1 Losses and damages from climate change: A critical moment for action

Losses and damages are happening now and the risks of future losses and damages will increase with climate change. This chapter briefly summarises the observed and projected physical changes due to climate change. It sets out both the framework for the analysis of climate risks and the associated risks of losses and damages that underpin this report. Some illustrative ways that climate risks manifest are presented and responsibilities for reducing and managing them discussed. The chapter also summarises the key messages and recommendations emerging from this report, including on the policy, financial and technological toolkits that can be used to reduce and manage the risks of losses and damages.

In Brief

A critical moment for climate action with losses and damages from climate change mounting

Climate-related hazards are having devastating and widespread impacts on lives; they are also directly impacting peoples' livelihoods. This is especially the case when they occur in conjunction with broader social, economic and political stressors. Unchecked, climate change will cause increasingly severe economic and social impacts. These impacts relate, for example, to changes in labour and agricultural productivity, health effects, loss of capital assets, displacement of people and changes to ecosystems. In an interconnected world, climate impacts experienced in one country – and the responses to those impacts – can impose threats beyond its borders.

Beyond the effects on economic production, people and communities are also vulnerable to intangible or non-economic losses and damages. These include the psychological or mental health impacts of extreme and slow-onset events, the loss of cultural artefacts and places, and loss of sense of identity and security. Intangible effects are not easily quantifiable and hence rarely feature in socio-economic assessments. However, many people consider vulnerabilities of some intangible aspects (e.g. health of family members, sense of safety) more important than the benefits of consumption associated with higher incomes.

Climate risk is a function of hazard, the exposure of people and assets, and their vulnerability to that particular hazard. It may be compounded by other unanticipated challenges (e.g. as many countries experienced during the COVID-19 pandemic). The extent of climate risks therefore will vary depending on a range of underlying factors. These include income and wealth, economic (including fiscal) and institutional structure, and geographic location. Different factors will also influence how people experience climate risks, including: i) values and worldviews; ii) a sense of place and the identities, cultures and values attached to places and landscapes; iii) perceptions of justice and accountability (e.g. distributive and procedural); and iv) discourses and power.

Developing countries, including Least Developed Countries and Small Island Developing States, are disproportionately affected by the impacts of climate change. Within countries, segments of the population marginalised by, for example, their socio-economic status, gender, race, age, disability, income, and class identities or geographic locations are particularly at risk. Future generations will carry the burden for inadequate climate action by current and past generations, especially those of large emitting economies and fossil-fuel exporting countries.

In this report, the ***risk of losses and damages*** refers to the harm that may result from the interactions of climate-related hazards, exposure and vulnerability. These can be reduced and managed through mitigation and adaptation efforts, as well as other interventions including disaster risk reduction, disaster risk finance and humanitarian assistance. Losses and damages are occurring now and will grow over time without urgent action to manage climate risks. In addition to rapid and deep cuts in greenhouse gas emissions to achieve climate neutrality globally, efforts should be scaled up to address the other two components of risk: exposure and vulnerability in their specific contexts.

The precise impacts of climate change on human and natural systems are subject to varying degrees of uncertainty. Given the nature and scale of the observed and projected natural and socio-economic impacts, some of which can lead to irreversible damages, these uncertainties have important implications for efforts to reduce and manage climate risks.

The context for action is complex and challenging. First, even at the temperature range set out in the Paris Agreement, a large share of current and future populations will face increasingly frequent and intense hazards, with some regions experiencing hazards not seen before, e.g. as disease vectors shift their range. This will all things being equal, drive increases in the losses and damages currently experienced for populations that may have contributed hardly at all to climate change.

Reducing exposure and vulnerability to climate change is also challenging. Complex historical processes have contributed to current exposures and vulnerabilities. Choices made today can further drive changes in these components that may be hard to reverse. Examples include expansion of urban and suburban developments, persistent inequality and increasing pressures on the environment (e.g. water resources). The capacity of countries to respond to climate change will also be subject to factors such as a strong and diversified economy, institutional and human capacity as well as ready access to finance and technology and effective governance structures.

Responsibilities for losses and damages are shared across many different actors, nationally and internationally. The level of climate hazard is driven by large greenhouse gas emitting countries. The scale and effectiveness of action to reduce and manage the risks will depend on several factors. These comprise the availability of financial resources (domestic and international, public and private); the availability of specific technical capacities; and the effectiveness and coherence of policy interventions designed to increase resilience and reduce exposure and vulnerabilities to climate-related hazards. In many developing countries, actions to reduce and manage the risks of losses and damages will rely on support from the international level. This is an active area of discussion and negotiation within the UN climate process, particularly in relation to current and future levels of climate finance.

A broad range of national policies and international support for sustainable development or disaster risk reduction, recovery and reconstruction will also be important. Indeed, decisions on climate action are not made in isolation. Rather, they are an integral component of countries' development objectives. As such, they must be assessed in relation to the broader spectrum of socio-economic risks and the associated uncertainties relevant for decision making. If not carefully managed, some measures intended to reduce and manage the risk of losses and damages may increase the risks for other segments of society or across countries.

1.1. Introduction

The lives and livelihoods of hundreds of millions of people, their cultures, development gains, economic prosperity and equality are at risk due to already occurring and future climate-related losses and damages. Temperatures continue to rise and climate-related hazards that cause major losses and damages in both developed and developing countries are becoming more frequent and intense.

The COVID-19 pandemic has demonstrated the potential scale and impact of global disruptions. At the same time, it has shown that decisive action is possible in the face of an urgent threat, initially to save lives but subsequently also livelihoods. This has contributed to calls for using the recovery to chart a new economic and ecological path that includes the net-zero transition, efforts to strengthen societal resilience, including related to climate change, and to integrate climate action with efforts to improve wider well-being, including on natural capital (Buckle et al., 2020[1]).

Early assessments of COVID-19 measures announced by OECD countries and major emerging economies suggest that just over 20% include an explicit focus on environmental objectives. The remaining share either does not consider environmental dimensions, or worse, reverses progress on some of them (OECD, 2021[2]). Important progress has nonetheless been made in recent years to address the challenges posed by climate change. Countries and other actors are committing to more rapid and ambitious action than might not have seemed possible a decade ago. Since 2019, a large number of countries have put forward commitments to reach by mid-century net-zero carbon dioxide or greenhouse gas (GHG) emissions (UNFCCC, 2015[3]). In May 2021, such commitments covered more than 70% of global emissions (CAT, 2021[4]). Climate action in line with these net-zero goals is, however, heterogeneous, and countries' shorter-term commitments are not yet always consistent with longer-term goals.

By March 2021, 126 developing countries were formulating and implementing National Adaptation Plans (NAPs), with 22 countries having completed the preparation of their first NAP (UNFCCC, 2021[5]). However, with mounting losses and damages, countries are recognising the need to strengthen the coherence of their approaches to climate change with that on disaster risk reduction (UNDRR, 2021[6]; OECD, 2020[7]). Meanwhile, the humanitarian community now considers climate change one of the greatest threats facing communities around the world (IFRC, 2021[8]).

