

Chapter V

Enhanced cooperation for climate-resilient development

Key messages

- Delivering on the commitments set out in the 2030 Agenda for Sustainable Development to revitalize the Global Partnership for Sustainable Development will be critical to strengthening resilience to climate change among the most vulnerable countries and population groups. Improving access to stable and adequate sources of finance for adaptation and contributing to the building of the information systems needed to guide policy-making for climate resilience are two concrete actions where greater international cooperation is needed.
- Funding for adaptation projects lags behind funding for mitigation efforts by a significant margin. Public domestic and international efforts are needed to mobilize sufficient resources and provide incentives to the private sector to invest in adaptation. This is especially important for building the resilience and adaptive capacity of the most marginalized areas and population groups.
- Identifying vulnerable people, understanding the risks they incur and designing policies aimed at building climate resilience require intensive collaboration, among a wide range of data programmes and across disciplines, on uncovering the interlinkages between vulnerability and climate hazards. Efforts in this direction require unprecedented levels of cooperation at the global and national levels as the foundation for a new form of data development.

Introduction

The 2030 Agenda for Sustainable Development¹ is a universal instrument that recognizes the importance of the contribution of all countries to achieving the goal of sustainable development, including through support to developing countries, particularly the most vulnerable among them. As discussed in chapter I of the present *Survey*, a significant component of the vulnerability of many developing countries, in particular low-income countries, is associated with their exposure and susceptibility to climate hazards. Left unattended, this vulnerability will make it difficult to achieve climate resilience as well as other development goals, especially those related to poverty and inequality reduction, food security, and improved nutrition and health.

The global annual average cost of climatic disasters, including floods, storms, droughts and heat waves, is estimated to have risen from \$64 billion during the period 1985-1994 to \$154 billion in the period 2005-2014.² A more complete estimate of global

¹ General Assembly resolution 70/1.

² Calculations of UN/DESA, based on data from the Centre for Research on the Epidemiology of Disasters (CRED) International Disaster Database (EM-DAT). Available from <http://www.emdat.be>.

costs, taking into account the loss associated with slow-onset climate events (e.g., sea-level rise and desertification), is likely to yield a larger figure. Slow-onset events have particularly devastating effects on climate-sensitive livelihoods such as agriculture, fisheries and forestry. It is developing countries which have fewer resources and less capacity to adapt to a changing climate—in particular small island developing States, and countries where livelihoods depend on climate-sensitive natural resources—that are the most exposed (see chap. I).

A Global Partnership for Sustainable Development can harness development capacities for building climate-resilience in the countries that are the most in need of it

Against this backdrop, a strengthened Global Partnership for Sustainable Development has an important role to play in supporting and harnessing development capacities for building climate-resilience in countries that are the most in need of it. The historical agreements adopted by the members of the international community in 2015, including the 2030 Agenda for Sustainable Development and the Addis Ababa Action Agenda of the Third International Conference on Financing for Development,³ usher in a unique opportunity to solidify effective global cooperation and coordination in support of global, regional and national efforts towards achieving sustainable development in general and climate-resilient development more specifically.

The imperative of limiting global warming to less than 2° C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5° C, together with the task of effectively reducing the impact of climate hazards on vulnerable populations, requires a profound transformation of international cooperation. Much of the previous focus of climate action has been on mitigating the effects of anthropogenic activity so as to limit global temperature rise. In addition to this effort, unprecedented levels of cooperation are needed for the specific purpose of achieving climate change adaptation. This cooperation must facilitate the complex task of assessing needs and policy options for meeting those needs as well as supporting actual implementation of interventions towards achieving climate resilience, including the kind of transformative policies that would help address the structural inequalities underlying climate change vulnerability, as discussed in previous chapters. Such an accomplishment demands that cooperation be strengthened in a number of critical areas, two of which are discussed in detail below.

The first critical area of support encompasses provision of stable and sufficient sources of financing for climate-resilient development. The second encompasses improvement in capacities to produce and utilize large and complex sources of data and information, which, within the context of adaptation and climate resilience, need to cover local and even more highly specific geographical resolutions.

The next section emphasizes a key point, namely, that funding for adaptation projects lags behind that for mitigation efforts by a significant margin. This reflects in part the general emphasis in climate discussions on mitigation, as noted in chapter I. While the challenges of adaptation are recognized in international forums, that recognition has not yet generated the resources and level of support required for climate-resilient development. Part of the adaptation gap in financing can be explained by four specific characteristics of interventions directed towards adaptation that impact risk and return and limit the interest of private sector investors: (a) adaptation projects are difficult to separate from other types of development investments, particularly those aimed at reducing the vulnerability of people to climate hazards; (b) based on (a), an operational definition of adaptation does not exist, which prevents an explicit focus on adaptation; (c) adaptation projects are public

³ General Assembly resolution 69/313, annex.

goods, whose benefits accrue mainly to local communities; and (d) adaptation impacts are difficult to quantify, which complicates investment decisions.

