between the perceived threat comprising perceived susceptibility and perceived severity and the net benefits comprising perceived benefits, and perceived barriers. These concepts inform people's 'likelihood of action'. Cues to action, activate and stimulate behaviour where people have self-efficacy to undertake them.	Rosenstock, I.M., 1974. Historical origins of the health belief model. *Health Educ. Monogr*. 2, 328–335.
Protection Motivation Theory	This suggests that people protect themselves based on five factors: (i) the perceived severity or consequences of a threat, and (ii) the perceived probability of exposure to a threat; (iii) the response efficacy of the recommended preventive behaviour, (iv) the perceived self-efficacy to carry out a measure, and (v) the response costs. Protection motivation is derived from the combination of both the threat appraisal (i & ii) and the coping appraisal (iii, iv & v).	Rogers, R.W., 1975. A protection motivation theory of fear appeals and attitude change1. *The journal of psychology*, *91*(1), pp.93-114.
Theory of Planned Behaviour	Action is guided by three considerations. Behavioural beliefs (attitudes), subjective norm beliefs (societal expectations), and control beliefs (extent to which people perceive control can be exerted). Combined together, these result to behavioural intentions. The stronger are those beliefs, the stronger the intention motivations.	Ajzen, I., 1985. From intentions to actions: A theory of planned behaviour. In *Action control* (pp. 11-39). Springer Berlin Heidelberg.

Returning to specific adaptive behaviours, a range of studies have emerged highlighting the importance of *experience* of risk exposure (rather than an information deficit) as critical in shaping adaptive action. For example, in a study of household adaptive action in the context of wildfires in Australia, Mortreux et al. (2020) identify a weak relationship between high adaptive capacity and actual adaptation. Their research identifies three critical factors that appear to influence or mediate this relationship: (1) household or individual attitudes to risk (further discussed in next section); (2) household experience of risk (i.e. whether the household had previous exposure to hazards/risks); and (3) their expectations of authorities, with households not taking adaptive actions instead expecting or relying on public assistance. Similar results were found in relation to a French case study of flood

protection measures by Richert et al. (2019), who highlight how household adaptation could be 'crowded out' by a focus on state-led intervention and new physical structures.

Household *experience of risk* is identified as the most critical factor in motivating adaptive responses across a range of studies addressing responses to different dimensions of climate vulnerability, such as flood risk (Grahn and Jaldell, 2019; Kuhlicke et al., 2020) and sea-level rise and erosion (Koerth et al., 2013). For example, Grahn and Jaldell (2019) in a Swedish study of flood risk management, suggest that homeowners were more likely to take adaptive measures if they had been previously exposed to flooding and perceived public flood protection measures as insufficient. Other dimensions motivating behaviour relate to the positive influence of social norms, which may lead to environmentally responsible behaviour (e.g. adaptive actions which have wider community or neighbourly benefits) or altruistic motivations (Kuhlicke et al., 2020; Carman and Zint, 2020; Adger et al., 2005). In this context, Lau et al. (2021) call for the need for further research into the role of social values and morals and the role they play in motivating and framing climate decisions, along with uneven power relations between social actors and different social groups. Devitt and O'Neill (2016), who reviewed media framing of flooding in Irish broadsheet media, also suggest that further research and discussion regarding the role of media in framing public debates regarding climate adaptation is required. In addition, local connectedness or place-attachment can be a powerful motivating factor, often underpinned by social and family connections, community bonds and social capital, and traditions (Tubridy et al., 2021). While social capital is generally identified positively in the literature, a study on individual responses to heat waves and adaptation in the UK, suggested that (bonding) social capital had the potential to perpetuate rather than challenge perceptions of low risk through reinforcing existing behaviours, and thus increasing vulnerability (Wolf et al., 2010).

Changes in behaviour at a household scale may also be influenced by economic factors (Adger et al., 2005). For example, price signals and market behaviour can act as a powerful motivating influence in shaping household decision-making, such as protecting property from damage and resultant repair costs. Price signals in the housing market may influence relocation decision-making, such as declining property worth in flood risk locations. A Dublin case study by Pilla et al. (2019) that reviewed house price impacts of proximity to previous physical flooding and also areas at risk of (potential) flooding, found that property prices were impacted by proximity to past flood events. However, being simply located in an area now assessed as being at objective flood risk did not significantly impact property prices. Adaptive actions may also be negated by reactive adjustments or interventions beyond the household. For example, in a US study, Frank (2020) notes how short term measures to protect

expensive coastal real estate through physical flood defences (e.g. sea walls) often leads to further residential development, thus entrenching future vulnerability. Marchman et al. (2020) also note how compensation schemes following climate change-related property damage often leads to inertia amongst affected households whereby state-led intervention leads to inaction in household adaptation to limit future impacts. Much of the literature on adaptation motivation and financial rewards tends to focus on specific high risk factors, such as protecting property from a place-specific flooding risk. In contrast, Porter et al. (2014) also outlines how longer term financial rewards may also spurn action in relation to 'slow burn' processes of change, for example in improving home ventilation to cope with warmer summers or building modification to better cope with increased storms. However, slow cost recovery is a significant barrier to adaptive action (ibid.).

