Chapter I

Climate change resilience for sustainable development

Key messages

- Climate change is increasing the frequency and intensity of the extreme weather and climate events that are affecting all countries. However, because of their geographical location, reliance on climate-sensitive natural resources and development gaps in general, developing countries, and low-income countries in particular, are at the greatest risk of climate hazards. Left unattended, climate hazards are likely to increase poverty, worsen inequalities, exacerbate food insecurity and cause health problems, among other hardships, which may reverse years of development progress in some countries.
- Climate hazards also have differential impacts on people and communities within countries. These impacts are largely determined by deep-rooted socioeconomic inequalities. As a result, they tend to be particularly detrimental to the most disadvantaged groups of society, which are hence disproportionately exposed and vulnerable to climate hazards.
- The universal consensus attested by the adoption of the 2030 Agenda for Sustainable Development provides a unique opportunity to build climate change resilience for sustainable development by addressing the structural inequalities that perpetuate poverty, marginalization and social exclusion and thus increase vulnerability to climate hazards.
- To be successful, disaster risk reduction and disaster management, social protection and adaptation strategies must all be part of a broader development framework which incrementally leads the way to the empowerment of today's disadvantaged groups, by improving their asset positions and access to input and product markets; by extending their access to quality basic services; and by changing the norms that foster their social and political exclusion.

The international consensus on sustainable development

In 2015, States Members of the United Nations took significant steps towards building sustainable development pathways

In 2015, world leaders took significant steps towards forging sustainable development pathways holding out the promise of eradicating poverty, reversing environmental degradation and achieving equitable and inclusive societies. From 25 to 27 September 2015, Heads of State and Government and High Representatives gathered at United Nations Headquarters in New York to adopt the 2030 Agenda for Sustainable Development,[1] which

1 General Assembly resolution 70/1, entitled "Transforming our world: the 2030 Agenda for Sustainable Development".

will drive global efforts towards achieving sustainable development until 2030. Previous efforts gave impetus to the adoption of this Agenda.

On 16 July 2015, the Third International Conference on Financing for Development, held in Addis Ababa from 13 to 16 July 2015, adopted the Addis Ababa Action Agenda of the Conference,[2] which puts forward a global framework for mobilizing resources and facilitating policy implementation for sustainable development. On 3 June 2015, the General Assembly endorsed the Sendai Framework for Disaster Risk Reduction, 2015-2030,[3] which had been adopted by the Third World Conference on Disaster Risk Reduction, held in Sendai City, Japan, from 14 to 18 March 2015. The Sendai Framework recognizes that it is the primary responsibility of Governments to reduce disaster risk and loss of lives, and preserve livelihoods, which will be critical to averting development reversals in the future.

The 2030 Agenda for Sustainable Development recognized that climate change, whose adverse impacts undermine the ability of all countries to achieve sustainable development, constitutes one of the greatest challenges of our time and, in that regard, acknowledged the sessions of the Conference of the Parties to the United Nations Framework Convention on Climate Change as the primary forum for negotiating the global response to that challenge. On 12 December 2015, the Conference of the Parties to the Convention at its twenty-first session adopted the Paris Agreement in which the parties to the Agreement announced quantitative commitments to reducing their greenhouse gas emissions, the major driver of climate change, and to supporting adaptation efforts.[4]

There is global consensus on the need to address the inextricable links between the human development and environmental agendas

These historic agreements are part of a global consensus on the need to address the inextricable links between the human development and environmental agendas. They signal acknowledgement, on the part of developed and developing countries, of the universal need for an integrated and coherent approach to tackling global development challenges, including consistent adaptation to climate change. Recognition of the urgency of moving towards sustainable development pathways comes at times when "warming of the climate is unequivocal" (Intergovernmental Panel on Climate Change, 2014e, p. 2, SPM 1.1) and is "increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems" (ibid., p. 8, SPM 2).

Building climate resilience presents a unique opportunity to reduce inequalities through far-reaching transformative policies supported by effective global partnerships

World Economic and Social Survey 2016: Climate Change Resilience - An Opportunity for Reducing Inequalities contributes to the identification of some of the challenges of implementation of the 2030 Agenda for Sustainable Development. The evidence points to the great economic, human and environmental losses brought about by climate hazards which, if left unattended, are likely to continue. The *Survey* addresses the challenges of strengthening the capacity of countries and people to avoid development reversals from those hazards. Recent data suggest that the world has already warmed 0.85° Celsius from pre-industrial levels and will continue to experience warming even if greenhouse gas emissions were immediately brought to a complete halt (Intergovernmental Panel on Climate Change, 2013). The consequences of the warming of the planet will continue to challenge the capacity of countries to prevent devastating impacts on people and ecosystems.

This *Survey* argues that building climate resilience presents a unique opportunity to reduce inequalities. The persisting inequalities in multiple dimensions have led to recognition that climate hazards have a differential impact on people and communities. It

2 General Assembly resolution 69/313, annex.

3 General Assembly resolution 69/283, annex II.

4 See FCCC/CP/2015/10/Add.1, decision 1/CP.21.

has also been recognized that the association between climate hazards and inequalities has not been sufficiently researched.[5] In response, the *Survey* has chosen to tackle the issue of climate change resilience, with a focus on the population groups and communities that are disproportionately vulnerable. It argues that, in the absence of well-assessed, far-reaching transformative policies at the national level, supported by effective global partnerships, building climate resilience will remain elusive and poverty and inequalities will likely be exacerbated. This would pose a fundamental challenge to the implementation of the 2030 Agenda for Sustainable Development.

Moving climate resilience forward in implementing the 2030 Agenda for Sustainable Development

The 17 Sustainable Development Goals and 169 targets set out in the 2030 Agenda explicitly elaborate on the interlinkages across the economic, social and environmental dimensions of development and the opportunities to build positive synergies among them. Some of these interlinkages and synergies are fundamental to facets of building climate change resilience and reducing inequalities.

Sustainable Development Goal 13 affirms the urgency of taking action to combat climate change and its impacts by calling for actions to strengthen resilience and adaptive capacity with respect to climate hazards; to integrate climate change measures into national policies; and to improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning. The interlinkages between climate change and other dimensions of development are also well reflected in other Goals. If the frequency and intensity of climate hazards increase, it will be harder for countries to end poverty and hunger, achieve food security, improve nutrition, promote sustainable agriculture and ensure healthy lives (Goals 1-3). Furthermore, the sustainability of water and energy systems (Goals 6 and 7) and the safety and resilience of infrastructure, cities and human settlements (Goals 9 and 11) will be challenged by climate hazards. Similarly, if climate hazards continue to undermine the ability of countries to achieve sustained growth and development, full employment and decent work will be harder to achieve (Goal 8).