A large part of the challenge of mobilizing resources to build resilience and adaptive capacity derives from the need to identify the vulnerable, understand the risk they incur and monitor the effect of interventions on reducing their vulnerability. Understanding the socioeconomic attributes of vulnerable groups and further assessing the potential impacts of climate hazards and policies on their livelihoods requires sound data and information, at the lowest possible geographical resolutions, with respect to where people live and where adaptation must take place. This is critical for enabling policymakers and population groups and communities to be better informed and acquire an understanding of the true nature of the problems to be confronted, as well as the expected impact of policy alternatives. When such fine-grained data and information are missing, rigorous climate impact assessments (chap. III) and the capacity of policy systems to respond (chap. IV) are seriously challenged. A discussion in a later section of this chapter will focus on the ways in which international cooperation can facilitate the building of capacity to collect and effectively use fine-grained data and information in support of policymaking processes aimed at building climate resilience.

Increasing financial flows for adaptation and supporting the construction of sound information systems for climate resilience require stronger global partnerships

Financing local climate adaptation at a global scale

At its twenty-first session, held in Paris from 30 November to 13 December 2015, the Conference of the Parties to the United Nations Framework Convention on Climate Change adopted the Paris Agreement.⁴ The 195 States parties to the Convention and the European Union achieved a historic partnership through the adoption of the Agreement, which is the first universal, binding global climate agreement to put the world on track towards mitigating global warming by limiting it to well below 2° C and pursuing efforts to limit the increase in temperature to 1.5° C.⁵ As of 29 June 2016, there were 178 signatories to the Paris Agreement.⁶ The process of confronting the challenge of implementation has already begun: to curb warming by limiting it to 1.5° C-2° C above pre-industrial levels will require a profound shift in the pathways of industrialization. The pursuit of efforts to achieve this shift offers new opportunities to address previously entrenched socioeconomic inequalities while building more sustainable economies.

The challenge is a formidable one and will be met only through a global partnership that includes all levels of government, in addition to the private sector and civil society. Prior to negotiations held at the twenty-first session of the Conference of the Parties to the Convention, 160 States submitted intended nationally determined contributions (INDCs) which laid out plans for reducing greenhouse gas emissions (Ecofys, Climate Analytics, New Climate Institute and Potsdam Institute for Climate Impact Research, 2014). The United Nations Environment Programme (UNEP) Emissions Gap Report 2015 (UNEP, 2015) estimates, however, that full implementation of the INDCs would achieve only half of the emissions reduction required for there to be a reasonable chance of keeping below

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

⁵ Limiting the temperature rise to 1.5° C is considered a much safer defence against the worst impacts of a changing climate.

⁶ The Paris Agreement was opened for signature on 22 April 2016 and will remain open for signature for one year.

The Paris Agreement calls for a road map for achieving the goal of \$100 billion dollars per year by 2020 for the financing of climate change mitigation and adaptation

the 2° C target in 2100 (Olhoff and Christensen, 2015). Accordingly, the Paris Agreement formally recognizes a significant gap between the current level of emissions reduction pledges contained in the intended nationally determined contributions and the 2° C pathway.

In order to help encourage bolder action towards a low carbon emissions economy, the Paris Agreement calls for developed countries to create a road map for ratcheting up financing for climate change mitigation and adaptation activities in developing countries to \$100 billion per year by 2020 (decision I/CP.21, para. 114). This goal is feasible: government measures in support of fossil fuels are conservatively valued at \$160 billion-\$200 billion per year (OECD, 2015a);⁷ and total new investment in renewable energy alone was valued at \$286 billion in 2015 (REN21 Renewable Energy Policy for the 21st Century, 2016).⁸ Raising \$100 billion in climate finance per year is safely within the realm of possibility. But will it be enough?

According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Chambwera and others, 2014), adaptation costs within the developing countries alone will range from \$70 billion to \$100 billion per year by 2050. An updated review by UNEP indicates that these figures are very likely to represent an underestimate. Further, the \$100 billion climate finance pledge is for both mitigation and adaptation finance.⁹ Put simply, climate finance streams will need to far exceed the Paris Agreement target if climate change needs are to be met.

Current estimates of climate finance flows are aggregated and reported on by the UNFCCC Standing Committee on Finance. According to its most recent report, the outlay of funds for climate change mitigation dominates the climate finance portfolio (United Nations Framework Convention on Climate Change secretariat, 2014). Some estimates suggest that mitigation accounted for 93 per cent of total climate finance in 2014 (Climate Policy Initiative, 2014).