While studies of motivation often focus on individuals acting out of rational self-interest, either from experience of risk exposure or to reduce costs, Brink and Wamsler (2019) in a Swedish study, also emphasise the role of values in shaping attention and action. In this study, the authors report on survey findings which identified the potential to contribute to a thriving, green society was as important a consideration as economic factors (a more so amongst female respondents), and a key motivation for engaging with adaptation was to support other community members perceived to be more at risk. However, this study also highlights an 'adaptation gap', whereby self-reported motivation to take adaptation measures did not always lead to actual action.

One area related to motivation that is currently under-researched relates to the co-benefits of adaptation actions. This theme has been identified in relation to wider institutional adaptation interventions: for example, Lennon and Scott (2014) identify the multifunctional benefits of green infrastructure delivered through planning frameworks that provide adaptation benefits (e.g. flood risk management, urban cooling etc.), but also provide opportunities as a health promoting environment, for noise/air pollution mitigation, and biodiversity gain. This aligns with the emergent bioeconomy[1] policy area that highlights both adaptation and mitigation benefits of ecosystem restoration (EC, 2018) and the need for cross-sectoral policy coherence (Kelleher et al., 2019). In a similar way, research and policy recognises the ancillary benefits of individual level climate mitigation actions, for example the health benefits of active travel that also reduces carbon emissions. These co-benefits are critical in developing a compelling case for 'no regret' action and in relation to adaptation, this approach is consistent with IPCC definitions of adaptation that also identifies the importance of taking advantage

[1] Defined in the EU's Bioeconomy Strategy as "All sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles" (EC, 2018:4).

of any opportunities that arises from adaptative actions. Co-benefits are perhaps easier to identify at a community scale, for example, in relation to community-led urban greening At a building scale, improving ventilation to cope with warmer summers will also future-proof buildings in relation to future pandemics and airborne infectious diseases.

8. Household perceptions of risk

Throughout this paper, we repeatedly refer to risk. Therefore, it is useful to explore the concept of risk before elaborating on people's perceptions of risk. Risk frequently includes reference to hazard or harm or the possibility of damage (Aven, 2012). Usually when risk is being discussed in professional/scientific settings it includes reference to uncertainty, likelihood or chance, whereas such factors are not necessarily implied in its everyday use (Althaus, 2005). Other definitions, noted by, *inter alia*, White (2010) and Jóhannesdóttir and Gísladóttir (2010), include concepts of vulnerability, exposure and hazard. Additionally, risk can be defined as comprising the product of probability and consequences (O'Neill et al., 2016; O'Neill, 2019), and importantly for this paper, this is the construct of risk used in statutory Irish planning and flood risk guidance (DEHLG and OPW, 2009).

Whilst scientists and engineers tend to focus on objective measures of statistical risk, social scientists have an interest in more subjective aspects of risk, including how people interpret risk. As noted by O'Neill et al. (2016), the variety of risk constructs that are understood can be explained by the range of ways that people perceive risk. Slovic and Peter (2006) note that people perceive and act upon risk in two principal ways: firstly through 'risk as feeling' through affective responses (e.g. outrage, worry, dread, fear) and through 'risk as analysis' through rational evaluation and responses. Given the variety of constructs of risk, there is no singular measure of risk perception with multiple measures used to capture components of 'risk perception'. Many factors have been shown to influence people's perceptions about risk and evidenced in psychometric studies (O'Neill, 2019). Table 4 below, based on Gibson et al. (2012), provides an overview of a variety of factors and how they can influence risk perception, for example, low risk perceptions tend to be associated with voluntary exposure to familiar risks, whereas high risk perceptions tend to be associated with involuntary exposure to new risks that may be the result of human activities.

Table 4: Factors shown to influence risk perception (adapted from Gibson et al., 2012: 10)

Factor	Low risk perception factors	High risk perception factors
Benefits	High benefits	Low benefits
Exposure	Voluntary	Involuntary
Type of risk	Chronic – kills one at a time; persistent	Catastrophic – kills large numbers at once
Familiarity	Old risk	New risk
Catastrophic potential	Common risk - learnt to live with	Dread - evokes emotional fear
Visibility	Visibility	Invisibility
Individual control	Possible	Not possible
Origin	Natural	Man-made
Knowledge	Known to those exposed	Not known to those exposed
Uncertainty	Known to science	Not known to science
Manifestation	Immediate or reversible damage	Delayed or irreversible damage
Damage	Not fatal	Fatal
Distribution of damage	Equitably distributed	Not equitably distributed
Damage visibility	Anonymous victims	Victims identifiable
Victims	Adult males	Children and women
Social or scientific status	Consensus possible	Controversial

Whilst the literature shows the most important factor to influence risk perception tends to be prior experience, other socio-economic factors (for example, age, education, gender, homeownership) also informs risk perception. In addition to cognitive and socio-economic factors, geographical factors, across a range of objective and perceived measures of proximity to hazard sources, have also been shown to influence people's risk perception e.g. elevation, distance, perceived distance (Botzen et al., 2009; Zhang et al., 2010; O'Neill et al., 2016). These are elaborated further in the two case studies outlined in Boxes 4 and 5 below.