This report provides analysis, insights, discussion and recommendations on the risks of losses and damages from climate change. It also highlights approaches to reduce and manage those risks that can inform relevant national and international policy and processes. This topic has been subject to much discussion under the United Nations Framework Convention on Climate Change (UNFCCC). Of particular importance in this context is Article 8 of the Paris Agreement, which encourages Parties to the Agreement to "enhance understanding, action and support […] with respect to loss and damage associated with the adverse effects of climate change". Through its analysis and recommendations, this report aims to contribute to that objective. The report takes a global perspective but highlights the diversity of circumstances in which people find themselves, with a particular focus on Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

The rest of this chapter is structured around five sections. Section 1.2 summarises the observed and projected physical changes due to climate change. Section 1.3 sets out the framework for the analysis of climate risks, impacts, and losses and damages that underpins this report. This includes a discussion on the losses and damages related to climate change that are already occurring, some illustrative ways climate risks are manifested, and the interrelationship between climate change and biodiversity. Section 1.4 provides context for action in reducing and managing the risks of losses and damages. Section 1.5 sets out the structure and intended audience for this report before Section 1.6 summarises key recommendations from the entire report.

1.2. Observed and projected climate change

This section briefly summarises observed and projected future changes in the climate. It also highlights some uncertainties inherent in projections of future climate change due to a range of different sources. This provides some illustrative insights without aiming to be complete. More comprehensive material can be found in the Intergovernmental Panel on Climate Change (IPCC) Working Group I contribution to the Sixth Assessment Report (AR6) (IPCC, 2021[9]) and the forthcoming contributions of Working Groups II and III, expected in 2022. Deep dives on different types of hazards are provided in subsequent chapters of this report.

1.2.1. Observed climate change

Human influence on the warming of the climate system is unequivocal (IPCC, 2021[9]). Average global surface temperature was 1.09°C higher in 2011-20 than over 1850-1900, with larger increases over land (1.59°C) than the ocean (0.88°C) (IPCC, 2021[9]). There are significant variations over the Earth's surface.

Polar regions and the land surface have experienced greater absolute warming than tropical regions and the sea surface, a pattern expected to continue (IPCC, 2021[9]). As well as increases in global surface temperatures, the physical impacts of climate change include increases in sea-level rise (SLR) (Frederikse et al., 2020[10]), and ice melt, as well as land degradation exacerbated by changes in the climate (IPCC, 2019[11]), among others.

Oceans absorbed over 90% of the additional heating due to climate change over 1971-2018 (IPCC, 2021[9]). This has warmed the oceans, particularly the upper layers since it takes a long time for the ocean as a whole to reach thermal equilibrium. The consequent thermal expansion was responsible for half of the increases in SLR over 1971-2018, with sea levels rising about 3.7 millimetres (mm) per year over 2006-18 (IPCC, 2021[9]). Other factors also increasingly contribute to accelerating mean SLR, such as the widespread shrinking of the cryosphere, i.e. frozen regions of the Earth system, though only ice melt on land contributes to SLR.

Climate is naturally variable, due to factors such as solar radiation, volcanic activity and complex interactions between the atmosphere and ocean. The temperature increase during the 20th century, however, far exceeded increases that could be attributed to natural variability (Crowley, 2000[12]). Indeed, the World Meteorological Organization (WMO) recently warned that, due to such variability, there was about a 40% chance that temporarily this temperature measure could increase to as much as 1.5°C in at least one of the next five years (WMO, 2020[13]). Natural variability and feedbacks in the climate system mean that the range of best estimates of the climate's response to anthropogenic GHG emissions – known as the climate sensitivity – remain uncertain. This uncertainty remains despite significant scientific advances in reducing the range (Sherwood et al., 2020[14]; IPCC, 2021[9]).

The scale of changes in the climate system and the current state of many of its aspects are unprecedented over centuries to millennia (IPCC, 2021[9]). Climate change is also contributing to increases in the severity, variety and frequency of some extreme weather events, such as heatwaves (Vautard et al., 2020[15]) and wildfires (Kirchmeier-Young et al., 2019[16]). The IPCC (2021[9]) is increasingly confident in the attribution of observed extremes (e.g. heatwaves, heavy precipitation, droughts) to human activity. Confidence in such attribution is greatest for hot extremes.

The ocean and the cryosphere have long response times to climate forcing by GHGs. The deep ocean will continue to warm and sea level to rise over the next several centuries, even if GHG concentrations stabilised today (IPCC, 2019[17]). This means that GHG emitted by humans – particularly carbon dioxide that has a long residence time in the atmosphere – will drive future climate change in these systems over several centuries. This points to the need to consider the potentially long-time scales in current evaluation of climate risks (Clark et al., 2016[18]).

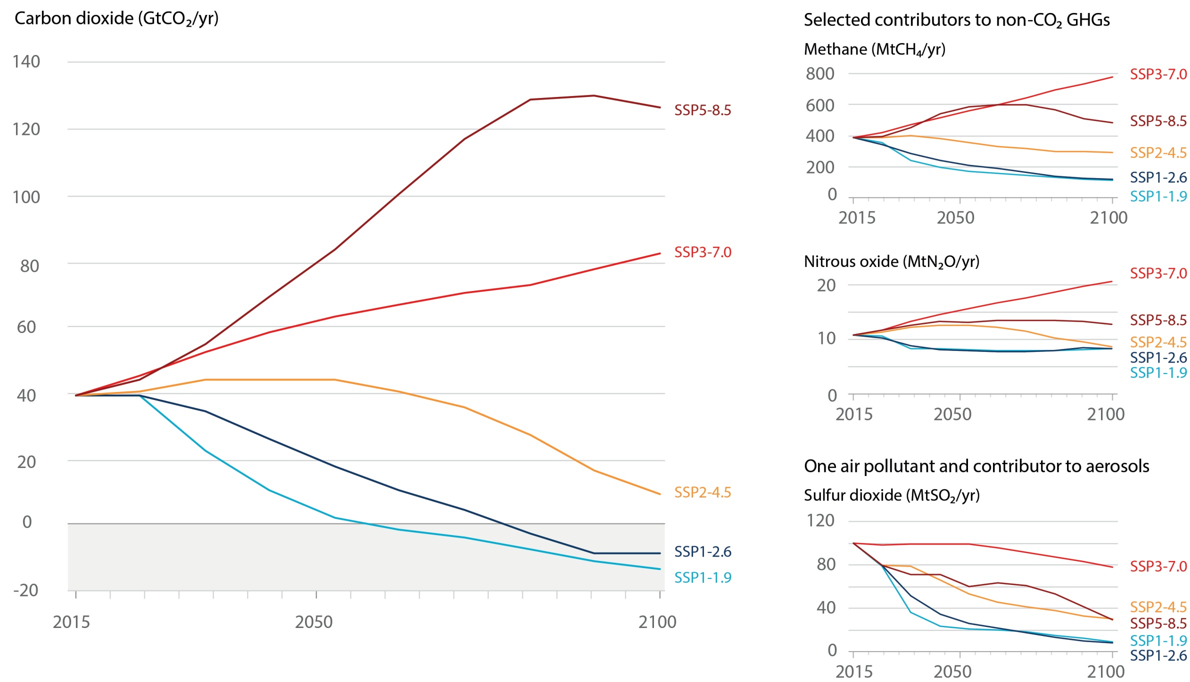
Climate change is also altering the geographical distribution of species at an accelerating rate (Pecl et al., 2017[19]). Some species are moving towards the Poles, while others are moving to cooler, higher altitudes. On average, terrestrial populations are moving 17 km per decade, while marine ones are moving 72 km per decade. The range of others subject to intolerable levels of heat is shrinking. Established species interactions are being disrupted and new relationships formed.