Sustainable Development Goal 10, which explicitly addresses the goal of reducing inequality within and among countries, includes targets focused on improving the income of the bottom 40 per cent of the population; promoting the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status; eliminating discriminatory laws, policies and practices; and achieving fiscal, wage and social protection policies for greater equality. With their references to universality, many other targets within the framework of the Goals provide the basis for reducing inequality in its multiple dimensions, encompassing access to key basic services such as health, education, water and sanitation, and energy (Goals 3, 4, 6 and 7), gender (Goal 5) and inclusive economic growth (Goal 8).

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5 The Intergovernmental Panel on Climate Change (IPCC) has already recognized that climate-resilient development pathways will have only marginal effects on poverty reduction unless structural inequalities are addressed. At the same time, the Panel has underlined that the importance of structural inequalities and their association with climate change remain insufficiently researched (Olsson and others, 2014, pp. 797 and 819).

The SDGs provide the framework for tackling the structural inequalities that increase vulnerability to climate hazards

Together, these Goals provide a framework for the implementation of policies that address the underlying causes of poverty, vulnerability and the risk of climate change. Yet, it is important to deepen the understanding of the interlinkages across these Goals and their policy implications in order to tackle the structural inequalities that perpetuate poverty, marginalization and social exclusion, the factors that increase the risk of climate hazards. Critical aspects of this understanding encompass integration of the various facets of the environment into development policy; the interaction of climate change with mega-trends which may magnify its impacts; and a continuum of policies that, while addressing immediate vulnerabilities, make it possible to incrementally achieve adaptation and transformative change for sustainable development.

Ensuring consistency across the economic, social and environmental dimensions of development policy is a core challenge in achieving sustainable development

Nowadays, the relationship between the economic and social dimensions of development is better understood owing to an extensive body of research and the experience of countries over the last decades. The trickle-down paradigm which prevailed in the 1980s was seriously challenged when new research and country experiences demonstrated that economic growth did not necessarily translate into human development. This understanding led to a major revision of development policies aimed at improving the consistency between economic growth and human development objectives. Developing countries made major efforts to increase investments in education, health, water and sanitation. They introduced comprehensive social protection programmes and experimented with new regulations and incentives designed to redirect private investments towards job creation and larger development objectives. However, those efforts were disconnected, more often than not, from efforts to meet environmental goals (United Nations, 2016).

Hence, there is much less experience and policy guidance on the integration of the various aspects of the environment into development policy. Building consistency across the economic, social and environmental dimensions of development policy will be a core challenge in building climate resilience and achieving sustainable development. It will demand greater technical capacities among policymakers and all stakeholders for building on the interlinkages across the multiple dimensions of development in the event of climate impacts and for policy responses. It will also be necessary to strengthen the capacities to negotiate commonly agreed objectives through building upon single-group interests. More broadly, policy systems as a whole will require systemic changes to enable the more coherent and more flexible design of integrated policies for climate resilience, with participation from all relevant stakeholders. For many developing countries, these changes will not be possible without global partnerships.

Important mega-trends that interact with climate change will shape development prospects and policy

The complexity inherent in addressing the links between the human development and environmental agendas is compounded by the uncertainty surrounding important mega-trends which will shape development prospects and policy in both the near and the distant future. Despite overall convergence in average per capita income across countries, within-country inequalities are on the rise. This important trend along with others, such as globalization and technological change, demographic dynamics, rapid urbanization and climate change itself, will exert additional pressures leading towards increasing inequalities both among and within countries. Moreover, if investment in green technologies is inadequate, if population growth continues to be high, if investment in human capital is low and if current socioeconomic inequalities remain, then income poverty and inequality are likely to increase in the future under scenarios where current unmitigated emissions are high. (See appendix I.1 for a full description of alternative development pathways.) This clearly points to the importance of understanding the options for building climate resilience with full consideration given to climate change and socioeconomic mega-trends.

Based on the evidence, there exists no doubt that moderating or avoiding the risks associated with climate change and reducing poverty and inequality, involve both mitigation (preventing future warming) and adaptation (finding better or safer ways to live on a warming planet). Unquestionably, the only way to prevent the adverse consequences of climate change for human and natural systems is through mitigation. However, effective policies focused on adaptation are urgently needed as well to enable the building of resilience; those policies may also assist both in preventing the negative impacts arising from climate hazards and in slowing the process of climate change. For a number of reasons, however, adaptation has received less attention than mitigation in the discussions centred around climate change and it is only recently that efforts directed towards adaptation are being incorporated in the global policy agenda. First, as adaptation is a public good, private provision will typically remain below socially desirable levels unless the public sector intervenes. Second, adaptation, is difficult to address as it requires actions along the economic, social and environmental dimensions of development, which depend on the specific context of each country. Finally, there are no clear metrics for assessing adaptation impacts; that is, unlike mitigation, for which there is a clearly defined metric (namely, tons of greenhouse gas emissions), assessing adaptation efforts requires a larger number of indicators closely related to wider development efforts.

For many reasons, adaptation has received less attention than mitigation and it is only recently that adaptation has become a focus of global attention

This *Survey* focuses more on adaptation than on mitigation. In doing so, it situates adaptation along a continuum of broader development policies for transformation — critical components of which are efforts to address immediate needs (for example, poverty alleviation and disaster risk reduction and management) while reducing structural inequalities. The capacity for integrating these policies will be at the centre of the challenge of implementing the 2030 Agenda. However, it is important to understand that while these policies will contribute to sustainable development in general, they will at the same time help build the climate resilience of the particular countries and population groups that are most at risk.

Successful adaptation requires broad development policies aimed at reducing the structural inequalities that leave people vulnerable to climate hazards

Climate change and variability, and the uneven impacts of climate hazards

Understanding the association between climate change and inequality requires proper identification of (a) the climate-induced events that people experience most and (b) the countries and the population groups within countries that are most vulnerable to those events.

The United Nations Framework Convention on Climate Change[6] (article 1) defines climate change as a change in the climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable time periods.[7] Climate change takes place

6 United Nations, *Treaty Series, vol. 1771*, No. 30822.

7 Climate change, as defined by IPCC, refers to a change in the state of the climate that can be identified (e.g., through use of statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It may be caused by natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use. The United Nations Framework Convention on Climate Change makes a distinction between climate change attributable to human activities altering the composition of the atmosphere and climate variability attributable to natural causes. For more details, see the glossary of terms in IPCC (2014b, annex II). For the purpose of this *Survey*, the focus of attention is on climate hazards as the manifestation of potentially damaging impacts from climate-induced events, regardless of their origin.

over a period of decades or centuries; what people experience in their daily life is climate variability and climate extremes.[8]

The scientific community now agrees that climate change is increasing the frequency and intensity of climate hazards…

There is consensus in the scientific community that climate change is increasing the frequency, intensity, spatial extent, duration and timing of extreme weather and climate events, which results in an unprecedented level of climate hazards (IPCC, 2012, p. 7). Climate hazards are understood as being the potential occurrence of a climate-induced physical event that may cause loss of life, injury or other health impacts, as well as damage to and loss of property, infrastructure, livelihoods, service provision and environmental resources.[9] The destruction generated by climate hazards when they hit countries and people with greater frequency may derail years of development efforts.