Box 4: Case Study Bray & River Dargle

A study at Bray, Co. Wicklow, sought to explore the risk perceptions, awareness and preparedness of residents living close to the River Dargle, which historically has been prone to major flooding. The study was undertaken prior to the development of a flood relief scheme, and surveyed individuals living inside and outside of the modelled flood zone. Each respondent undertook a face-to-face survey and also outlined on a map the areas they believed to be at risk of flooding within the study area. The researchers found a positive, significant relationship between worry and previous flood experience and preparedness. Whilst the

majority of respondents living in the flood zone (86 percent) were aware that their home was at some level of flood risk, there was a significant minority, both inside and outside of the modelled flood zone, who incorrectly assessed their flood risk exposure. The researchers found a significant relationship between worry and distance to the perceived flood zone, suggesting that perception is important in understanding worry. This is important as worry can act as a motivator for taking action.

The majority (81 percent) of respondents were unprepared for a major flooding event, with respondents stating that they had not thought much about it (51 per cent) or were not planning to undertake any preparations (30 percent). This is interesting given that half of respondents believed themselves to be at some degree of flood risk. A higher level of preparedness, on average, was found among those who were previously flooded. Examining different stated levels of preparedness, only 6 percent of respondents who stated that they were at 'no risk' of flooding intended to take any preparedness actions, compared to 42 percent of those who state they were at risk. Those respondents who have been previously flooded, and those who believe that they were at risk of flooding were more likely to have undertaken physical flood preparedness actions. In a related qualitative study at Bray, Fox-Rogers (2016) found that preparedness can be undermined by low levels of efficacy amongst individuals in terms of the preparedness measures available to them and their own personal capacity to implement them.

Box 5: Rural Settlement Patterns, Domestic Wastewater Treatment Systems (DWWTS) and Private Wells

Rural Ireland is characterised by a dispersed rural settlement pattern with 'one-off' houses located throughout the open countryside. These houses are typically serviced by DWWTS (locally referred to as septic tanks systems) and drinking water sources from private wells. Approximately one-third of Irish households rely on a DWWTS and there are an estimated 750,000 private well users comprising about 16% of the national population. Private wells remain a largely unregulated source of drinking water. There is significant evidence that the combined distribution of people, livestock, unregulated groundwater sources (private wells) and DWWTS, is resulting in the highest incidence rates of symptomatic verotoxigenic Escherichia coli (VTEC) infection in the European Union. Specifically, Ó hAiseadha et al. (2017) concluded that VTEC infection in Ireland is significantly associated with cattle density and private well reliance, with density of DWWTS also found to be significant, and that in some respects VTEC infection may be characterised as a "rural illness". However, a study by Hynds et al. (2018) found that up to 25 per cent of DWWTS owners reported not desludging their DWWTS, and that subszequent to a national information campaign there was little evidence of behavioural engagement among respondents. Devitt et al. (2016) found that householder capacity to engage in regular DWWTS risk management is reduced by limited perceptions of risk susceptibility and severity, thereby impeding cues to action. In a separate study of Irish private well owners Musacchio et al. (2021) found that 72.5% of respondents who reported previous flooding experience failed to adopt protective actions for their private well. Only 10.1% of respondents adopted water treatment and frequent testing which

aligned with reported low levels of risk perception and poor awareness of the associated between risk factors (e.g. floods, contamination sources) and groundwater quality. Moreover, McDowell et al. (2020) identified gender-related differences in flood risk perception and behaviours among Irish private well users.

The lack of self-protection against waterborne infection represents a significant health threat to rural dwellers and private well users that will be exacerbated by climate change unless adaptive behaviours are embraced. Recommendations emerging include, *inter alia,* establishing social norms for DWWTS and private well monitoring and maintenance, targeting communications at vulnerable population sub-groups, provision of free well water testing, increased rate of statutory inspection of DWWTS, and a wider programme of remediation and replacement of deficient DWWTS and installation of treatment at private wells.

9. Opportunities for influencing household behaviour

As discussed earlier, household adaptation actions are not autonomous but are structured and influenced by rules, institutions, action and inaction by other actors (government, private sector actors), and market signals. Therefore, household adaptation action can be incentivised or disincentivised, constrained or enabled, depending on these wider factors. In this section, we summarise how householders' adaptive capacities can be better supported through a portfolio of policy measures.

9.1 Regulatory controls

Regulation can often be viewed negatively, potentially constraining individual rights; however, regulatory controls remain the dominant approach to environmental policy design. Regulation can support household adaptive actions in a number of ways. For example, in relation to *enabling* regulation, effective building and planning regulation can enable (or limit) building occupants to adapt to hotter summers through ensuring new buildings have adequate thermal insulation and natural cross ventilation to moderate extremes and adapt to potential heat stress and discomfort. Flexible working regulations could also ensure that individuals are not exposed to heat stress risk through introducing flexible work practices. In relation to *constraining* regulation, this could be applied to preventing maladaptation, concerns with individuals gaining short term benefits that create negative effects for others, or modifications with negative impacts on others. For example, English planning authorities require planning permission for households seeking to remove front gardens in favour of impermeable paved areas to prevent additional run-off to urban drainage systems. Regulations could also address household flood risk adaptation that displaces risk to neighbouring properties. This can

also be considered in a rural setting in relation to maintenance of DWWTS which have the capacity to impact on groundwater that is a common pool resource shared with neighbouring well-water users.