1.2.2. Projections of future climate change

Future emissions pathways will be determined by the complex and rapidly evolving range of societal, technological, economic and political choices made by governments, countries and citizens in the short-, mid- and long-term. Climate models since the 1970s have performed well in predicting global mean surface temperature rise using scenarios of atmospheric concentrations of GHGs (Hausfather et al., 2020[20]). There is a good understanding of how different choices will influence future emissions, even if there is some uncertainty about how these will translate into atmospheric concentrations of GHGs due to changing interactions between different components of the climate system as the planet warms.

The IPCC has established five central Representative Concentration Pathways (RCPs), bounded by a low-carbon mitigation scenario (RCP1.9) and a carbon-intensive baseline scenario (RCP8.5). Each pathway represents a potential future of climate forcing, with higher atmospheric GHG concentrations leading to higher levels of global mean surface temperature increase. Figure 1.1 shows illustrative pathways for different future worlds, based on the RCPs.

Figure 1.1. Future annual emissions of CO_2 and of a subset of key non-CO_2 across five illustrative RCP pathways



Note: Emissions of carbon dioxide (CO_2) alone, selected contributors to non-CO_2 and one air pollutant and contributor to aerosols. The scenario categories summarise the wide range of emission scenarios published in the scientific literature. The trajectories provided refer to a RCP scenario coupled with a Shared Socioeconomic Pathway (SSP) (see Chapter 2 for details). These provide the socio-economic and technological factors that result in different emissions and thus concentration pathways. SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5 refer respectively to RCP/SSP scenario combinations RCP1.9/SSP1, RCP2.6/SSP1, RCP4.5/SSP2, RCP7/SSP3 and RCP8.5/SSP5. These form a basis for the physical study of different future worlds, with different levels of warming and climate change impacts.
Source: (IPCC, 2021[9]).

The projected increases of global mean surface temperatures for selected 20-year time periods in the near-, mid- and long-term relative to the end of the 19th century (1850-1900) are provided in Table 1.1. As shown in the table, only the low (SSP1-2.6) and very low (SSP1-1.9) GHG emissions scenarios are unlikely and extremely unlikely, respectively, not to exceed 2°C during this century. Between 2021 and 2040, all scenarios are projected to at least reach or exceed the 1.5°C level. Climate change is projected to continue to lead to changes in the frequency, intensity, spatial extent, duration, variety and timing of many weather extremes that may result in unprecedented extremes (IPCC, 2021[9]). Indeed, temperature records in many places of North America, for example, were recently broken by several degrees.

Table 1.1. Changes in global surface temperature resulting from different RCP scenarios

	Near term, 2021-40		Mid term, 2041-60		Long term, 2081-2100	
Scenario	Best estimate (°C)	Very likely range (°C)	Best estimate (°C)	Very likely range (°C)	Best estimate (°C)	Very likely range (°C)
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

Note: Changes in global surface temperature (relative to 1850-1900), assessed based on multiple lines of evidence, for selected 20-year time periods and the five illustrative emissions scenarios considered. The figures provided refer to the RCP scenario coupled with an SSP (see Chapter 2 for details). These provide the socio-economic and technological factors that result in different emissions and thus concentration pathways. SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5 refer respectively to RCP/SSP scenario combinations RCP1.9/SSP1, RCP2.6/SSP1, RCP4.5/SSP2, RCP7/SSP3 and RCP8.5/SSP5. These form a basis for the physical study of different future worlds, with different levels of warming and climate change impacts. The "very likely" range refers to the range between the 5th to 95th percentiles.
Source: Table SPM1 in (IPCC, 2021[9]).

Multiple emissions pathways are consistent with each RCP scenario. Non-constant factors influence GHG concentrations in the atmosphere. including the uptake of atmospheric carbon by plants and the ocean and the share and trajectory of different GHGs and other climate forcers. Projections of the temperature increase at lower levels of emissions such as those consistent with RCP1.9 and RCP2.6 are likely to be more precise and more accurate than forecasts of the impacts of higher levels of emissions. Current trajectories in line with emissions reductions commitments seem consistent with warming of around 2.4°C by the end of the century (CAT, 2021[4]).

Climate-related hazards will continue to increase in severity with increasing warming levels (IPCC, 2021[9]). These include SLR (Frederikse et al., 2020[10]), ice melt and land degradation exacerbated by changes in the climate (IPCC, 2019[11]), among others. Climate change is projected to continue to lead to changes in the frequency, intensity, spatial extent, duration, variety and timing of weather extremes, potentially resulting in unprecedented extremes (Seneviratne et al., 2012[21]; Kirchmeier-Young et al., 2019[16]; Vautard et al., 2020[15]).

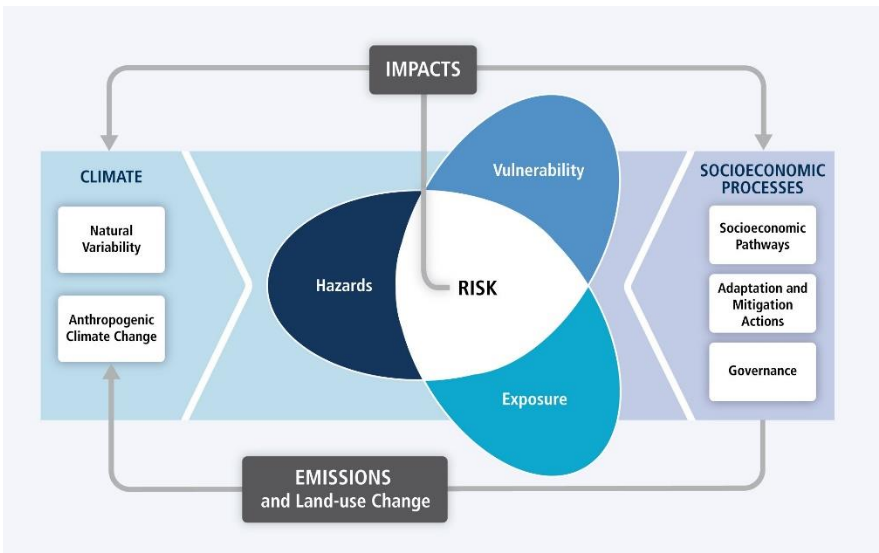
Climate change also has the potential to push components of the Earth system past critical thresholds. Evidence is mounting on the risk of exceeding such tipping points of the climate system, including some during this century (Lenton et al., 2019[22]; IPCC, 2019[17]). Tipping points consist of thresholds of abrupt, often irreversible long-term changes that cannot be avoided once the threshold is crossed. Tipping elements of the Earth system include ice sheet and glacier mass loss and permafrost degradation. These effects are expected to be irreversible on time scales relevant to human societies and ecosystems.