For the twenty-first century, scenarios unambiguously predict continuing slow-onset changes such as higher surface and ocean temperature, ocean acidification and global rise of sea level. They also predict increased or more intensified extreme weather-related events, such as heat waves and precipitation extremes. In particular, those scenarios predict the most severe effects in tropical areas, where most developing countries are located.

…which are likely to slow down economic growth, increase food insecurity and exacerbate health problems, thereby increasing poverty and inequalities

If left unaddressed, these manifestations of climate change are likely to cause an increase in poverty incidence and inequalities by slowing down economic growth and exacerbating food insecurity, health problems and heat stress; and to result in surface-water scarcity and increased exposure to storms and precipitation extremes, coastal flooding, landslides, air pollution and droughts. They may also induce displacement of people and involuntary migration, among other hardships.

Weather-related disasters are becoming more frequent in all corners of the world, with a total of 6,457 events in 1995-2015, which represents an average of 323 disasters per year. Those disasters claimed more than 600,000 lives and affected about 4.2 billion people during the same period (table I.1). Floods constitute the major cause of deaths and had the greatest effect on people's lives. The number of people exposed to water-related hazards, together with storms, lies in the billions. Land-related disasters, such as droughts, landslides and wildfires, are other major factors affecting people's lives and their livelihoods. Importantly, the impacts of these climate hazards are not distributed evenly across countries, or across and within population groups in countries. This is a critical fact underlying the association between climate change and inequality.

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8 Climate variability refers to variations in the mean state of the climate and may result from the same factors that explain climate change, as noted above. A climate extreme (i.e., an extreme weather or climate event) occurs when the value of a weather or climate variable is above (or below) a threshold value near the upper (or lower) end of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events tend to be referred to collectively as "climate extremes" (IPCC, 2014b, annex II).

9 The City Climate Hazard Taxonomy developed by C40, a network of the world's megacities committed to addressing climate change, classifies climate hazards within five groups of events: (a) meteorological: short-term or small-scale weather conditions; (b) climatological: long-term or large-scale atmospheric processes; (c) hydrological: mass movement of water or a change in the chemical composition of water bodies; (d) geophysical: originating from mass movement of solid earth; and (e) biological: a change in the way living organisms grow and thrive, which may lead to contamination and/or disease (see http://www.c40.org/).

Table I.1
Number of people killed or affected by disasters, by type, 1995–2015[a]

Thousands		
Disaster type	**Number killed**	**Number affected**[b]
Floods	157	2 300 000
Drought	22	1 100 000
Storms	242	660 000
Extreme temperature	164	94 000
Landslides and wildfires	20	8 000
Total	**605**	**4 162 000**

Source: Centre for Research on the Epidemiology of Disasters (CRED) (2015).
a Up to August 2015.
b Those injured, left homeless or in need of emergency assistance, not including those killed.

Uneven impacts across countries

Not all countries experience the effects of climate hazards on their human and natural systems in the same way or proportion. Scenarios unambiguously predict that tropical areas are at higher risk of climate hazards. According to the Notre Dame Global Adaptation Index (ND-GAIN) (Chen and others, 2015),[10] for example, countries at the highest risk of climate change are concentrated in Africa and South and South-East Asia, where the capacity to prevent (or even cope with) most negative impacts is poor (figure I.1). While some high-income countries (Italy, Japan and the United States of America) exhibit relatively high risk levels owing to their high exposure to climate hazards, they possess greater capacity (resources) to manage those risks.

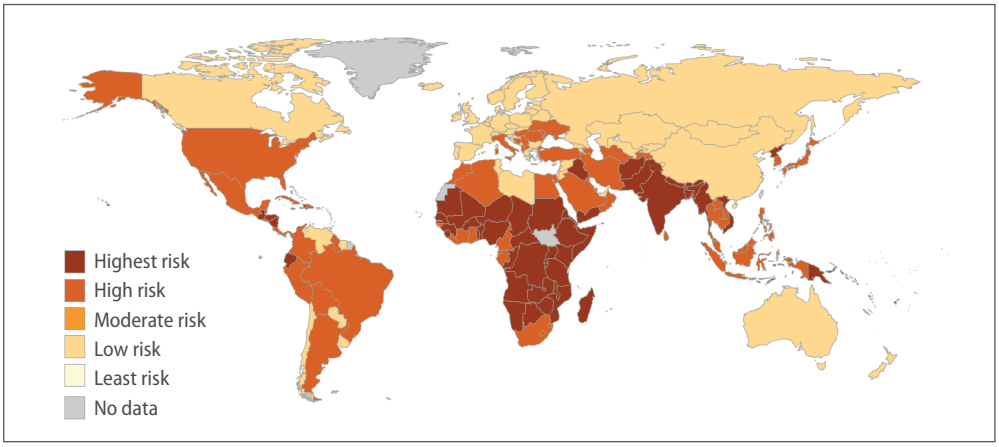
The effects of climate hazards on the human and natural systems are uneven across countries and among population groups

In absolute terms, total economic losses owing to climate hazards are most significant for high-income countries. In CRED (2015), total economic losses are defined as the estimated cost of damage to property (housing and infrastructure), crops and livestock. However, because of the distribution of risks and level of development, the greater economic losses relative to national income are observed in countries at lower levels of income. Low-income countries lost an estimated 5 per cent of gross domestic product (GDP) during the period 1995-2015 (figure I.2).[11]

10 This Index ranks countries' risk of climate change. Risk is constructed by summing rankings for vulnerability and exposure to climate change and the number of weather-related events. Vulnerability is assessed by considering six "life-supporting sectors": food, water, health, ecosystem services, human habitat and infrastructure. Each sector in turn represents three cross-cutting components: the exposure to climate-related hazards, the sensitivity to those impacts and the adaptive capacity to cope or adapt. Exposure is measured by projected changes in (not levels of) the following components, some of which are due to projected climate change: cereal yields, population, water run-off, groundwater recharge, deaths from climate change induced diseases, length of transmission season of vector-borne diseases, biome distribution, marine biodiversity, warm period, flood hazard, hydropower generation capacity and sea-level rise impacts. For the technical treatments of the index, see Chen and others (2015).