9.2 Voluntary methods

Voluntary methods are based on advice, communication and demonstration to influence individual behaviour. On a basic level, this applies to the effective communication of climate change related risk to inform household decision-making, while also providing advice and examples of potential actions (and costs and benefits), such as building modification.

While information can inform voluntary actions, over the last decade behavioural economists have increasingly focused on the actual organisation of the choice settings with which the consumer is confronted i.e. so-called '*nudge theory*' based on the notion that our behaviour is governed not only by reflective and conscious processes but also by automatic and unconscious processes (Ölander and Thøgersen, 2014). A nudge is defined in economics as a change in the decision environment (referred to as 'choice architecture' by behavioural economists) that influences people's behaviour without prohibiting any choices or significantly changing the economic incentives (Thaler and Sunstein 2009). The concept of nudging has also found its way into environmental policy, with nudges influencing people's behaviour to reduce negative externalities such as waste and resource use. Carlsson et al. (2021) identify two types of environmental nudges. Firstly, a 'pure nudge' is a behavioural intervention that aims to make it easier for the individual to "do the right thing", often designed to counteract decision-making errors such as inattention or self-control problems/laziness that lead to undesirable outcomes. For example, as outlined by Carlsson et al., individuals might decide not to sign up for a green electricity tariff, but when defaulted into a green tariff by their provider, their inattention or 'laziness' might prevent them from switching back to their original choice. The second type of nudge is referred to by Carlsson et al. as a 'moral nudge', which reward people for doing the right thing through psychological utility, for example through intentionally triggering psychological reactions such as fun, fear, shame, or pride. The most prominent moral nudge identified by Carlsson et al. is the use of social proof e.g. "*compared to your neighbours with similar sized houses, you consume far more energy*". Both types of nudges may have utility for influencing adaptive behaviour, however, Lades and Delaney (2019) raise ethical concerns with nudge policies, proposing an ethical framework for nudge application based on fairness and openness.

A further voluntary method relates to *citizen science* as a means of knowledge co-production on climate adaptation (between citizens and scientists), which in turn has potential to influence

behaviour amongst citizen participants (Kumar et al., 2020). Citizen science is the active participation of the public in scientific research projects, and is a rapidly expanding field. Two specific methods offer potential to inform adaptive behaviour at an individual or local level, specifically in providing data collection tools for geospatial data. Firstly, the use of volunteered geographic information (e.g. web-based georeferencing tools) can assist with providing crowdsourced environmental monitoring data, for example, in relation to coastal erosion or local flooding, that not only has potential to influence policy but also can build local knowledge of change processes. Secondly, the use of low-cost sensors has enabled citizen science methods to be applied to environmental monitoring in relation to indoor and outdoor air quality. Box 6 below outlines a case study of a citizen science project in Dublin in relation to air quality that demonstrates how this translated to community knowledge and change of behaviour.

Box 6: Citizen science and the iScape Horizon 2020 project

The iScape project was funded by the EU's Horizon 2020 Programme and coordinated by UCD to examine citizen science approaches to air pollution monitoring. The project adopted a 'living labs' approach to engage with local communities across six European cities (including Dublin). At the heart of the project was an ethos of 'co-creation' of new knowledge that would empower local communities to collect data using low cost censor monitors and to mobilise this data to influence policy actors and also to influence individual behaviour amongst participants. As outlined by Riccetti and Vaittinen (n.d.), such co-creation, based on human-centred methods, eventually leads to having informed citizens, conscious about the real challenges both from a technical and non-technical perspective. Acquiring the knowledge on air pollution issues and challenges and being part of an active space such as the Living Lab, the citizen is empowered and facilitated in approaching real solutions, by developing and improving new and existing local policies. The method was also applied to local schools to examine air pollution as a result of school drop-offs by car, with Kumar et al. (2020) concluding that data on air pollution levels highlighting higher concentrations during peak drop-offs and collections. This data was collected through a co-designed approach involving a primary school and local community, which raised new awareness of air pollution impacts and resulted in shifts in commuting behaviour to the school.

For project details, see: https://www.iscapeproject.eu

For the iScape manifesto on citizen science methods, see https://www.iscapeproject.eu/wp-content/uploads/2020/01/iSCAPE_Policy_Brief_No2_iSCAPE-manifesto-for-citizen-engagement-in-science-and-policy.pdf

9.3 Active citizenship, participation and collaboration

Participation is defined by Parry et al. (1992: 16) as "taking part in the process of formulation, passage and implementation of public policies". As Lowndes et al. (2006) outline, this includes a wide range of activities undertaken by citizens in seeking to influence decisions ultimately taken by public officials and elected representatives at the local level such as: voting, working in campaigns, making financial contributions to campaigns, contacting public officials, contacting or lobbying elected representatives, organising or attending protests, and petitions. While citizens can participate in decision-making on an individual level, more commonly citizens organise collectively at the local scale as a means of influencing policy through community or residents' groups, which provide a vehicle for engagement or opposition to decisions that impact on a neighbourhood or locality, providing a forum for community development.