Another tipping element of the ocean is the Atlantic Meridional Overturning Circulation (AMOC), which is at its weakest in the last millennium. A collapse, or even slowdown, could have potentially large impacts on regional weather patterns that support human and ecological systems (Caesar et al., 2021[23]). This could affect ecosystems, as well as human health, livelihoods, food security, water supply and economic growth at a global scale. For example, Europe would become colder and drier, which would reduce agricultural productivity. Changes in sea-surface temperature and rainfall patterns in the tropical Atlantic would impact the stability of the Amazon and could lead to the disruption of West African and Indian Monsoons. As Earth's systems are interconnected, passing one climate tipping point could also trigger others (Rocha et al., 2018[24]). Such a global cascade of tipping points would constitute a clear emergency (Lenton et al., 2019[22]). The implications are examined in detail in Chapter 3.

1.3. Climate risks, impacts and losses and damages

Climate risks are a key starting point for any analysis of losses and damages. This report uses the IPCC's conceptualisation of climate risk that frames it as a function of the climate-related hazard; the exposure of people and assets; and their vulnerability to that particular hazard (IPCC, 2014[25]) (see Figure 1.2). At the intersection of hazard, exposure and vulnerability the consequences of climate risks materialise with "effects on lives, livelihoods, health and well-being, ecosystems and social and cultural assets; services (including ecosystem services); and infrastructure" (IPCC, 2018[26]). While the impacts can be both adverse and beneficial, the focus in this report is on the former.

Figure 1.2. Illustration of the core aspects underlying the IPCC framework concept of risk



Note: Climate risks result from the interaction between hazards resulting from changes in the physical climate, the exposure of people or assets to those hazards and the vulnerability of those exposed elements. Changes in the climate system (left-hand side), including anthropogenic climate change, and in socio-economic processes (right-hand side), including socio-economic pathways, mitigation and adaptation actions, influence hazards, exposure and vulnerability.
Source: (IPCC, 2014[25]).

Hazard refers to the potential occurrence of a natural or human-induced physical event or trend. It may lead to the loss of lives, livelihoods and natural or produced assets, among others. Climate-related hazards range from extreme weather events (e.g. heat waves, cold spells, droughts, floods and storms) to slow-onset changes (e.g. SLR). Hazards also include tipping points in the climate system that will be triggered and unfold on different time and spatial scales and at different intensities if certain thresholds are crossed. Humans may never have experienced some hazards (e.g. some of the tipping points); hazards that are more familiar may, now and in the future, occur in places they did not before. In other words, risk management needs to consider novel hazards.

Exposure describes the lives, livelihoods, natural and economic assets that are geographically and temporally exposed to the effects of particular hazards of a given intensity. The nature and extent of exposure will depend on the hazard, as well as the characteristics of the relevant area. A more severe hurricane or tropical cyclone, for example, is likely to affect more people and assets in a coastal area than a weaker hurricane. Moreover, exposure will change with time: SLR is expanding the areas exposed to potential storm surges for a given intensity of hurricane. Additionally, urbanisation and development change the number of people and value of assets exposed. The exposed people and assets are far greater in a major city than in a sparsely populated coastal area. As noted above, the geographical extent and nature of hazards are likely to change, leading to novel exposures.

Vulnerability refers to the multifaceted ways people and assets are sensitive to, and can be adversely impacted, by climate-related hazards. Vulnerability to hazards is driven by socio-economic assets, structures and circumstances. These shape, support or constrain the ability of people to access the tangible and intangible resources needed to reduce exposure to the hazards and manage the impacts. Vulnerability varies across geographic regions, across economic sectors, within segments of the population (e.g. based on gender, class or ethnicity). It also depends on individual characteristics such as age and health. Responses to hazards may be gradual, such as refurbishment of houses or changes in construction material. However, given a sufficiently intense hazard, some transitions may be irreversible (e.g. relocation of an entire community after an intense wildfire). Another important aspect of vulnerability is whether systems can recover after the occurrence of an intense hazard. Both the speed and extent of recovery are important to reduce losses and damages.

Although humans live in very diverse climatic regimes, each society has culturally adapted over millennia to the climate of a particular location, from which change or deviations may result in losses and damages. While some regions may experience benefits from climate change, such as the expansion of certain agricultural regions to higher altitudes and latitudes in Siberia (Tchebakova et al., 2011[27]) and Canada (Hannah et al., 2020[28]), these benefits would be accompanied by environmental impacts, including on water, nature conservation and carbon storage (Hannah et al., 2020[28]). The benefits are therefore minimal compared to the potential negative climate impacts globally. At risk are the lives and livelihoods of hundreds of millions of people, their cultures, development gains and economic prosperity.

In this report, the ***risk of losses and damages*** refers to the potential harm that may result from the interactions of climate-related hazards, exposure and vulnerability. These can be reduced and managed through mitigation and adaptation, as well as other interventions including disaster risk reduction, disaster risk finance and humanitarian assistance. The risks of losses and damages will vary depending on a range of underlying factors that influence the nature of the hazards and countries' exposure and vulnerability to them. This includes: i) the (changing) intensity and frequency of the hazard; ii) geographic location; iii) exposure of people and assets; iv) vulnerability of people and assets to that hazard; and v) the extent to which the immediate losses and damages have longer-term implications for livelihoods and larger-scale development outcomes.

Developing countries, including LDCs and SIDS, are disproportionately affected by the impacts of climate change. This is due to their geographic location at low latitudes, generally lower levels of development and economic diversification, fiscal constraints and their physical characteristics. Within countries, some segments of the population are particularly at risk. These include segments marginalised by, for example, their socio-economic status, gender, race, age, disability, income and class identities (Eriksen et al., 2021[29]). In many developing countries, women may be more vulnerable to climate hazards than men within the same household. This is the result of social practices, such as less extensive social networks for women or less accumulation of human capital, which lead to less awareness about the risks and available responses (Alhassan, Kuwornu and Osei-Asare, 2019[30]; Rahman, 2013[31]). Estimates suggest that climate change could pull more than 130 million people into poverty by 2030 (Jafino et al., 2020[32]). In several regions, this can degrade political stability and weaken social cohesion (Sofuoğlu and Ay, 2020[33]).