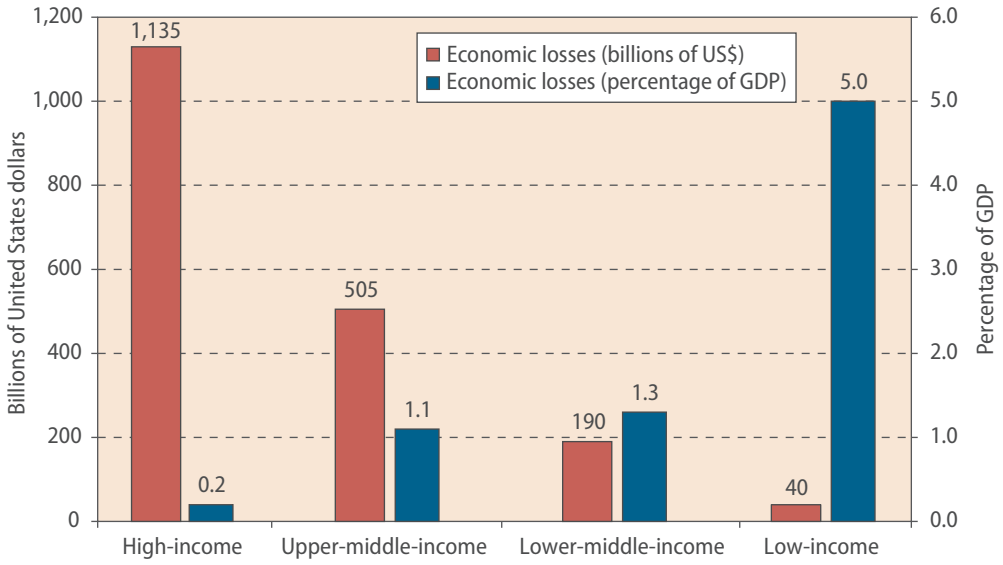
11 See, in this regard, the definition of "estimated damage" found in the glossary for the Emergency Events Database EM-DAT. Available at http://www.emdat.be/Glossary.

Figure I.1
Risk of climate change of all countries, by quintile, 1995–2014



Source: UN/DESA, based on University of Notre Dame Global Adaptation Index (available at http://index.gain.org) and Centre for Research on the Epidemiology of Disasters (CRED) (2015).

Figure I.2
Economic losses of countries from climate hazards, by income group, 1995–2015



Source: Centre for Research on the Epidemiology of Disasters (2015).

Least developed countries, countries in Africa and small island developing States are the most vulnerable to climate change

Countries with a high reliance on agriculture, the majority being least developed countries, are particularly vulnerable. Current agricultural practices are a major contributor to environmental degradation through greenhouse gas emissions and poor management of land and water resources. At the same time, agriculture is highly sensitive to climate change. As temperature rises, crop productivity is predicted to decrease at lower latitudes — although it is also expected to increase at mid-high latitudes. Warming, together with changes in water precipitation and unpredicted climate variability, affects the timing and length of growing seasons and yields, with strong impacts on farmers' livelihoods and on food security more generally (United Nations, 2011b, pp. 74-76). There is evidence for the

period 1981-2003 that land productivity decreased in sub-Saharan Africa, in South-East Asia and southern China, in north-central Australia, in the pampas and in the swathes of boreal forest in Siberia and Northern America (ibid.).

According to IPCC projections, countries in Africa are particularly vulnerable to climate change impacts. By 2020, between 75 million and 250 million people in Africa are projected to be exposed to increased water stress owing to climate change and as a consequence, yields in some countries could be reduced by up to 50 per cent. Agricultural production, including access to food, in many African countries is projected to be severely compromised. By 2080, in Africa, an increase from 5 to 8 per cent in arid and semi-arid land is projected under a range of climate scenarios. Further, the projected cost of adaptation could amount to 5-10 per cent of GDP.[12]

In the worst cases, climate change and the associated sea-level rise threaten the very existence of some small island developing States (such as Kiribati and Tuvalu) because of the latent risk that their territories may become submerged under water.[13] Other island States are facing severe drought and water shortages.

Uneven impacts across population groups

Not only are the impacts of climate hazards uneven across countries, they are also felt differently across population groups within countries. While identifying particularly vulnerable groups globally and at country level remains challenging, it is particularly important for policymaking directed towards building climate resilience.

People in low-lying coastal areas, drylands, and mountainous and remote areas are particularly vulnerable

Unfortunately, current information systems are not adequate to the challenge of following trends at the intersection between climate-related events and socioeconomic vulnerabilities. People living in low-lying coastal areas, drylands, and mountainous and remote areas and population groups whose livelihoods rely on forest products are particularly at risk. Yet, basic information on population size, socioeconomic characteristics and risk factors which could help identify those groups remains in the form of very rough approximations. Some of those groups are difficult to reach owing to their geographical location, but the lack of basic information is also associated with an insufficiency in the resources for producing statistics at the level of disaggregation required to identify specific population groups.

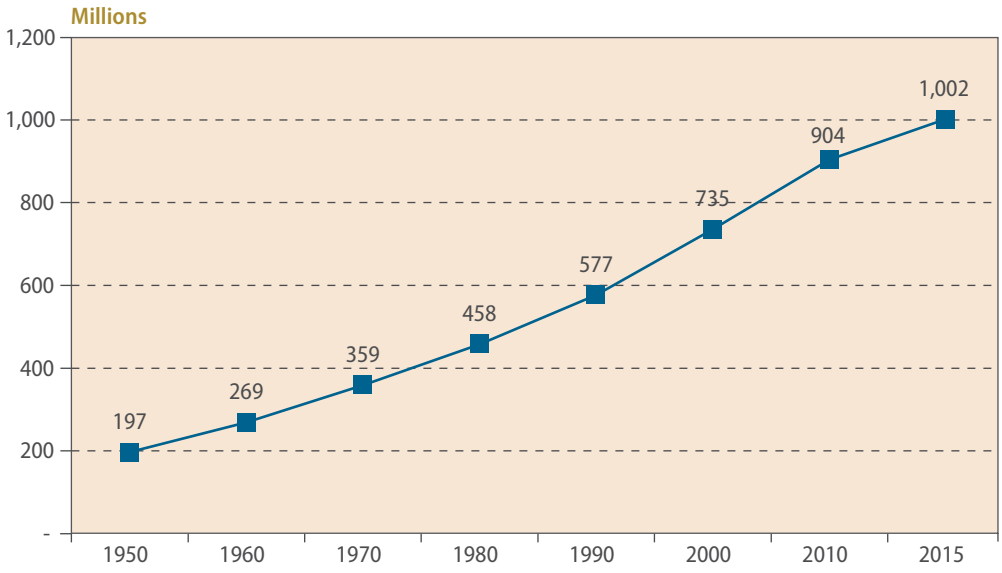
In spite of limited information, existing data and studies have enabled important inferences to be made with regard to the uneven distribution of climate-induced vulnerabilities and impacts across population groups. For example, despite the increased frequency of water-related risks such as sea-level rise and coastal erosions, more and more people in both developing and developed countries have settled in low-lying coastal areas, thereby

12 See fact sheet entitled "Climate change in Africa: what is at stake?", comprising excerpts from IPCC reports, the United Nations Framework Convention on Climate Change and the Bali Action Plan, as compiled by the African Ministerial Conference on the Environment secretariat. Available at http://www.unep.org/roa/amcen/docs/AMCEN_Events/climate-change/2ndExtra_15Dec/FACT_SHEET_CC_Africa.pdf. Information given above derived from IPCC (2007), "Summary for Policymakers".