The arguments for community involvement in environmental policy processes have been well-rehearsed (see for example, Burby 2003; Healey, 2008; Scott et al., 2012) and can be summarised as both a 'means' and an 'end' in environmental governance: involving people is viewed as a means of addressing complex, multidimensional environmental problems, while also espoused as an end in itself by building 'inclusive' and 'empowered' communities (Jones, 2003). Therefore, as Burton et al. (2006) suggest, if local citizens are more involved in policy processes, decisions will be better in two respects: they will command greater respect from local residents and hence carry more legitimacy and secondly, they will benefit from the insights and local knowledge brought by local residents acquired through living in the area. Participation can operate through both formal and informal avenues. For example, local community or residents' groups may be invited to participate in policy forums by public officials or local groups may organise around statutory opportunities for public engagement in the planning system. However, local groups may also participate or attempt to influence decisions through more informal avenues, such as lobbying or direct protest. In a study of activities led by residents' groups in the greater Dublin area, Scott et al. (2012) identify a range of both formal and informal practices mobilised to influence local development outcomes, which illustrates how local residents engaged with the planning system (illustrated in table 4 below).

Table 4: Summary of residents' groups participation methods in a study undertaken in Dublin by Scott et al. (2012)

	Policy formulation	**Policy implementation**
Formal arrangements	Statutory involvement in development plan formulation: • Pre draft public meetings	• Written submissions on applications for planning permission

	• Written submissions on Issues Paper • Public meetings following publication of draft plan • Submissions on draft plan	• Appeals: 3rd party appeals against the granting of planning permission • Judicial review: on point of law (this cannot reopen planning merits of case)
Informal practices	• Organising community meetings • Form coalitions with other residents' groups (often involving an 'up-scaling' of conflicts) • Lobbying of elected representatives • Media campaigns • Use of social capital networks to lobby officials and elected representatives	• Negotiating directly with developers prior to submission of planning application • Street protest • Petitions • Lobbying elected representatives and officials • Letter writing campaigns in local media • Generating high levels of local interest through social networks

This study by Scott et al. (2012) provides some insights into how local residents potentially may engage with local adaptation actions. Firstly, participation was often motivated by 'defending' local interests and the value of individual properties. This can often lead to a focus on short term outcomes that have local rather than strategic or longer term concerns. In relation to adaptation, such motivations could lead to lobbying for short term measures such as building physical flood defences, which may simply offer a short term solution or displace the risk to other localities. Secondly, a key explanation for community action related to the perceived failures of local officials and politicians in managing environmental change. Therefore, it could be argued that civic engagement, rather than being nurtured through formal arenas, is being prompted by failings and mistrust in local government and the local decision-making processes. Local groups appeared to perform a key function in attempting to ensure that developers, public officials and elected representatives are held accountable through fulfilling agreed obligations, implementing stated policy aims, addressing the negative externalities of local development, and making development control decisions which are consistent with local, regional and national planning guidelines. Therefore, mistrust in the effectiveness of national or local government adaptation interventions may actually prompt local activism. Thirdly, participation does not always lead to more sustainable outcomes. This is evident in relation to mitigation debates whereby social opposition can act as barrier to renewable energy roll-out (Horbaty et al., 2012), or the well known opposition amongst local residents in Clontarf, Dublin, to the construction of a new sea-wall that was perceived to impact negatively on residential amenity (see Box 7 below for further

discussion). Finally, this study revealed wide variation in the *ability* of different residents' groups to influence policy or decisions, which was often dependent on the socio-economic status and the social and cultural capital available to residents' groups, such as political connections, financial resources or availability of technical skills. In relation to the ability to influence adaptive actions, this suggests a bias towards more affluent areas, which reinforces existing socio-economic inequalities.

Box 7: Barriers to Transformative Adaptation: Responses to Flood Risk in Ireland

An Irish study exploring barriers to transformative adaptation in response to flood risk concerns at Clontarf (Co. Dublin) and Skibbereen (Co. Cork) highlighted three thematic barriers to implementation of transformational adaptation strategies:

i. Social and cultural values, particularly place attachment and identity can inhibit transformational change where certain values are ascribed to a place. It may not be until extreme events exceed social thresholds that transformation becomes a societal demand.

ii. Institutional reliance on technical expertise which fails to look beyond traditional technocratic approaches. Whilst flood risk management is now advocated, this study found a continued reliance on traditional structural measures to address flood concerns.

iii. Institutional regulatory practices. The traditional forms of public consultation via existing institutional bureaucracies and regulations are inflexible and impede adaptation with a more inclusive model that engenders public engagement and support for the process required to enable movement towards transformative change.

Findings in this study (Clarke et al. 2016) suggested that where social or institutional barriers emerge, that transformational adaptation strategies may have more chance of success when progressed incrementally.

These potential limitations of participation are not an argument against public engagement. Instead, this analysis serves to emphasise that citizen engagement and participation for effective adaptation processes should be designed to ensure equity, fairness, accountability, trust-building, and social learning. In this context, carefully designed deliberative forms of engagement have moved centre-stage as a means of reaching collective decisions under conditions of conflict – as Warren (2007) suggests, decisions resulting from deliberation are likely to be more legitimate, more reasonable, more informed, more effective, and more politically viable. Developed largely from Habermasian ideas, deliberative or collaborative approaches emphasise a discursive and interactive process as a means of identifying priorities and developing strategies for collective action, stressing the importance of reasoned dialogue among participants to overcome the deficits of other policy process models (see for example, Healey, 1992, 1997; Innes, 1996, 1998; Booher, 2008). Its proponents argue that deliberative methods potentially offer a model for policy-making within diffuse and fragmented governance-beyond-the-state processes, formalising the style, rules and arenas for policy formulation

to overcome narrow self-interest and to incorporate difference and oppositional views into negotiation and consensus-building – see Box 8.