The present section addresses the factors that explain the vast difference between mitigation and adaptation financing. The first part presents a brief summary of the state of and prospects for climate finance, arguing that adaptation needs are currently underserved. In the second part, the discussion turns to an analytical assessment of the barriers to adaptation finance. By unpacking the black box of those project barriers, the analysis reveals that some areas of adaptation are better funded than others. The third part, which focuses on closing the gap, zeroes in on the notion that different types of adaptation activities require different types of support. Case studies bolster the argument that the public sector will have a continuing and strengthened role to play in all areas of adaptation programme implementation. This section also puts forward three policy scenarios, or leverage points, for ramping up private sector assistance in adaptation. Finally, an analysis

⁷ This figure can be considered conservative because it includes subsidies only from OECD partner countries and key developing-country partners (Brazil, China, India, Indonesia, the Russian Federation and South Africa). Further, only direct subsidies are included. The International Monetary Fund (IMF) estimates, which include indirect subsidies (e.g., non-taxation of externalities), are much higher.

⁸ Investments include all biomass, geothermal and wind power generation projects of more than 1 megawatt (MW); all hydro projects of between 1 and 50 MW; all solar power projects, with those less than 1 MW estimated separately and referred to as small-scale projects or of small distributed capacity; all ocean energy projects; and all biofuel projects with an annual production capacity of 1 million litres or more.

⁹ The Paris Agreement has called for a working group to draft a formal—and urgently needed—definition of what constitutes climate finance.

of the lessons learned from these cases yields some principles applicable to the question of how partnerships and policy interventions may be used to promote effective, locally appropriate and scalable adaptation measures.

The many ways to count to \$100 billion

In 2009, under the Copenhagen Accord (para. 8),¹⁰ agreed by Heads of State, Heads of Government, Ministers and heads of other delegations at the fifteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, held in Copenhagen from 7 to 19 December 2009, developed countries committed to mobilizing \$100 billion per year for financing climate action in developing countries by 2020.¹¹ In the lead-up to the climate negotiations in Paris at the Conference of the Parties to the Convention at its twenty-first session, developed and developing countries sought greater clarity on the sources and quantity of flows for climate change mitigation and adaptation, as well as on the creation of policies designed to address recovery for loss and damage from climate change impacts.

The UNFCCC Standing Committee on Finance, which provides an operational definition of climate finance as “all finance that specifically targets low-carbon or climate-resilient development” (UNFCCC secretariat, 2014), estimates that climate finance mobilized by developed for developing countries ranges from \$40 billion to \$175 billion per year. In 2015, the Organization for Economic Cooperation and Development (OECD) and the Climate Policy Initiative reported that those flows had reached \$52 billion in 2013 and \$62 billion in 2014 (OECD, 2015a).¹² The total, including public finance provided by donor Governments, including non-concessional loans, did not include the value of capacity-building, policy interventions and the creation of enabling environments (ibid.), which, as seen in previous chapters, are critical facets of building climate resilience.

Even if only climate finance flows from developed to developing countries qualify as being part of the \$100 billion pledge, a larger estimate is still useful in providing some idea of other, additional funds from other sources. All global climate finance, including public and private resources devoted to addressing climate change in all countries, yields a much larger estimate. According to the “Global landscape of climate finance”, total global climate finance, including available estimates of domestic financing, amounted to \$391 billion in 2014 (Climate Policy Initiative, 2015; and figure V.2).¹³

Under the United Nations Framework Convention on Climate Change, it is estimated that climate finance mobilized by developed for developing countries ranges from \$40 billion to \$175 billion per year

¹⁰ FCCC/CP/2009/11/Add.1, decision 2/CP.15.