13 The Government of Kiribati, for example, acknowledges that the relocation of its people may be inevitable, owing to climate change, which would threaten the survival of the country. The Government has stated that "it would be irresponsible to acknowledge this reality and not do anything to prepare our community for eventual migration". See Republic of Kiribati, Office of the President, "Relocation", Kiribati Climate Change. Available at http://www.climate.gov.ki/category/action/relocation/ (accessed 25 January 2016).

exposing themselves to greater risks (see figure I.3). A study issued by the US Census Bureau shows that since 1960, there has been a steady increase in the population living in coastal areas of the United States and concludes that the trend, driven by social, economic and environmental factors, can be expected to continue (Wilson and Fischetti, 2010).

Figure I.3
Population living in coastal cities with 300,000 inhabitants or more on 1 July 2014, 1950–2015[a]



Source: United Nations (2015b); Gu and others (2015).
a Preliminary estimates for 2015 only.

The problem is particularly acute for developing regions where, according to Johnston (2016), just over 10 per cent of the population (518 million out of 4,912 million) were living in low-elevation coastal zones (that is, zones less than 10 metres above sea level) in 2000 (table I.2) and 3 per cent (148 million) were living in a 100-year floodplain (that is, a plain that has a 1 per cent probability of being hit by a flood event in any given year). The same study predicts that in 2030, 767 million people (about 11 per cent of the population of developing regions) will be living in a low-elevation coastal zone and 224 million in a 100-year floodplain. These estimates suggest greater exposure to climate hazards and thus larger climate-related human costs in the future for particular population groups if effective climate adaptation and mitigation policies are not in place.

The rapid rise in the number of people living near the coast is doubtless to a large extent a manifestation of two mega-trends: one towards rapid population growth and the other towards urbanization. However, socioeconomic factors play a role as well: in the absence of more diversified economies that provide job opportunities in less-exposed areas, people are settling in low-lying coastal areas in search of a livelihood.

For example, the fishing population was estimated to have reached 43.5 million by 2006, with much of the "absolute growth in numbers largely explained by the wide expansion of the aquaculture sector" (Food and Agriculture Organization of the United Nations, Fisheries and Aquaculture Department, n.d.). Moreover, "(f)ishers, aquaculturists

Table I.2
Populations living in low-elevation coastal zones and 100-year floodplains in developing regions, 2000 and 2030

Millions						
	Population		Population living in low-elevation coastal zones		Population living in 100-year floodplains	
	2000	2030	2000	2030	2000	2030
Africa	811.0	1 562.0	54.0	109.0	13.0	24.0
Asia[a]	3 697.0	4 845.0	461.0	649.0	137.0	201.0
Latin America and the Caribbean	521.0	702.0	32.0	40.0	6.0	8.0
Pacific islands	7.0	12.0	1.0	2.0	0.3	0.4
Developing regions, total	4 912.0	7 002.0	518.0	767.0	148.0	224.0
Least developed countries	662.0	1 257.0	93.0	136.0	13.0	21.0
World	6 101.0	8 298.0	625.0	893.0	189.0	271.0

Source: Johnston (2016).
a Including Japan.

and those supplying services and goods to them assure the livelihoods and well-being of a total of about 520 million people, 7.9 per cent of the world's population" (ibid.). However, exploitation and climate change are threatening the collapse of livelihoods derived from fishing (Jackson and others, 2001). This situation is problematic because the fishing industry has historically played a major role in providing food security and income and more recently, aquaculture has played a rapidly growing role. Fishing is, to a large extent, a low-wage or subsistence-based activity and its decline due to climate change would be expected to affect large population groups.

Large vulnerable population groups are also found in drylands and mountainous and remote areas. Populations in these areas largely comprise nomadic, semi-nomadic and sedentary agricultural inhabitants. Large areas of populated drylands with growing subsistence populations, in particular, pose challenges to agricultural development and food security in Africa and large parts of central and South Asia. It is estimated that nearly 2 billion inhabitants in the developing regions were vulnerable to desertification and drought in 1995, the latest year for which data are available, and the number is considered to be increasing owing, as in the case of coastal zones, to population growth and migration. According to Millennium Development Goals reports for Ghana and Kenya, while the proportion of the population in extreme poverty declined in many regions of those countries, their poorest and most remote parts witnessed rising poverty rates (Johnston, 2016).

The problem of deforestation is also raising concerns for important population groups (United Nations, Economic and Social Council, United Nations Forum on Forests, 2009a; 2009b). According to the Food and Agriculture Organization (FAO) (2016a), forests are estimated to contribute to the livelihoods of at least 1.6 billion people in the world, with some 60 million people, mainly in indigenous communities, living within forests and another 350 million being highly dependent on forests. The forest industry, both formal and informal, is estimated to employ roughly

50 million of the world's people.[14] Deforestation is fundamentally challenging the existence of those livelihoods. As FAO also estimates, deforestation accounted for a loss of forest cover of approximately 13 million hectares per year between 2000 and 2005 — a loss that could not be compensated by the 5.7 million hectares recovered during the same period from the natural expansion of forests and forest plantations.

Deforestation and global warming are threatening the livelihoods of indigenous people and other communities

Indigenous people, in particular, are under siege, as their livelihoods are seriously affected owing to the alteration of forests. Local human activities that are being undertaken in and near forests — mostly unsustainable logging, conversion of forests to agricultural land, conversion of coastal mangrove forests for aquaculture, mining, infrastructure creation and the expansion of human settlements — as well as forest fires, further accelerate deforestation and degradation.

Deforestation also increases a community's risk of experiencing disasters. Forest degradation lowers the capacity of forests to provide the community with the livelihood resources needed to withstand and recover from disasters. Deforestation is known to cause severe floods, river-basin flooding, flash floods, mudslides and landslides (Hammill, Brown and Crawford, 2005) and leads to an increased number of disasters and extensive damage.

Indigenous people are a particularly vulnerable group. Their vulnerability is linked not only to deforestation but also to other manifestations of climate change. Their close relationship with their natural environment makes them particularly sensitive to the effects of climate change (Baird, 2008). In the worst cases, their way of life, and even their existence, is being threatened by climate change. For example, in the Arctic, where rises in temperature are most noticeable, there are some 400,000 indigenous peoples, which include the Sami of northern Norway, Finland, Sweden and the Russian Federation, for whom herding reindeer is a way of life. The Sami people had observed signs of climate change as early as the mid-1980s, when winter rainfall increased. Higher temperatures and increased rainfall began to make it difficult for reindeer to reach the lichen that they consume. When temperatures drop, and lichen is covered with ice, many reindeer are likely to starve. In addition, the thinning of the Arctic ice has made tracking reindeer herds more dangerous, as the inherited local knowledge regarding safe tracking is then no longer useful.