1.3.1. Current losses and damages

Climate-related hazards are already having devastating and widespread impacts on lives and livelihoods, particularly when they occur in conjunction with broader social, economic and political stressors. In 2018, for example, droughts, floods and storms in India caused around USD 6.1 billion in damages (Guha-Sapir, Below and Hoyois, 2021[34]). When Hurricane Dorian made landfall in the Bahamas in 2019, it caused at least 70 deaths, with losses and damages estimated at a quarter of the Bahamas' GDP (Zegarra et al., 2020[35]). The 2019-20 Australia wildfire season resulted in 19 million hectares (ha) of land being burned and at least 33 deaths. The economic impacts were estimated at AUD 20 billion (Filkov et al., 2020[36]). There is robust scientific evidence that climate change made these events more likely (Shultz et al., 2020[37]; Hunt and Menon, 2020[38]; van Oldenborgh et al., 2021[39]).

The extraordinary weather events during the northern hemisphere summer of 2021 showed that no one is immune from the effects of extreme events. Record-breaking heat over Europe, the west of North America and the northeast of the Russian Federation (hereafter "Russia") triggered deadly heatwaves and devastating fires. Some scientists considered the heatwave in North America virtually impossible without human-induced climate change (Sofuoğlu and Ay, 2020[33]). Lytton, a village in British Columbia, Canada, recorded a maximum temperature of 49.6ºC, a staggering 4.6°C higher than the previous maximum temperature ever observed in Canada. Shortly thereafter, a wildfire largely destroyed the village (WMO, 2021[40]). In July, some parts of Europe saw two months of normal rainfall in just two days. This led to floods, around 200 deaths and significant damage to key economic infrastructure (World Weather Attribution, 2021[41]). Extreme heat in eastern Mediterranean in July and early August 2021 led to severe wildfires in Turkey and Greece. Later in the month, the heatwave extended further west, leading to fires in other European and African countries, such as Italy and Algeria. Heavier than normal monsoon rains in India and the rest of South Asia, and incessant and prolonged rainfall in the People's Republic of China, also led to significant economic losses, deaths and injuries.

Over 1970 to 2019, disasters from weather, climate and water extremes represented 50% of all recorded disasters, 45% of deaths related to disasters and 74% of related economic losses (WMO, 2021[42]). Improvements in early warning are saving lives, with deaths from these disasters falling to about 40% of their level in the 1970s by the 2010s. More than 91% of the deaths occurred in developing countries. The WMO assessment reported an almost eightfold increase in average daily economic losses between 1970-79 and 2010-19. However, the absolute value of reported economic losses is likely to underrepresent the impact of such disasters on development and livelihoods. It may also reflect reporting gaps in developing countries. For example, Africa saw 35% of the deaths related to weather, climate and water extremes but just 1% of reported global economic losses (WMO, 2021[42]).

1.3.2. Transmission mechanisms and factors influencing the experience of risk

This section sets out some illustrative ways or transmission mechanisms through which climate change can cause economic and non-economic losses and damages. Climate change is putting lives at risk and directly impacting peoples' livelihoods, for example, through changes in labour and agricultural productivity, certain health effects, the loss of capital assets and the functioning of ecosystems. Other, more indirect impacts on livelihoods include changes in the demand of goods and services, disruption of supply chains, faster spread of certain infectious diseases and negative effects on broader well-being. Examples below illustrate socio-economic impacts observed in empirical assessments for relatively small deviations in past climate:

- ***Health:*** The physiological limit of human survival is 35°C with 100% humidity (or 35°C wet-bulb temperature; equivalent to 45°C with 50% humidity). Accordingly, high temperature levels are strongly associated with high mortality rates across countries (Deschênes and Greenstone, 2011[43]; Carleton et al., 2019[44]). Rising temperatures also contribute to increased morbidity from vector-borne diseases. For example, mosquitoes can reproduce faster around warming waters. This, in turn, could increase spread of malaria (Linthicum et al., 1999[45]; Luque Fernández et al., 2009[46]; Makin, 2011[47]). At the same time, fertility decreases with rising temperatures affecting the health of reproductive cells (Lam and Miron, 1996[48]; Fisch et al., 2003[49]; Barreca, Deschênes and Guldi, 2018[50]).

- ***Production:*** Climate change may cause severe and more chronic food insecurity, increasing the propensity of malnutrition (Jankowska et al., 2012[51]; Grace et al., 2012[52]). This could occur through disruption of agricultural production, storage, supply chains and the nutritional value of crops. When climatic events destroy crops and cattle or reduce agricultural yields, they also impact food prices. The 2010 Russian heatwaves, for example, led to export ban of grains in Russia. This, in turn, raised grain prices around the world (Welton, 2011[53]) (see Chapter 4, Box 4.1).
- ***Productivity:*** In light of the health effects of heat stress, high temperature levels also decrease general labour productivity for both manual and cognitive tasks (Cai, Lu and Wang, 2018[54]) (Graff Zivin et al., 2020[55]). For example, one study observed that worker productivity in the Chinese manufacturing sector declined by 2% for every Celsius degree increase above 25°C for the day (Cai, Lu and Wang, 2018[54]). Temperature rise is also associated with decreased GDP growth. The magnitude of the decline depends on the geography of the country, the approach and assumptions for assessing the effect (Dell, Jones and Olken, 2012[56]; Burke, Hsiang and Miguel, 2015[57]).

Extreme events can have strong negative effects on economic growth that can last years or decades as the effect of disaster dissipates slowly (Botzen, Deschênes and Sanders, 2019[58]; Hsiang, 2010[59]; Loayza et al., 2012[60]) (see Chapter 5). The slow recovery of New Orleans after Hurricane Katrina in 2005 illustrates the potentially long-lasting and non-linear impacts of extreme events. Sixteen years after the event, employment in New Orleans has not recovered to pre-Katrina levels due to out-migration (Bureau of Labor Statistics, 2021[61]). Reconstruction and recovery are burdens on the budget and depend on the economic capacity of the affected region, among other factors. This underlines the importance of adequate emergency relief and support for reconstruction and recovery after such events. With particularly strong or repeated extreme events, full recovery may not always be possible. This can lead to short or longer term displacement of people (see Chapter 4, Box 4.6).

In an interconnected world, the climate impacts in one country – and the responses to those impacts – can impose threats beyond its borders. These impacts can occur through global supply chains that disrupt the price, quality and availability of goods and services (IPCC, 2019[11]), the spread of infectious diseases (Liang and Gong, 2017[62]), and the movement of people responding to the impacts of environmental and climate change (McLeman, 2019[63]). For example, Hurricane Katrina damaged a significant portion of the oil refinery capacity of the United States. This caused energy prices to shoot up by 40% around the world, which then decreased demand for cars (Kilian, 2008[64]).

Climate risk is compounded by the potential for losses to cascade across interconnected socio-economic systems and impose intolerable burdens on countries (UNDRR, 2019[65]; Zscheischler et al., 2020[66]). The nature of such compound events varies with three types highlighted here (see discussion in Chapter 3):

- Two or more extreme events occurring simultaneously or successively, e.g. Tropical Cyclone Harold affected several Pacific island states during 2020, while people and systems were responding to COVID-19.
- Combinations of extreme events with underlying conditions that amplify the impact of the events, e.g. Hurricane Harvey leading to floods in Texas during 2017, amplified by land subsidence.
- Combinations of events that would not in themselves be considered extreme but which cumulatively lead to a large impact. With climate change, such mutually reinforcing slow-onset changes and extreme events could cause diverse potential impacts, such as large disruptions of food production around the world (Kummu et al., 2021[67]).