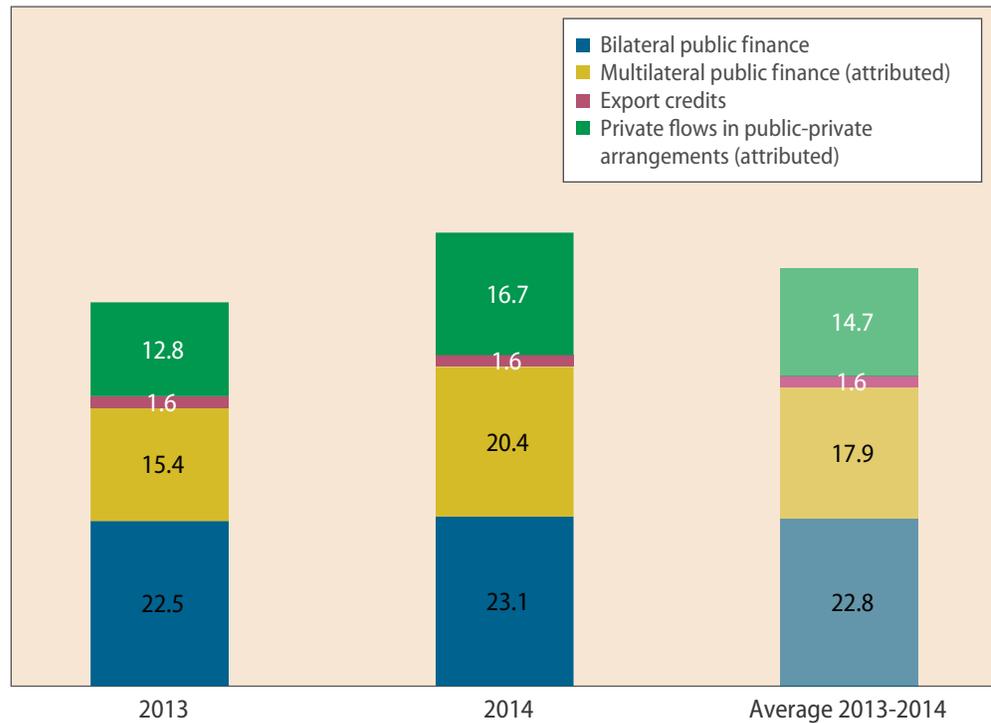
¹¹ This would come from bilateral or multilateral public or private sources, including innovative financing sources. Public financing may take several forms: financing by multilateral funds such as the Green Climate Fund; financing from multilateral or regional institutions such as the World Bank; government contributions; and financing from bilateral institutions.

¹² It should be noted that those figures have not been immune to criticism. Developing countries, for example, argue that official development assistance (ODA) flows may be double-counted and that the methodology for calculating mobilized private finance needs improvement. The figures exclude finance for high-efficiency coal plants, which Japan and Australia argue should be considered a form of climate finance. Japan has provided \$3 billion for such projects over the period 2013-2014.

¹³ The Climate Policy Initiative estimates that the domestic public budget for climate-related development not captured in the report could reach at least \$60 billion per year.

Figure V.1
**Mobilized climate finance from developed to developing countries,
 by funding source, 2013–2014**

Billions of United States dollars



Source: OECD (2015a, 2015b).

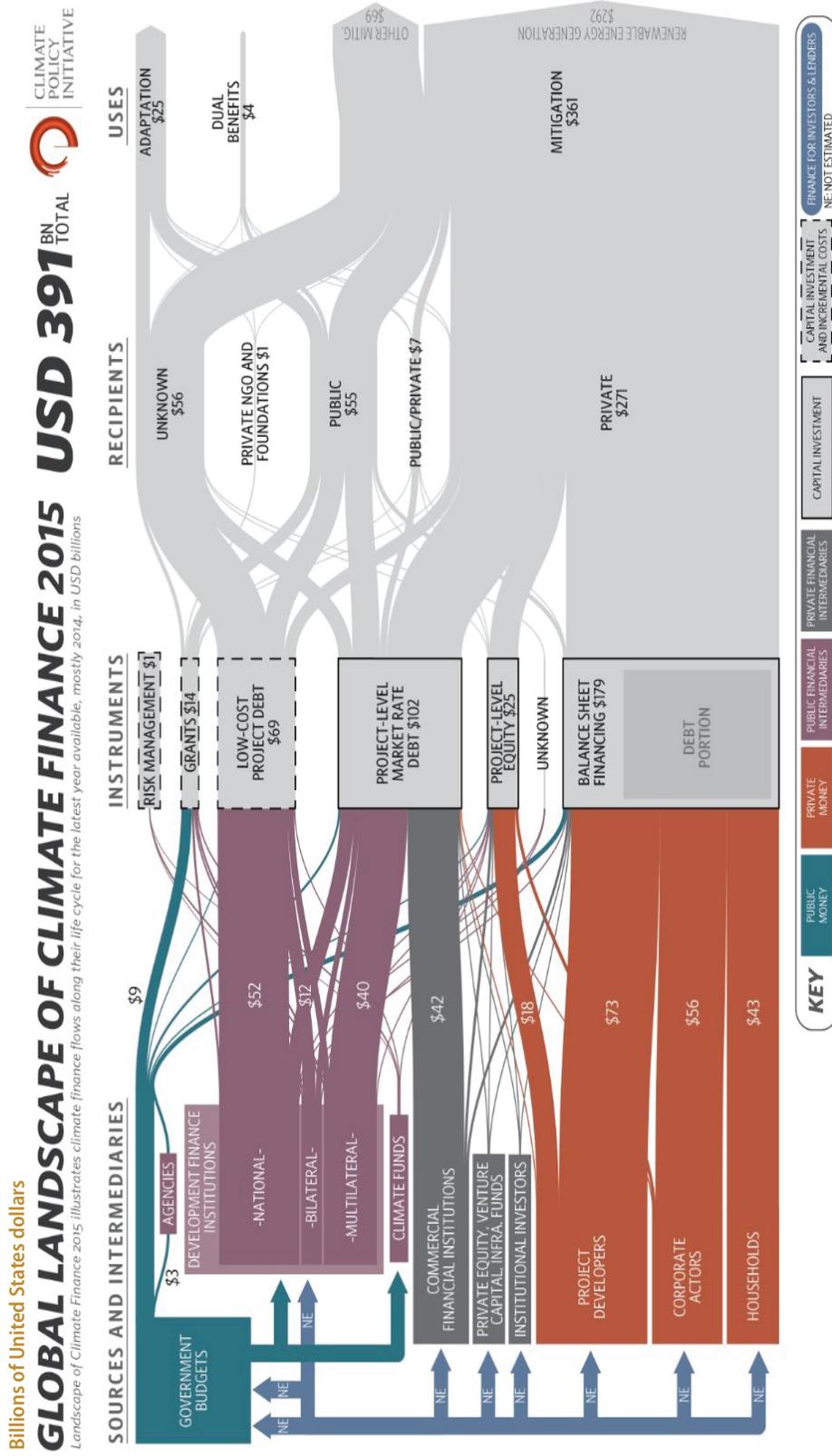
Of the global total of financial resources channelled to developing countries, more than 11 per cent represents South-South cooperation