Uneven impacts within population groups

Vulnerability to climate change is largely driven by low income, less access to resources, and unfavourable socioeconomic status more generally

The evidence demonstrates that some people and some communities are particularly vulnerable compared with the rest of the population. This is clear when considering the case of Nepal, a least developed country, where rising temperatures, erratic rain- and snowfall, and the unpredictability of the beginning of the monsoon season have resulted in slow growth and decreased crop production. In principle, all people and communities whose livelihood is associated with crop production should be negatively affected by these hazards. However, Gentle and others (2014) have shown that the impacts are not uniform among people and communities. Their study shows that the severity of climate-related impacts depends on geographical location and the vulnerability of households, which is in turn determined by a number of socioeconomic characteristics such as household size, quality

14 These numbers are all rough estimates lacking a basis in clearly defined concepts and sources. While the Global Forest Resources Assessment 2015 gives detailed country data on forest employment, it does not provide an estimate for the total.

of farmland, social status within the community, education of the head of household, and access to financial resources.

These socioeconomic factors shape the structural inequalities that perpetuate poverty, marginalization and social exclusion in the face of climate hazards. In fact, the interviews conducted by the authors of the study revealed that the number of climate hazards experienced by Nepalese households was largely concentrated among the poor. On average, poor households experienced 2.63 climate hazards over the six-year period of the study; better-off households experienced 1.76 hazards on average. The proportion of the members of poor households who were injured or killed was 6.3 per cent, while 81.3 per cent experienced damage to their house, land or livelihood. The corresponding proportions for well-off households were 2.6 and 55.3 per cent, respectively.

In the Sahel region of Africa, where the livelihood of considerable portions of the population derives from farming and raising livestock, all farmers and pastoralists are witnessing the same reductions in the level of rainfall and rising desertification. It is poor farmers and pastoralists, however, who have been shown to be most vulnerable, given their limited ability to mobilize the resources necessary for adapting to these climate changes, which include water and land, and their lack of political power in society (Cotula, 2006; Silva, 2016).

A framework for understanding risk and policy

Structural inequalities that reproduce poverty, marginalization and social exclusion leave some population groups at higher risk of climate-related hazards

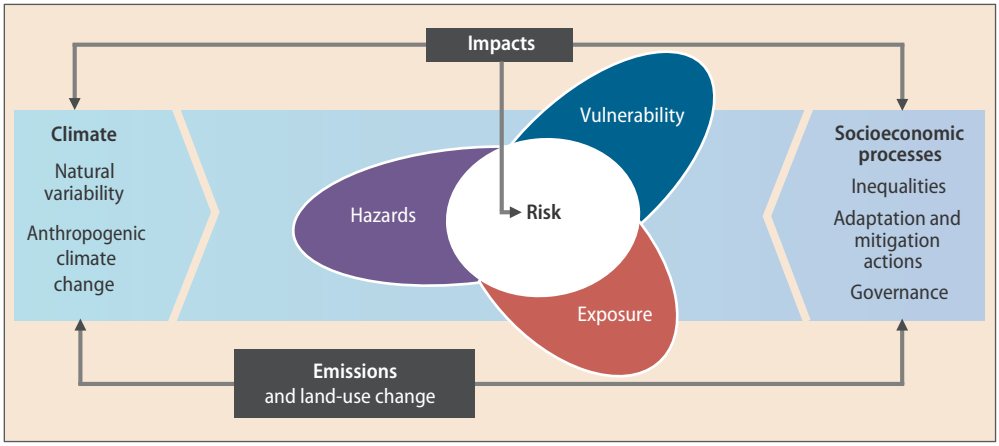
All of the above evidence attests to what is to be the core focus of the present *Survey*. Climate change is increasing the frequency and intensity of the extreme weather and climate events that are affecting all countries. However, it is developing countries, in particular small island developing States, and countries where livelihoods depend on climate-sensitive natural resources, that are the most exposed to climate hazards; additionally, they have fewer resources and less capacity to adapt. In those countries, there is a clear-cut association between inequality and vulnerability to climate change. Certain population groups are particularly at risk owing to their socioeconomic characteristics which leave them disproportionately exposed and more vulnerable to climate hazards. In most countries, the disproportionately high risks experienced by particular population groups are determined by structural inequalities which reproduce poverty, marginalization and social exclusion. Deepening the analysis of this problem with a view to identifying policies that can act upon the structural drivers of vulnerability requires a consistent analytical framework.

Exposure, vulnerability and structural inequalities

The degrees of exposure and vulnerability of people determine climate risk

The IPCC Fifth Assessment Report considers people to be at risk when they are faced with the potentially adverse consequences of an uncertain outcome and where something of value is at stake in the human and natural systems, such as human lives; livelihoods; health; ecosystems and species; and economic, social and cultural assets and service flows arising out of them (see IPCC, 2014c, annex II: Glossary). In this framework, the intersection between the occurrence of climate hazards and the exposure and vulnerability of people and natural systems to them is the central source of risk (figure I.4). Exposure refers to the presence of people (including their livelihoods), ecosystems and species, or economic, social, or cultural assets in places that could be adversely affected by climate hazards. Vulnerability is defined as the propensity or predisposition to be adversely affected, which encompasses

Figure I.4
Human interface with the climate



Source: UN/DESA, based on IPCC (2014d), p. 3.

two elements: (a) sensitivity or susceptibility to harm and (b) lack of capacity to cope and adapt. Exposure and vulnerability are thus determined implicitly by the conditions of poverty, marginalization and social exclusion as they affect specific population groups.

Exposure and vulnerability are determined by the socioeconomic processes leading to persisting inequalities

Except for a few countries at very low levels of development, where poor living conditions are widespread, poverty, marginalization and social exclusion are, in most cases, the result of deeply entrenched inequalities regarding access to physical and financial assets; and access to quality health services, education and employment; and as regards the unevenness of the opportunities of people and communities to voice their concerns and participate in political decision-making. As discussed in the *Report on the World Social Situation 2016: Leaving No One Behind – The Imperative of Inclusive Development* (United Nations, forthcoming), the term social exclusion refers to both the inability of individuals to participate fully in the economic, social, political and cultural life of the community to which they belong and the processes leading to their exclusion. The structural inequalities that result in social exclusion are reproduced by the economic rules, institutions and social norms that govern societies. Cultural, institutional and political regimes that determine the differential rights of people according to the difference in their status, as based on gender, tribal, ethnic or racial markers, have reproduced those inequalities over time.[15]

Structural inequalities matter when examining the impacts of climate hazards on people and communities. People and communities are relatively more exposed and vulnerable to climate hazards when their livelihoods depend on natural resources and they have few options for diversifying their income sources; when they are without appropriate access to insurance and financial markets; and when they have low levels of education and inadequate access to health services or inadequate access to appropriate facilities for persons with disabilities and older persons.