Beyond the effects on economic production, the population will also be vulnerable to intangible or non-economic losses and damages. These include loss of cultural artefacts, places, and loss of sense of identity and security due, for example, to displacement (Graham et al., 2013[68]; Barnett et al., 2016[69]; Adger et al., 2012[70]). These effects are not easily quantifiable and hence rarely feature in socio-economic assessments. However, many people consider vulnerabilities of some intangible aspects (e.g. health of family members, sense of safety) more important than vulnerabilities of consumption associated with higher incomes (Tschakert et al., 2019[71]). The psychological or mental health impact of extreme and slow-onset events is one example of an intangible effect (Rataj, Kunzweiler and Garthus-Niegel, 2016[72]; Hayes et al., 2018[73]). The 2018 California wildfires, for instance, have shown to have a large impact on severity of depression, post-traumatic stress disorder (PTSD) and anxiety; direct exposure is associated with 30% worse PTSD symptoms than no exposure (Silveira et al., 2021[74]). However, such quantification will be partial. Lived experiences within and across communities due to occupation or other identities, for example, also determine the perception of climate risks. This, in turn, determines the response to the risks constructed (Rühlemann and Jordan, 2020[75]; Eriksen et al., 2021[29]).

Factors that influence how climate risks are experienced at the household and community levels include (Granderson, 2014[76]):

- ***Values and worldviews***, including standards, assumptions, beliefs, preferences and interests that guide peoples' perceptions of themselves in the world and their views on what is worth protecting and doing. Values and worldviews further highlight certain risks, informing decision-making processes. Other risks may be hidden.
- ***Sense of place,*** and the values attached to places or landscapes, shape perceptions of climate risks. The impacts of climate variability and change are manifested in places and landscapes. However, these contexts also anchor identities, values and institutions. When places are disrupted or lost (e.g. due to SLR, fires or loss of glaciers), cultural beliefs and practices often tied to places and landscapes will guide options being considered.
- ***Perceptions of justice and accountability*** vary over space and time, and can be examined in two ways. A distributive perspective looks at equity and fairness of outcomes, while a procedural perspective is concerned with inclusive, deliberative, accountable and transparent decision-making processes. Marginalised segments of society, within and across national borders, have often contributed little to climate variability and change. Yet they will often be more vulnerable to the impacts of these changes due to their available resources. Future generations similarly carry the burden of inadequate climate action by current and past generations reluctant to act on climate risks often perceived as too uncertain to take ambitious action.
- ***Discourses and power*** will determine whose constructions of risks, and whose responses, count in decision making. They are further a reflection of politics and power dynamics, empowering some as experts and legitimising specific responses.

1.3.3. Climate change and biodiversity

Unchecked, climate change will cause increasingly severe economic and social impacts. These include through its impact on biodiversity and the ecosystem services on which societies and individuals depend (IPBES, 2019[77]). For example, wildfire has been important in biological evolution and in shaping ecosystems for millennia. However, due to climate change and other human drivers, it is now threatening species with extinction and radically changing terrestrial ecosystems that have never been exposed or adapted to such hazards (Kelly et al., 2020[78]). The changing distribution of species driven by climate change discussed above will exacerbate biodiversity loss, affect ecosystem functions, impact human health and ecosystem-based livelihoods, and even feedback onto climate change (Pecl et al., 2017[19]).

Policy makers need to consider these significant interdependencies between climate change and biodiversity in formulating strategies and actions. For example, ecosystems are vital to livelihoods for many communities. Through nature-based solutions, ecosystem approaches may help reduce both the vulnerability of communities to climate hazards and the severity of hazards themselves by carbon sequestration. There are risks however, if such approaches are implemented without the full engagement and consent of local communities and Indigenous people, do not integrate both climate change and biodiversity goals, or distract from other vital climate and biodiversity policy priorities (Seddon et al., 2021[79]).

1.4. Reducing and managing the risk of losses and damages: Context for action

Section 1.3 highlights that losses and damages are happening now and the risks of future losses and damages will increase with climate change. The complexity and pace of change are stretching the ability of human and natural systems to cope with current impacts, and to reduce and manage risks. These risks threaten development gains.

Losses and damages can materialise even where risks are well understood and potentially avoidable. This might be due to the cost of reducing the risks; failure to mitigate GHG emissions (collectively) and adapt (nationally or locally); economic, social or technological barriers or inequalities; the effectiveness and coherence of policy interventions; physical limits to adaptation; the contribution of compounding factors such as diseases; or factors other than climate change (see Box 1.1). Efforts to reduce and manage the risks of losses and damages therefore need to consider actions in relation to all three components of climate risks. Specifically:

- limit the increase in the frequency and intensity of hazards through deep and urgent reductions in GHG emissions and actions to protect and enhance natural carbon sinks
- minimise the exposure of lives, livelihoods and assets to those hazards
- reduce the vulnerabilities of exposed human and natural systems to these hazards.

Science shows that any delay to mitigate GHG emissions and actions to protect and enhance natural carbon sinks such as forests and peatland increases the risks of adverse and increasingly severe climate impacts (IPCC, 2021[9]). Therefore, increases in the intensity and frequency of damaging climate-related hazards should be urgently limited. This can happen through rapid and far-reaching emission reductions from developed countries, as well as large, rapidly growing emissions-intensive developing economies aligned with the temperature goal of the Paris Agreement (UNFCCC, 2015[3]). The level of hazard is not something that can be influenced by individual developing countries, other than the largest, emissions-intensive ones.

Even if the temperature range in the Paris Agreement is attained, a large share of the Earth’s current and future population will face increasingly frequent, intense and even novel (i.e. new to that region) climate-related hazards. For example, SLR will continue long after global temperatures have been stabilised. This will, all things being equal, drive increases in losses and damages currently experienced for populations that may have contributed little or not at all to climate change. Efforts must therefore also be scaled up to address the other two components of risk: exposure and vulnerability.

Exposure and vulnerability are the result of complex processes, endowments and choices. These include historic patterns of economic and social development (such as colonial influences), as well as individual and policy choices. Some drivers of exposure and vulnerability can be addressed through domestic processes (e.g. through land-use management or infrastructure standards). Others may be subject to international co-operation and changes, such as in today’s global markets.

Box 1.1. Summary of discussion on limits to adaptation in the IPCC Fifth Assessment Report

Research has explored the issues of barriers and limits to adaptation determined by, for example, actors' values, objectives and planning horizons. Perceptions of the risks will influence risk management approaches. Some risks will be considered routine or with limited impact and therefore acceptable. Other risks will be seen as intolerable since they pose fundamental threats to actors' objectives or the sustainability of natural systems. Risk management aims to avoid such intolerable risks or reduce them to a tolerable level through various interventions. However, the capacity of societal actors and natural systems to reduce and manage the risks is finite due to biophysical, institutional, financial, social and cultural factors. These factors create limits to adaptation as do real or perceived deficiencies in human, social and financial capital.