Developed countries are not the only contributors of financial resources to developing countries. The smaller figures reported by the Standing Committee on Finance and OECD/Climate Policy Initiative are limited to cross-border financial flows from developed to developing countries (i.e., South-South cooperation is not included). On the other hand, of the global total, more than 11 per cent represents South-South cooperation (OECD, 2015). Both methods of accounting for climate finance flows fill in part of the overall picture, but each has its limitations, as recognized under the United Nations Framework Convention on Climate Change¹⁴ and by relevant institutions. For example, the fact that there is no central accounting mechanism for climate finance flows makes it particularly difficult to quantify beyond those resources channelled through multilateral development banks and other public institutions. There is therefore a need for a comprehensive definition of and monitoring system for climate finance.

A further complication is revealed through discussion on the mainstreaming of private investments into climate finance. Taking into account private flows, resources for climate-related finance are reaching record highs each year, owing in large part to investments in renewables and energy-efficient technologies by the private sector. Global private investment in renewable energy grew to \$243 billion in 2014, up 26 per cent, from

¹⁴ United Nations, *Treaty Series*, vol. 1771, No. 30822.

Figure V.2
Climate finance flows along their life cycle, for latest year available (mostly 2014)



Source: Climate Policy Initiative (2015).

2013 (Climate Policy Initiative, 2015).¹⁵ Again, achievements in mainstreaming climate-compatible technology into the global economy render the current \$100 billion dollar metric misleading in some instances. Negotiations therefore continue on how climate finance accounting can be clarified and made more informative operationally for all.

Finally, while the Paris Agreement promises to strengthen efforts to provide \$100 billion in climate finance from developed countries as a floor, the salient issue for developing countries is likely not only the volume but also the quality and predictability of the financial flows.

Official development assistance and climate finance

Developing countries have argued that financing for climate objectives should be offered in addition to official development assistance

Ambiguities associated with the definition of climate finance are symptomatic of the tension and ambivalence displayed within the political context of the climate negotiations themselves. While there have been efforts to further integrate climate considerations into the greater development agenda, developing countries have argued that finance for climate objectives should be offered in addition to official development assistance (ODA). In order to scale up ambition prior to 2020, the Conference of the Parties to the United Nations Framework Convention on Climate Change, in its decision 1/CP.21, entitled “Adoption of the Paris Agreement”: “*strongly urge(d)* developed country Parties to scale up their level of financial support, with a concrete road map to achieve the goal of jointly providing USD 100 billion annually by 2020 for mitigation and adaptation while significantly increasing adaptation finance from current levels and to further provide appropriate technology and capacity-building support” (para. 114).

It is significant that the operational language of the Paris Agreement focuses on the purpose of the \$100 billion promise but does not provide a clarification of the relationship between climate finance and regular ODA budgets, which is critical going forward. Without clear distinctions and definitions, cases where development projects are also considered climate-compatible projects can lead to the double-counting or under-counting of flows offered for ODA and/or climate finance.