Policies whose goal is climate change resilience must address the underlying structural inequalities that leave people at high risk

To be effective, the building of climate change resilience must entail addressing the processes underlying such structural inequalities. This *Survey* will strive to delineate the structural inequalities that most increase vulnerability and exposure to climate hazards.

15 See chap. I of the *Report on the World Social Situation 2016* (United Nations, forthcoming) for an extensive discussion on the concept of social inclusion/exclusion.

The policy implications of such an analysis are most important. If effective actions for climate resilience are not put in place, climate hazards are likely to exacerbate inequalities, leading to increasing poverty, marginalization and social exclusion.

Transformative policies for climate resilience

Sound development policies are the kind of policies, above all, needed to build climate resilience through building people's resilience to socioeconomic and climate-related shocks. Addressing the root causes of vulnerability requires a continuum of policy interventions leading to the structural transformations that strengthen people's opportunities and agency.

A continuum of policy interventions is required to address immediate needs and enable the structural transformations needed to build climate-resilient and sustainable societies

Today's policies must lead the way towards achieving the kind of transformations required to build inclusive and climate-resilient societies. Disaster risk reduction and disaster management are obviously playing an important role in strengthening the preparedness and early warning capacities needed to confront climate hazards. Social protection policies are necessary to protect lower-income groups against the threats of climate hazards. Adaptation policies, such as those entailing the adoption of new crops or improved irrigation systems in agriculture, are critical to preventing a deterioration of livelihoods as a result of climate hazards. To be successful, however, these highly specific policy responses must be part of a broader development framework which leads the way incrementally to the empowerment of today's disadvantaged groups by improving their asset positions and access to input and product markets, by extending their access to quality basic services such as health, education and sanitation, and by changing the norms fostering their social and political exclusion.

The adoption of the 2030 Agenda for Sustainable Development, with its vision of "transforming our world", provides a unique opportunity to strengthen policymaking systems in such a way as to enable them to effectively take the lead in the transformation process required for sustainable development, including the building of climate resilience. While broad international consensus has supported this view,[16] the challenge going forward is nevertheless centred around the adoption of national policies which will, within each country's context and constraints, drive efforts towards poverty eradication, human development and climate resilience.

There is an extensive literature devoted to the past experiences of countries on alternative interventions in response to extreme climate hazards. However, there is less experience with and less recognition of the challenges posed by both slow setting events and the accumulation of weather-related hazards, which can have devastating consequences on livelihoods. In the absence of government support, even small changes in temperature or rain and wind patterns can push people into poverty traps (Olsson and others, 2014). Those who are the most exposed and vulnerable are also the ones who are already economically and socially disadvantaged and the least likely to have access to support systems.

Climate change adaptation presents a public-goods related problem requiring public policies to address it

Public policy will have to play a critical role in providing public goods for adaptation and ensuring that social processes and institutions are flexible enough to learn and adapt and assess policy options. Climate change presents a public goods-related problem, one that

16 In fact, in the 2030 Agenda, as adopted by the General Assembly (resolution 70/1), the Heads of State and Government and High Representatives declared that "(o)n behalf of the peoples we serve, we have adopted a historic decision on a comprehensive, far-reaching and people-centred set of universal and transformative Goals and targets", that "we are setting out a supremely ambitious and transformational vision" and that "(w)e envisage a world free of poverty, hunger, disease and want, where all life can thrive".

produces socially undesirable results. Information and accurate climate forecasts, public infrastructure, flood control systems, early warning systems, knowledge and technology are public goods, all of which are essential for adaptation. But it is precisely because they are public goods that they cannot be provided adequately by the private sector.[17] It is thus public policies that play the critical role in their provision.

In the presence of large development gaps and incomplete markets,[18] public policies also have an important role to play in creating the incentives and regulations capable of increasing provision by the private sector of the goods and services (including their accessibility) that facilitate climate change adaptation among vulnerable groups. Inadequate access to credit and insurance markets constrain people's options with regard to investing and protecting their assets under the effects of shocks. Creating the incentives needed to expand access to credit and insurance markets is an example of government activity that would contribute to reducing the structural inequalities constraining the capacity of people to diversify their livelihoods and adapt to climate change.

At the same time, social processes and institutions need to be flexible enough for learning adaptation and assessment with regard to development options. Climate change resilience will demand that social, economic and ecological systems become capable of reorganizing so as to maintain their essential functions, identity and structure, while also maintaining their capacity for adaptation, learning and transformation.[19] This will pave the way towards sustainable development — as long as the structural inequalities that drive poverty, social exclusion and vulnerability are addressed.

Building resilience requires improved technical and political capacity to implement integrated policies with participation from all stakeholders

This *Survey* has been structured to elucidate the distinct ways in which national efforts in the most vulnerable countries can confront these challenges. At the same time, it identifies concrete areas where national efforts will need to be supplemented through enhanced international cooperation.

Organization of the chapters of this *Survey*

Chapter II reviews the literature on the impact of climate change on human systems and stresses the need to advance understanding of the link between climate change and inequalities, both conceptually and empirically. The chapter builds upon the idea that climate hazards and inequalities are locked in a vicious cycle, whereby those hazards affect people experiencing socioeconomic vulnerability disproportionately. If resources are not adequate

17 A public good is both non-excludable (i.e., individuals cannot be prevented from using it) and non-rivalrous (i.e., the use of the good by one individual does not reduce its availability or utility to others). Common examples include fresh air, national security and street lighting. Providers cannot discriminate among users or exclude non-payers from the good and therefore have no incentive for providing the good.

18 Incomplete markets are those where the conditions for market formation are not fully met. In these circumstances, service provision by private firms satisfies only a small part of potential demand, which is typically the case for credit and insurance markets within the rural environments of developing countries.

19 As defined by Shaw (2012, p. 309), climate resilience is a dynamic process of "bouncing forward" (as opposed to "bouncing back to what it was"), which requires reacting to crises by moving up to a new state that is more sustainable in the current environment. So described, the resilience-building process is often called evolutionary resilience, as it entails the ability of complex human and natural systems to change, adapt and crucially transform in response to climate hazards rather than return to normality (Davoudi, 2012).

to the challenge of recovery from climate hazards, inequality in its multiple dimensions will deepen. Using evidence from the existing literature, chapter II explores the economic, social and political channels that shape the structural inequalities through which climate hazards both increase the level of exposure and susceptibility to damage of disadvantaged groups and weaken their capacity to cope and to recover. The evidence reviewed points to the need for a well-integrated continuum of policies, planning and practices for addressing the root causes of inequalities which impose disproportionate impacts on people when they are hit by climate hazards. The transformations leading to adaptation and climate resilience need to be well sustained by assessments and fully supported by a sound policymaking system.