Limits to adaptation have been exemplified by thresholds related to different features of climate change. Beyond these thresholds, non-linear responses are possible for agricultural crops, species of fish and forest, and marine communities, such as coral reef. This phenomenon is related to the concept of climate tipping points; triggering these points may cause large, non-linear changes in the climate system (see Chapter 3). Across most regions and sectors, however, it remains challenging to quantify magnitudes of climate change that would constitute future adaptation limits. In addition, economic and technological developments, as well as changes in cultural norms and values, will determine the capacity of a system to avoid such limits. This has led to the differentiation between "soft" and "hard" adaptation limits with the argument that there is scope to alleviate soft limits over time but no prospects for avoiding intolerable risks for hard limits.

Source: (IPCC, 2014[25]).

Reducing exposure can be challenging and, in some cases, undesirable for wider socio-economic reasons. Despite (rather than because of) the increasing concentration of people and assets, urbanisation rates continue to be high. Further examples include the continuing development in areas of high climate-related hazard. For example, urban and suburban development have expanded into forested areas, even with climate strategies to address vulnerability in place (Goss et al., 2020[80]). In addition, enhancing the resilience of infrastructure to more intense hazards will eventually become prohibitively expensive. In some situations, building such protective infrastructure could fundamentally change the character of the place it is designed to protect (see Chapter 4 for a discussion related to SIDS). Some adaptation actions may be relatively low cost, such as placing houses on stilts in coastal areas prone to floods. However, they may not make systems resilient to all physically possible levels of hazard intensity.

Reducing vulnerabilities to climate change also poses challenges. Many of the most vulnerable countries lack key elements of adaptive capacity to respond to climate change (Hallegatte, Fay and Barbier, 2018[81]). These include a strong and vibrant economy, ready access to finance and technology (including information dissemination systems) and strong governance with well-defined roles and responsibilities for adaptation. Capacity and resource constraints in any country will only make the risks of losses and damages more difficult to reduce and manage. This is especially true in a context of still increasing climate change and where there is rapid urbanisation.

In addition, managing and reducing losses and damages must be informed by a good understanding of the risks. Human action is driving climate change. However, the precise impacts of climate change on human and natural systems, which will vary over space and time, also have varying degrees of uncertainty (see Chapter 2). Even physical changes stemming from altered dynamics of the atmosphere or ocean are exceptionally difficult to model. It is more challenging still to model how these changes then interact with and affect human and natural systems, where uncertainties may be at least as great. Some observed and projected natural and socio-economic impacts can lead to irreversible damages. Given the nature and scale of these impacts, uncertainties have important implications for efforts to reduce and manage climate risks.

In many developing countries, these actions will need to be supported adequately by the international community. This is an active area of discussion and negotiation within the UN climate process, particularly in relation to current and future levels of climate finance. A broader range of national policies and international support for sustainable development or disaster recovery and reconstruction will also be needed. These can help determine a country's resilience to climate risks, as well as the humanitarian assistance provided in anticipation of or in response to an extreme event.

Indeed, decisions on climate change are not made in isolation. Rather, they are an integral component of countries' development objectives. As such, they must be assessed in relation to the broader spectrum of socio-economic risks and the associated uncertainties relevant for decision making. Such an assessment can be direct or indirect. Direct assessment, for example, would look at land-use management, agricultural practices and infrastructure standards. Indirect assessment could examine livelihoods development, social protection and basic health care provision. In addition to addressing the drivers of change in the three components of climate risk, the process could assess the coherence of approaches across policy domains beyond climate change. If not carefully managed, some measures intended to reduce and manage the risk of losses and damages may increase the risks for segments of society or across countries (Eriksen et al., 2021[29]).

Many different actors, nationally and internationally, therefore share responsibilities for losses and damages that occur now and in the future. The scale and effectiveness of action to reduce and manage the risks of losses and damages depends on several factors. These include the availability of financial resources (domestic or international) and specific technical capacities. Equally important are the effectiveness and coherence of policy interventions to increase resilience, and reduce exposure and vulnerabilities to climate-related hazards. The balance of these different factors will vary over time in each geographical context. The relative responsibilities of major emitters – developed and developing – for the GHG emissions driving the level of hazard is relatively uncontentious scientifically and open to quantitative analysis. However, responsibility for exposure and vulnerability is more open to debate. Determinations of relative responsibility for these risk components would require careful analysis and deliberation. Further, it requires judgements about respective roles and capabilities at different points in time across the range of relevant actors. Box 1.2 sets out some further issues around the responsibility for losses and damages, focusing on the policy debate on Loss and Damage within the UN climate process.

Ultimately, the OECD cannot provide answers to these questions, or even propose them. The issue of responsibility for losses and damages goes to the political heart of the multilateral process on climate change, disaster risk reduction as well as the broader context of sustainable development and must be resolved through those processes. Most important perhaps, those involved should aim to ensure that the effort leads to enhanced levels of international co-operation, solidarity and support, and not the reverse.

Box 1.2. Negotiations on Loss and Damage within the UN climate process

The Alliance of Small Island States initiated discussions on Loss and Damage from climate change within the UN climate process in the early 1990s. This discussion emerged in the context of compensation for losses in these countries from sea-level rise and other climate change impacts. The Warsaw International Mechanism (WIM) was established in 2013 with a mandate to "address loss and damage associated with impacts of climate change, including extreme events and slow-onset events in developing countries that are particularly vulnerable to the adverse effects of climate change" (UNFCCC, n.d.[82]). The Paris Agreement in its Article 8 further states that "Parties recognize the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change [….]" (UNFCCC, 2015[3]).

The discussions on Loss and Damage within the UN climate process focus on developing countries. They have been politically contentious as they touch upon issues of equity and fairness. At the core of this debate is the question of proving historical responsibility of developed countries for the climate hazards and associated losses and damages that occur in developing countries. Some of the most vulnerable countries, including some Small Island Developing States and Least Developed Countries, have called for compensation from developed countries for those losses and damages. However, the Paris Decision "agrees that Article 8 of the Agreement does not involve or provide a basis for any liability or compensation" (UNFCCC, 2016[83]).

As these discussions evolve as part of the international climate negotiations, they will involve difficult scientific, political and legal judgements on the extent to which climate change has caused or amplified the adverse impacts related to a specific climate hazard. The impacts due to climate change are conditional on exposure and vulnerability, which primarily depend on historical processes and national decision making. Given the political difficulties that surround the issue of responsibility for Loss and Damage, this report does not attempt to define or provide direct guidance on this issue. It does, however, provide analytical insights and recommendations that could inform discussions within the WIM and the wider negotiation process.