Current financing trends in adaptation

Up to 77 per cent of climate finance is allocated to climate change mitigation compared with 16 per cent for climate change adaptation

Even given the constraints of current accounting possibilities, the OECD/Climate Policy Initiative is able to estimate that 77 per cent of climate finance from developed to developing countries is allocated towards climate change mitigation objectives, compared with the 16 per cent allocated for climate change adaptation (the remaining 7 per cent is allocated for activities that target both mitigation and adaptation in combined form). These results are driven by the dominance of mobilized private climate finance which leans towards mitigation-related activities (over 90 per cent). While the financing gap between mitigation and adaptation activities is significant, the public sector is slightly more amenable than the private sector to slating climate finance flows for adaptation. This may be explained in part by the public good nature of some adaptation projects, as discussed in chapter I. The Climate Funds Update (Heinrich Böll Stiftung (HBF) and Overseas Development Institute, 2016) estimates that 81 per cent of multilateral development bank funding goes for mitigation. It also reports that OECD members channel 53 per cent of their overall climate contributions to mitigation projects (when REDD+ funds are included, this share

¹⁵ See <http://climatepolicyinitiative.org/press-release/global-climate-finance-increases-to-usd-391-billion/>.

risers to 69 per cent), while 31 per cent is directed to adaptation projects and projects that combine mitigation and adaptation efforts (ibid).¹⁶

In response to pressure from developing countries on narrowing the gap between mitigation and adaptation resources, the Green Climate Fund, established as the principle mechanism for the financing of agreements adopted by the Conference of the Parties to the United Nations Framework Convention on Climate Change, committed to directing 50 per cent of its funds to adaptation, with half of that amount going to least developed countries, small island developing States and African States—which are, as was seen in chapter I, among the countries most vulnerable to changing climate conditions. Five years after its launch, the Green Climate Fund has so far given away \$168 million to eight projects. In line with the Fund’s mandate, the majority of those eight projects include an adaptation component (Green Climate Fund, 2015).

Five years after its launch, the Green Climate Fund has given \$168 million to eight projects

Other formal acknowledgements of the gap between adaptation and mitigation financing exist at the highest level of international climate policy. In its decision 1/CP.21, the Conference of the Parties to the Convention requested the Adaptation Committee and the Least Developed Countries Expert Group, in collaboration with the Standing Committee on Finance and other relevant institutions, to make recommendations for consideration and adoption by the Conference of the Parties serving as the meeting of the parties to the Paris Agreement on the necessary steps towards facilitating the mobilization of support for adaptation in developing countries and on reviewing the adequacy and effectiveness of adaptation and support (para. 45). In addition, long-standing efforts have been directed towards responding to the special needs of least developed countries. As early as its seventh session, held at Marrakesh from 29 October to 10 November 2001, the Conference of the Parties to the Convention decided that support should be provided for the development, by the least developed countries, of national adaptation programmes of action (NAPAs), with funds from the Least Developed Countries Fund allocated to finance the preparation of the programmes of action and the implementation of the plans proposed.¹⁷ A NAPA Project Database was established and is maintained at the UNFCCC website. The Least Developed Countries Fund is currently financed at \$415 million, and it is estimated that an additional \$550 million has been raised in co-financing for the 47 projects that have been approved for funding (Heinrich, 2016).

Explaining the adaptation financing gap

The adaptation financing gap is defined by UNEP (2016, p. 2) as the difference between the costs of meeting an adaptation target and the funds available to do so. Adaptation targets are themselves subjective: the act of “adapting” implies that there is a baseline of needs that can be safeguarded within a changing climate. It is also assumed that beyond a certain level of climate change, no amount of expenditure on adaptation will be sufficient

¹⁶ Dedicated adaptation funds data are compared with those for general climate funds on the Climate Funds Update website, a joint initiative of Heinrich Böll Stiftung (HBF) and the Overseas Development Institute (ODI). REDD+ stands for countries’ efforts to reduce emissions from deforestation and forest degradation and foster conservation, sustainable management of forests, and enhancement of forest carbon stocks.

¹⁷ See FCCC/CP/2001/13/Add.1 and Corr.1 and Add.4 and Corr.1 for the relevant decisions adopted by the Conference of the Parties to the Convention at its seventh session, namely, decisions 4/CP.7, 7/CP.7 and 28/CP.7.

to maintain conditions suitable for human life, which means that the gap would be even larger. This fact, together with the priorities of high-income countries, partially explains the prioritization of mitigation activities, given that mitigation is the first and most fundamental action required in an effective response to climate change. Moreover, as noted in previous chapters, the fact that mitigation is easier to measure using common reference metrics (e.g., tons of greenhouse gases and radiative forcing values) makes it easier to estimate the resources needed for progress in mitigation compared with adaptation, which, owing to its intrinsic association with the multiple dimensions of development, is multi-metric in nature. These and other barriers to financing of adaptation projects (e.g., their public good nature and the difficulties inherent in separating adaptation investments from other development investments and therefore in creating incentives for adaptation) are discussed further below.