Box 8: Experiments with deliberative policy-making

Experiments with deliberative policy-making are common across a range of related policy domains and at a range of spatial scales. These include the use of citizen assemblies at national scale, exemplified by Ireland's Citizen Assembly on Climate Change as a deliberative forum for climate action dialogue (Farrell et al., 2019). Citizens' assemblies bring together randomly selected, representative samples of the population and task them with deliberating on public policy questions (Devaney et al., 2020). Similarly, citizen juries or citizen panels have been deployed at a more local scale to deliberate on environmental policy problems (Murray, 2008). As outlined by Flynn (2009), in practice citizen juries typically involve a small group of citizens, usually from a given local area, who are asked to decide over a fairly specific question or policy problem. Juries vary in size between 12 to 25 members and are facilitated in their "deliberations by an adjudicator or moderator(s) and by teams of expert witnesses as well as other facilitators whose job is to prod and probe the jurors into debate and discussion. The jury is allowed to call expert witnesses and examine them through oral, written and audio-visual evidence" (Flynn, 2009: 58). More common than assemblies or juries, however, is the use of deliberative methods designed to engage multiple (and often large groups of) stakeholders in problem-solving based on principles of consensus and open dialogue, frequently employed in spatial planning and environmental management. Examples include visioning exercises (Gaffikin and Sterrett, 2006), participatory village design statements (Owen et al., 2011), design charrettes[2] (Richardson and White, 2021), or 'game-based' methods as a means of problem-solving (Lennon et al., 2016).

Deliberative methods offer significant potential for harnessing local knowledge in adaptation planning. These approaches move beyond participation as a form of 'community reaction' to a set of proposals, to include individuals and communities in a wider framing of adaptive governance. For example, Ayers (2011) argues that local experience and culturally specific knowledge are critical resources in understanding vulnerability requiring adaptation decision-making processes that are open to insights generated by local stakeholders rather than being restricted to impacts-based scientific inputs alone. Moreover, deliberative decision-making includes a dialogue which may challenge pre-existing positions or lead to social learning amongst participants. These processes require institutional support and investment; however, Ireland already has well established community structures in place, such as local Public Participation Networks (PPN) and Strategic Policy Committees (SPCs) to enable the public to take an active, formal role in policy-making and oversight

[2] A Design Charrette is an intensive, hands-on workshop that brings an interdisciplinary design team together with members of the community to explore design options for a particular area. It differs from a traditional community consultation process in that it is focused on producing a design scheme.

(Rafferty and Lloyd, 2014) established under local government reforms. However, there is limited evidence that deliberative methods or existing community structures have been mobilised to address adaptation responses.

9.4 Community-led action

While participation and deliberative methods have potential to enhance opportunities to include collective, community voices in adaptation planning, community engagement with adaptation can also take more direct and action-orientated forms. These include community-led environmental management, community-led responses following an extreme weather event, or even direct community ownership of environmental assets utilised for adaptation actions. One area of increased community level response relates to flood risk management with an onus being increasingly placed on actions beyond-the-state in adapting to risk. For example, Forrest et al. (2017) identify 234 flood groups currently working in England and Wales (community flood 'forums', 'committees' and 'action groups'). Their research shows that flood groups were involved with elements of both action and advocacy. Several flood groups were action-orientated and focused on preparation measures to reduce flood risk (e.g. clearing out ditches or creating temporary water storage areas). Other flood groups focused on actions to reduce the consequences of flooding (e.g. flood stores). Advocacy activities ranged from discussing local flood issues to actively pressuring and seeking to influence authorities on flood issues (e.g. the development of flood attenuation ponds or commenting on planning applications with flood risk implications).

A further example of direct action relates to community ownership of environmental assets with potential for enhancing local resilience to climate change. Scotland provides a useful example of the use of Community Land Trusts (involving the transfer of land assets to community-based organisations) to enable community-led responses to a range of environmental and socio-economic issues. These include developing rural affordable housing schemes, the use of community owned land for community-owned wind turbines (for local energy use) and local employment generating schemes. As outlined by Moore and McKee (2012), community land trusts (CLTs) have a long history, first established in the USA in the late 1960s to provide marginalised communities with greater access to land and asset ownership. Interest in CLTs has grown rapidly since the early 2000s. CLTs are non-profit, community-led organisations constituted to deliver community facilities or amenities through the ownership of land assets. Gallent et al. (2020, p. 547) suggest that the rise of interest in CLTs 'can be viewed as both an outlet for community frustrations and ambition', but can be inhibited by land availability and a dearth of mechanisms for bringing land into community ownership. However, land

reform and the transfer of land assets to community groups has grown significantly in Scotland over the last decade, supported by a Community Land Fund. In Box 9 below, we outline a case study of a community-owned forest in the Scottish Highlands. While climate adaptation has not been explicit to the community's plans, reduced flood risk through increased upstream water retention has been an ancillary benefit of the re-use of the forest alongside exploiting the forest's social and economic potential. Indeed, Simon et al. (2020) argue that combining adaptation actions along with broader wellbeing and socio-economic initiatives offers a more meaningful pathway for community engagement; in other words, developing adaptative approaches with demonstrable co-benefits, such as the creation of new greenspaces or which provide local enterprise opportunities.