1.5. Structure of report and intended audience

This chapter presented the climate risk framing as conceptualised by the IPCC and summarised climate change and its observed and projected impacts on natural and socio-economic systems. Climate change is happening and anthropogenic GHG emissions are unequivocally driving it. This is enough to justify urgent emissions reductions to achieve the goal set out in the Paris Agreement but it is not sufficient to inform efforts to reduce and manage climate risks. This is set out in ***Chapter 2***, which examines the different levels of confidence and associated uncertainties influencing understanding of these risks that decision makers need to understand and adopt. ***Chapter 3*** describes the types of hazards from climate change. It provides new analyses examining the impacts of slow-onset changes (with a focus on SLR), extreme events (heatwaves) and tipping points (AMOC), their associated risks of losses and damages, and the potential for cascading impacts spanning over different sectors and regions. The rest of the report focuses on the ways in which the risks of losses and damages from climate change can be reduced and managed through policy (***Chapter 4***), finance (***Chapter 5***) and technology (***Chapter 6***). The final section of the present chapter sets out the recommendations emerging from this analysis.

This report is primarily aimed at policy makers responsible for exploring and assessing potential actions to reduce and manage the risks of losses and damages from climate change. However, many key insights apply more widely across society. Key audiences include officials in ministries of environment and disaster risk management organisations at national and local levels involved in developing or informing countries' climate action commitments and plans. However, the report may equally be of interest for their counterparts in other ministries such as finance, infrastructure, water and agriculture that increasingly need to consider the adverse impacts of climate change. The report distils information and enhances understanding of some important issues regarding these risks. In so doing, it hopes to inform (international and domestic) political and public dialogue, and to stimulate action indirectly through stakeholders in the private sector and civil society.

1.6. Taking the agenda forward

The call for urgent action on climate change is at or near the top of most political agendas, despite the continuing pandemic and related economic dislocation. This is true in the context of the international climate negotiations and also at local, regional and national levels. In different ways and with different resources and levels of ambition, governments, the private sector, researchers, civil society organisations and individual citizens – often in partnerships – are taking action. These different stakeholders have complementary roles that offer areas for further action and collaboration. Recommended actions to reduce and manage both economic and non-economic losses and damages are highlighted below, with a focus on the role of governments:

1. **Take a precautionary approach by aiming to limit the temperature increase to 1.5°C:**
    - *Accelerate the transition to net-zero*, recognising that different countries will follow different pathways and developed countries should aim to reach net-zero earlier than 2050.
    - *Rapidly scale up finance, technology, capacity development,* and other support for mitigation and adaptation action in developing countries, delivering on developed country commitments.
    - Put in place credible, ambitious and adequately resourced *shorter-term targets and plans* that generate wider socio-economic benefits and deliver on longer-term or net-zero commitments.
2. **Create a more effective international development finance landscape supporting efforts to reduce and manage current impacts and projected risks of losses and damages:**
    - *Scale-up climate-related development finance* to support communities and countries already experiencing losses and damages, and to reduce and manage future risks, particularly for LDCs and SIDS.
    - *Improve access to finance and reduce transaction costs* by streamlining multiple accreditation and reporting requirements and s*trengthen complementarities* across financing mechanisms.
    - *Develop local and national capacity*, foster country ownership and better align international development finance with national priorities, circumstances and needs.
    - *Enhance the predictability* of international support for efforts to reduce and manage the risks of losses and damages.
3. **Strengthen the global architecture for climate and disaster risk finance:**
    - *Enhance the availability and access to financial protection* that is comprehensive (i.e. to different hazards) and systematic (e.g. different layers of risk), particularly for the most vulnerable.
    - *Increase the coherence of international support* for climate and disaster risk finance through enhanced exchange, co-operation and agreement on joint principles by providers of support.
4. **Enhance fiscal resilience to deal with increasingly adverse impacts:**
    - *Implement a comprehensive approach to risk management,* using a set of complementary financial mechanisms to *reduce, retain and transfer* risks of losses and damages.

- *Limit contingent liabilities*, incentivise and enable private actors to reduce and manage their own risks, including through disclosures, understanding and awareness of climate risks.
- *Review the implications of climate risks for debt sustainability* and identify options for addressing these, including the eligibility of countries highly vulnerable to climate risks to international financial support.

5. **Protect livelihoods, reduce precarity through insurance, social protection and humanitarian assistance:**
    - *Develop insurance markets* to make available coverage for climate risks and incentivise those with the financial capacity to do so to manage them.
    - *Enhance social protection for the most marginalised segments of society* that do not have the financial means to access formal insurance markets to reduce vulnerability to climate-related hazards and subsequent losses and damages.
    - Reduce losses and damages through *anticipatory humanitarian action* and improve the predictability of humanitarian assistance.
6. **Adopt approaches to decision making that account for uncertainties in climate risks:**
    - *Manage risks across different time and spatial scales* and understand how they can compound and cascade across systems and borders.
    - *Enhance capacities* within the decision-making process to incorporate quantitative and qualitative assessments of the *implications of uncertainty* for options and outcomes.
    - *Adopt iterative and adaptive decision-making processes*, guided by learning and evolving understanding of the risks and take a strict precautionary approach when choices may lock-in long-term changes to risks.
    - *Identify and manage* risks that may overwhelm local capacities by anticipating future thresholds and decision points where alternative responses may be needed.
7. **Integrate climate and sustainable development objectives and improve policy coherence:**
    - *Approach decisions on climate risks as an integral component of sustainable development* and assess options in relation to the broader spectrum of socio-economic risks and uncertainties relevant for decision making.
    - *Increase coherence across national and international policy communities*, including climate change adaptation and risk management, humanitarian and the broader development communities, building on their respective strengths and areas of expertise.
8. **Improve data, capabilities and processes for climate risk governance:**
    - *Enhance international support* for access to observational and forecasting capabilities, technology and capacity building in developing countries, prioritising *high quality, high resolution observational data collection* and management.
    - Prioritise international action to enhance the *collection and interpretation of data on extreme events and impacts* in developing countries, including to underpin attribution studies and climate policy.
    - *Further strengthen weather and climate information services,* particularly in LDCs and SIDS, ensuring they are demand-driven, usable and useful.
    - *Establish an international mechanism to monitor climate tipping elements* to enhance understanding on their potential impacts and to develop techniques to detect and, where feasible, provide early warning for strategies and actions.

9. Facilitate inclusive stakeholder engagement that builds on the knowledge, expertise and values of different actors and gives due recognition to intangible losses and damages:

- *Develop partnerships to enhance coordination and collaboration* nationally and internationally, across policy, science, and other expertise, including Indigenous and local communities.
- *Improve awareness and understanding* of how climate change threatens what people value and develop context-specific approaches to reducing and managing intangible, as well as economic, losses and damages.
- *Leverage private sector expertise* to support broader societal efforts to reduce and manage the risks of losses and damages.

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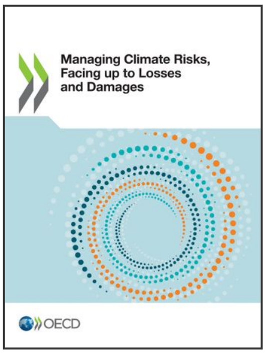

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