Given that global mean temperature is already 0.85° C above pre-industrial levels, adaptation expenditure is particularly urgent in countries where there is greater exposure and where infrastructure and health services need to be strengthened

Given that global mean temperature is already 0.85° C above pre-industrial levels, adaptation expenditure is essential for safeguarding livelihoods and human life. This is particularly urgent in countries where there is greater exposure and where infrastructure and health services need to be strengthened for coping with and recovering from climate hazards. According to the IPCC Fifth Assessment Report, existing estimates of adaptation costs range from \$70 billion to \$100 billion per year by 2050 within developing countries alone (compared with the \$25 billion spent on adaptation projects in 2015 (figure V.2)). An updated UNEP review indicates that it is highly likely that these numbers are an underestimate. The difficulty of estimating adaptation costs is explained by the significant uncertainty in future climate scenarios and the multidimensional development areas that adaptation must address if it is to be achieved. The true totality of financing needs is dependent on greenhouse gas emission levels: costs nearly double for a 4° C versus a 2° C pathway by mid-century, and higher rates of climate change across the modelled scenarios indicate exponential cost differentials (UNEP, 2016). Hence, it stands to reason that quantifying the financing gap implies identifying a moving target, in view of the uncertainties associated with climate projections (see chaps. III and IV for a discussion on the importance of including uncertainty in assessments and in the design of policy interventions). In addition, as noted in chapters I and II, adaptation requires a continuum of development policies under changing conditions which need to effect incrementally the transformations required for climate resilience.

In recognition of the fact that political processes have not kept pace with the severity and impacts revealed by climate science, developing countries and small island developing States have taken steps since 2006 to advance the adaptation agenda (alongside the mitigation agenda). As climate impacts worsened, developing countries and small island developing States negotiated effectively for the establishment of the Warsaw international mechanism for loss and damage associated with climate change impacts¹⁸ at the Conference of the Parties to the Convention at its nineteenth session, held in Warsaw from 11 to 23 November 2013. Thus, the spectrum of climate finance includes money spent on climate mitigation activities, funds allocated towards adapting and promoting resilience to climate hazards, and a relatively new tranche of funding for payouts associated with climate catastrophes which hurt those least responsible for climate change such as small island developing States and the least developed countries, which have produced historically minimal emissions levels.

¹⁸ FCCC/CP/2013/10/Add.1, decision 2/CP.19.

Adaptation needs and the need for anticipatory climate adaptation action and finance are highest in developing countries. Unfortunately, they mirror broader trends in global inequality, where those least well off have the highest level of need for anticipatory climate adaptation action and finance. The results of a recent assessment of municipal spending on climate adaptation within 10 megacities indicate that current financing trends will exacerbate inequalities. The assessment entailed calculation both of the municipal spending per capita and of that spending as a proportion of municipal gross domestic product allocated for adaptation. It was found that the spending on adaptation by developing countries as a proportion of municipal gross domestic product was less than the corresponding proportion for their developed-country counterparts: for each of the developing-country megacities studied, the proportion was approximately 0.15 per cent, except for Beijing, for which the figure was 0.33 per cent. In contrast, the corresponding figure for each of the developed-country megacities was 0.22 per cent. Further, developing-country spending per capita was significantly less than that of their developed-country counterparts (Beijing again being the exception). The study suggests that adaptation financing is driven by wealth rather than by vulnerability and that major population centres in developing and emerging economies are underserved (Georgeson and others, 2016).

Adaptation actions and financing are most needed in developing countries

Mitigation investments, and their returns, are (relatively) quantifiable

Mitigation investments are relatively easy to evaluate for effectiveness: the cost per ton of abated greenhouse gas emissions is a metric of investment effectiveness. The international carbon market established under the Kyoto Protocol to the United Nations Framework Convention on Climate Change¹⁹ has created a method for translating greenhouse gas mitigation efforts into carbon offset credits, which can be traded and sold on various internationally regulated and voluntary markets. Under the Paris Agreement, a future role is explicitly nominated for market instruments in the 2020 climate regime, indicating a likely long-term upward trend in utilizing market mechanisms to integrate climate action into the global economy.

Beyond the establishment of carbon markets and its status as a global public good, mitigating climate change is increasingly becoming a feasible business proposition on its own. According to one estimate, 93 per cent of the \$391 billion in total global climate finance in 2014 was directed towards mitigation projects, of which the vast proportion (81 per cent) went for investments in renewable energy (Climate Policy Initiative, 2015). Technical innovations aimed at increasing the efficiency and diversifying the supply of energy make sound business sense under any climate scenario. Admittedly, part of the reason why investments in renewable energy make up such a large share of climate finance is the lack of data on private investments beyond this sector (ibid.).