Box 9: Aigas Community Forest, Scotland (adapted from Gkartzios, Gallent and Scott, 2022)

Aigas Forest is located along the River Beauty around 20km west of Inverness in the Highlands of Scotland, and adjacent to the parish of Kilmorack with a population of around 2,300. Aigas Community Forest is a community-led social enterprise responsible for managing 260 hectares of forest. Previously, Aigas Forest had been managed and owned by the Forestry Commission Scotland, which had engaged in tree planting in the 1960s on land adjacent to native woodland. The forest had been neglected and poorly managed over a 20 year period, and by the late 2000s, the Forestry Commission advised the local Kilmorack Community Council that it would be putting Aigas Forest on the market, giving the local community the first option on the sale. An initial community meeting was held in 2009 in which there was unanimous support for the creation of a steering committee tasked to explore the feasibility of purchasing the forest. With funding from the local municipality and Highlands and Islands Enterprise, an initial business plan was prepared to explore the feasibility of community ownership and a business model to underpin a social enterprise based on the sustainable use of the forest's resources while also deriving additional social and environmental benefits for the local community.

The primary benefits of the new community owned forest relate to social and economic benefits. In terms of social benefits, the forest now provides a new community space, used for local education, events and for recreation and health benefits. Local job creation and enterprise development is based on sustainably managing and harvesting commercial timber and tourism income from camping. Moreover, increasing biodiversity gain and ecosystem service benefits have also been central to the community's vision. This involves a new planting and woodland management strategy. For example, trees have been removed from naturally wet lands in favour of willows, and drains have been dammed to construct new ponds to increase wildlife hubs. As an ancillary benefit, the forest now retains more water following heavy rain, reducing downstream flood risk for the nearby village from the River Beauty.

This case illustrates how a local community has taken a neglected and poorly managed asset owned by a state body and reimagined it as the basis for new economic activities, as an ecological resource and as a focal point for community activities. This initiative is possible through the advancement of a new legislative framework alongside both technical capacity-building and access to funding that allows local communities to take direct ownership and to transform land into an asset for local prosperity and local wellbeing. Encouragingly, the community trust is putting land to a socially-productive purpose but based on sound environmental management and through recycling of income into further community-based activities.

While not focused on adaptation, the above example demonstrates how community land trusts or direct community action can reimagine how land is used that has important adaptive benefits. Community buy-in is also generated through providing immediate local social and economic benefits, suggesting that multi-functional schemes offer significant potential. Ireland has a rich tradition in both urban and rural areas, of community self-help initiatives for social and economic development, which has often been harnessed by the state to deliver urban or rural development programmes (or EU programmes, such as LEADER). A similar community energy could also be activated to support local adaptation, the scale at which individuals and households will experience climate impacts. However, effective community action is not simply a spontaneous process, but requires institutional support, capacity building (critical to avoid maladaptation), and also financial support (such as Scotland's Climate Challenge Fund – see Creamer, 2014).

9.5 Leave it to the markets

Market-based instruments (MBIs) are policy tools focused on providing market incentives or disincentives to influence individual and consumer behaviour. At a macro-level, MBIs have been deployed in climate change mitigation strategies, for example, emissions trading and carbon taxes. However, they have been widely adopted within environmental policy over the last two decades to *influence individuals* towards more sustainable behaviour. A simple example of a successful disincentive scheme is the plastic bag levy, whereby the introduction of a standard charge for a plastic bag was designed to shift consumers to less environmentally damaging behaviour. Examples of incentives may be in the form of market subsidies to encourage home energy efficiency, tax incentives to encourage refurbishment of historic properties, or payments for ecosystem services for landowners. Indeed, MBIs have been used extensively in areas such as carbon trading, biodiversity conservation, watershed protection, urban planning, and renewable energy to address market failures, to increase the cost-effectiveness of public spending, and to leverage new sources of funding for social and environmental objectives. However, as outlined by Baumber and Metternicht (2020),

they are yet to be widely applied to climate change adaptation, or to practices that enhance the resilience of communities.

Filatova (2014) argues that MBIs can be an effective activation of individual level adaptation that can be used to complement more traditional command and control regulatory instruments. MBIs aim to deliver socially-desired outcomes by encouraging behaviour change through market signals, rather than through explicit control directives. Filatova argues, in relation to flood risk adaptation, that Individual behavioural change might occur in a form of spatial adaptation, i.e. growing demand for safer areas resulting in fewer and cheaper developments in high-risk areas, or alternatively, individuals may change their choices regarding damage mitigation by means of insurance or waterproofing buildings. The author identifies a range of instruments that could be applied to encourage household adaptation as follows: subsidies, taxes, insurance, marketable permits, transferable development rights (TDRs) – which create incentives for individuals to act in their own interest while collectively delivering socially desired outcomes. On a basic level, market subsidies or incentives can be used to encourage households to take measures to protect their property from damage to offset retrofitting costs and the perception of slow return of savings on adaptive actions. Incentivised actions may include property retrofitting, drainage work or greater use of permeable surfaces surrounding a dwelling. A further example may relate to using taxes to alter development patterns (Clinch and O'Neill, 2010; Shahab et al., 2018) by providing incentives for individuals to internalise negative externalities of their activity or to account for positive externalities of a public adaptation measure. For example, riverside and coastal developments impose externalities when inhabitants enjoy locational amenities at the expense of all taxpayers who fund flood defences. A preferential tax reflecting the 'beneficiary-pays principle' should differentiate in benefits from public adaptation, or discourage (re)development in a high-risk zone and reward it in a safe one.