Chapter III introduces the methodologies used in "integrated climate impact assessments" which combine different types of modelling tools to uncover the interlinkages across the environmental, economic and social dimensions of development. To the extent that the occurrence and impacts of climate hazards are associated with a high degree of uncertainty, integrated assessments have to provide robust estimates of plausible climate outcomes and policy responses. The chapter argues for the need to sharpen the focus of these assessments in several ways, targeting the importance of bringing inequalities to the fore. It is also argued that engaging stakeholders (policymakers, experts and researchers, vulnerable groups and local communities) in the design of policy scenarios and in the discussion of policy options is critical to strengthening the political process through which policy decisions are made. Bringing forth the evidence provided by integrated climate impact assessments with full transparency regarding both the use of data and the assumptions built into the modelling tools that facilitate those assessments will critically improve the knowledge base, policy options and political processes in countries seeking to build climate change resilience as an integral part of sustainable development policies. In addition, chapter III focuses on areas where capacities need to be strengthened so that developing countries can expand the construction and use of assessments.

Improving assessments is only one of the many possible means of strengthening policymaking. Chapter IV introduces the subject of the complexity of policy decision-making processes that is introduced when multiple objectives are being pursued within the continuum of policies required for resilience and sustainability. A central claim of the chapter is that, given the presence of three factors — the underlying uncertainty of climate change, the locality where it exhibits its effects, and the interconnected nature of the various sectors in which its impacts are felt — a policymaking system is required that meets three core criteria: it has to be coherent, participatory and flexible.

International cooperation will have a critical, supportive role to play in ensuring that the most vulnerable countries possess the means to strengthen their capacity to forge climate-resilient development pathways as part of their strategies for sustainable development. While the 2030 Agenda for Sustainable Development respects the mechanisms by which countries make their own policy choices, it also recognizes the importance of development cooperation, especially within the context of countries with special needs. Chapter V explores two important areas of international cooperation: international financing for climate change adaptation and the development of improved systems of information and data sharing.

Appendix I.1

Uncertainty of the prospects for the global distribution of income in 2050 based on alternative development pathways

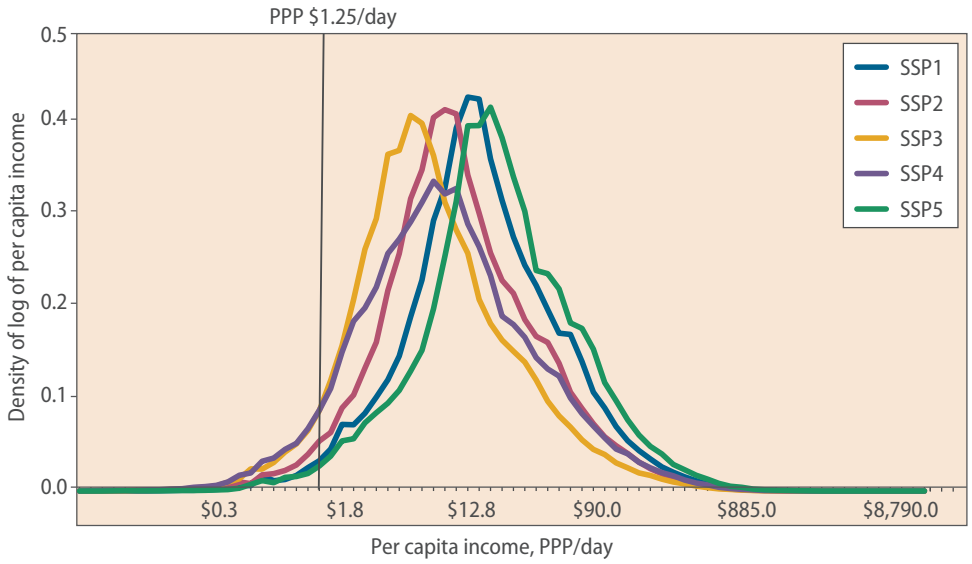
Development trends are hedged in by large uncertainties arising from the uncertainty associated with the estimation of future climate change. Those uncertainties are compounded by the interaction of climate change with mega-trends related to demographic dynamics, urbanization, globalization and technological progress. In order to in some way address these conditions of uncertainty, the international research community has adopted a set of narratives which consider possible pathways for development. The estimation of plausible scenarios in the future are produced by different combinations of those mega-trends.

These narratives, known as shared socioeconomic pathways (SSPs), were proposed initially by Kriegler and others (2012). They have gone on to serve in the creation of a correspondence, which has featured prominently in climate change assessments, between shared socioeconomic pathways and greenhouse gas concentration trajectories under different mitigation scenarios (or representative concentration pathways (RCPs)).

Each shared socioeconomic pathway is associated with different mitigation and adaptation challenges depending on the distinct evolution of mega-trends, as illustrated in table A.I.1.

Alternative shapes of the global distribution of per capita income in the year 2050 have been determined for each of the SSPs from the Global Income Distribution Dynamics database of the World Bank (Osorio Rodarte, 2016; and van der Mensbrugghe, 2015). An important finding of this exercise has been that, as shown in figure A.I.1, the overall level of welfare, inequality and poverty varies significantly, depending on the path taken. Poverty incidence is highest in those cases where adaptation efforts are weak (SSP3 and SSP4).

Figure A.I.1
Global distribution of income in 2050 based on different shared socioeconomic pathways



Source: Osorio Rodarte (2016).

Table A.I.1
Mitigation and adaptation challenges associated with different shared socioeconomic pathways

SSP	Challenges	Illustrative starting points for narratives
SSP1 (Sustainability)	Low for mitigation and adaptation	Sustainable development proceeds at a reasonably fast pace, inequalities are lessened, and technological change is rapid and directed towards environmentally friendly processes, including lower-carbon energy sources and high productivity of land
SSP2 (Middle of the road)	Moderate	A case intermediate between SSP1 and SSP3, viewable perhaps as business-as-usual
SSP3 (Fragmentation)	High for mitigation and adaptation	Unmitigated emissions are high owing to moderate economic growth, a rapidly growing population and slow technological change in the energy sector, making mitigation difficult. Investments in human capital are low, inequality is high, a regionalized world leads to reduced trade flows and institutional development is unfavourable, leaving large numbers of people vulnerable to climate change and many parts of the world with low adaptive capacity
SSP4 (Inequality)	High for adaptation, low for mitigation	A mixed world, with relatively rapid technological development in low-carbon energy sources in key emitting regions, leading to relatively large mitigation capacity in places where it matters most for global emissions. However, in other regions, development proceeds slowly, inequality remains high and economies are relatively isolated, leaving those regions highly vulnerable to climate change, with limited adaptive capacity
SSP5 (Conventional development)	High for mitigation, low for adaptation	In the absence of climate policies, energy demand is high and most of this demand is met by carbon-based fuels. Investments in alternative energy technologies are low, and readily available options for mitigation are few. Nonetheless, economic development is relatively rapid and is itself driven by high investments in human capital. Improved human capital also produces a more equitable distribution of resources, stronger institutions and slower population growth, leading to a less vulnerable world which is better able to adapt to climate impacts

Source: UN/DESA, based on van der Mensbrugghe (2015), table 2.