Beyond MBIs as policy interventions, insurance provides an approach market signalling that serves as a risk-sharing and risk communication device to help individuals rationalise their land-use choices in flood-prone areas (Filatova, 2014) or areas at risk of coastal erosion. As a risk-sharing mechanism it distributes risk across time and space for locations, which are otherwise too risky to develop. Insurance also is a risk-communication mechanism. As outlined by Filatova, if individuals have biased risk perception, compulsory insurance with premiums proportional to private and social cost of occupancy of flood-prone areas helps individuals to make a rational decision. If risks are correctly priced in premiums, insurance allows location in hazard-prone areas for those who are ready to bear risks without increasing a burden on taxpayers. Alternatively, insurance discounts could be offered

when householders have taken adaptive actions to protect their property from damage. In this context, Surminski and Thieken (2017) call for a more collaborative approach between insurers and government to incorporate property insurance into an anticipatory form of risk management (rather than simply a reaction to property damage) through enhancing risk knowledge and incentivising property-level protection. This approach involves risk-based pricing with government assistance to account for unaffordability (Hudson et al, 2016). For their part, governments see incentives for individual risk management as a way of reducing the burden on taxpayers on the rising cost of property damage caused by climate change induced events. However, Lucas and Booth (2020: 1) identify the shift to a privatisation (through risk-based insurance) of climate adaptation as problematic, as it erodes the "solidaristic and collective discourses and practices that support adaptive behaviour". They argue that individual adaptation based on pure market insurance models, while financially efficient, lack fairness, solidarity, equitability and protection of the most vulnerable. This is particularly the case when insurance proves unaffordable or through the refusal of insurance in high risk areas.

10. Conclusion

Individuals are already experiencing the impacts of climate change and as climate disruption deepens, this exposure to risk will become more heightened. Some impacts will be experienced 'in-place', at the scale of everyday life and home, leading to household exposure to property damage, disruption to essential infrastructure and health and wellbeing impacts. Other impacts will result from wider global challenges, for example, as climate change disrupts global supply chains, food production and energy security, with potential cost of living implications. Critical in evaluating the potential impacts and exposure to risk, is to understand *social vulnerability* – put simply, different households living in identical houses in the same street, may experience the impacts of climate change in very different ways due to individual and household characteristics, including income, age, social networks, physical ability and so on. These same characteristics also impact on an individual or household's *capacity to adapt*.

A common theme in the literature, however, is that capacity to act does not necessarily lead to individual and household *adaptation actions*. Instead, understanding individual motivation to act is critical. Factors at play may include motivation to limit property damage and resultant financial savings or altruism, but the key explanations identified from the literature included: (1) perceptions of risk; (2) exposure to risk in the recent past; and (3) how the state is perceived in terms of protection (resources, effectiveness etc.). These are useful insights in terms of coping with increased exposure to

hazards such as flooding, storms and other extreme weather events, but more limited in terms of understanding how households may respond to 'slow burn' processes (rather than more dramatic, sudden events), such as increasingly warmer summers or the health implications of climate change.

As noted by Adger et al. (2005), individual adaptation is not autonomous, but is structured through social norms, institutions, property rights and other legal frameworks, and market conditions. Therefore, it is important to consider how individual action can be *constrained* or *enabled* through these wider processes. In this context, this paper examined various policy tools that can influence or support individual or household adaptation. These included the influence of the market (e.g. insurance) and market-based instruments (incentives/disincentives), regulation, and voluntary methods. However, we also considered the role of community level responses through policy engagement and participation, and through more direct forms of community and collective actions. Given Ireland's rich tradition of active citizenship and grassroots and community action, these avenues offer significant potential, but require nurturing, capacity building and resources. Research from elsewhere suggests that community actions that can combine adaptation with wider socio-economic development offer the greatest potential for community buy-in.

However, while individual, household and community adaptation are a necessary response to climate change, adaptation-beyond-the-state raises some ethical issues that should be fully explored. For example, placing more emphasis on individual actions shifts the balance in the *responsibilization of risk* away from the state towards the individual or to communities in areas that have traditionally been led by public agencies. More affluent areas or wealthier households may have greater access to financial resources, greater experience or knowledge and may have more political influence. Therefore, the outcomes of placing more responsibility at individual or community level may be uneven. Moreover, individuals or communities acting independently of guidance or steer, may displace risks to neighbouring areas or result in maladaptation, while relying on market forces and individualised responses have the potential to entrench pre-existing socio-economic inequalities. So while fully engaging with individuals and communities may be an efficient use of (limited) state resources, any resultant adaptation actions must also be *legitimate*, *effective*, *robust* and lead to *just outcomes*.

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