An estimated 93 per cent of the \$391 billion in global climate finance in 2014 was directed towards mitigation projects, with the vast proportion for investments in renewable energy

The Paris Agreement makes the clear business case to the private sector that investments in a green economy will pay off (Krauss and Bradsher, 2015). In order to invest, private investors need “long, loud, and legal” policy to reduce their investment risk (Hamilton, 2009). Further, the Addis Ababa Action Agenda, which sets the framework for financing for development for the next 15 years, calls for the rationalization of fossil fuel subsidies, as one of many measures for mobilizing financing for sustainable development.

¹⁹ United Nations, *Treaty Series*, vol. 2303, No. 30822.

Barriers to adaptation finance

Explanations for the existence of the adaptation financing gap are wide-ranging, but most analyses tend to target one of four characteristics of adaptation project design.

Public, local good nature of adaptation projects

Adaptation investments often benefit a local group, without actually producing an economic profit. For example, the Adaptation Fund is financing a project on ecosystem-based adaptation to climate change in Seychelles, which enhances the region's ability to store adequate water in dry seasons. Climate change has resulted in more net annual precipitation than expected (historically speaking), but the rainfall is intermittent and Seychelles lacks storage capacity to retain the water. The ecosystem-based adaptation employed by the project essentially entails a concerted effort to restore wetlands, support natural coastal processes and maintain the watershed systems so that Seychelles is able to achieve its maximum water storage capacity even with intermittent inflows. The United Nations Development Programme (UNDP) is implementing the project with an incremental grant which will total \$6,455,750; further, the projected benefits for the poor and vulnerable justify the use of public funds (UNDP, 2011).

The complexity of quantifying adaptation impacts

Economic gains can often be derived from an adaptation project, but quantifying and attributing those gains make for a complex undertaking

While economic gains are often to be derived from an adaptation project, quantifying and attributing those gains in terms of a payout to an individual organization can make for a highly complex undertaking. For example, the World Health Organization (WHO) reports that China has the highest rate of cerebro-cardiovascular disease and respiratory illness in the world and that labour-related losses and associated health-care costs are above \$2,500 million annually. Heat waves cause an increase in the incidence of those types of illnesses. Vulnerable population groups such as seniors and infants—whose members are also the least equipped to advocate for themselves—are particularly at risk for serious injury or death in a heat wave, at a level that is 2-3 times above the normal (Ebi, 2015) (see chap. II for a more detailed discussion of these types of exposure and vulnerability).

Following record-breaking summer temperatures in China in 1988, 1990, 1994, 1998, 1999 and 2002-2008, WHO, the Institute for Environmental Health and Related Product Safety (Beijing), the Centers for Disease Control and Prevention (CDC) China and UNDP decided to implement an early warning system designed to predict heat waves and provide guidance on mounting a coordinated response through preparing and educating vulnerable populations. While the need for enhanced information and improved preparation in responding to heat waves remains beyond dispute, quantifying or attributing benefits from the project to a specific implementation organization or individual is all but impossible.

Lack of an operational definition of adaptation

That there is no internationally agreed process for identifying what constitutes an adaptation project renders it difficult to catalogue potential adaptation activities and estimate the cost of investment in those activities: investment in adaptation remains identified and priced on a case-by-case basis (Barbier, 2015). IPCC (2007) defines adaptation as “adjustment in natural or human systems in response to actual or expected climatic stimuli or their

effects, which moderates harm or exploits beneficial opportunities”. The all-encompassing nature of this definition accords with the fact that adaptation project outcomes are highly varied. As with financing development projects more generally, the goals are specific to local needs at the point of implementation. Any outcome (economic, environmental, social) that increases people’s options and resources for adapting to crises can potentially qualify as a metric for project success. This being the case, wide room is left for interpretation, which increases the difficulty of comparing adaptation outcomes across a portfolio of projects.

The difficulty of separating adaptation investment from other forms of development investment

Separating adaptation finance from development assistance is a complex and often subjective exercise (Abadie, Galarraga and Rübhelke, 2012). In order to achieve the IPCC goal of implementing “no-regret policies”, any development project should be able to integrate climate-adaptation components. On the other hand, if they are effectively integrated within all sectors of development, adaptation activities become all the more difficult to track. Efforts to mitigate climate change through reducing emissions from deforestation and forest degradation (REDD), which include adaptation components, provide an illustrative example. Such projects often include rehabilitating riparian zones, increasing forest diversity, incorporating fruit- and nut-bearing trees into a forested area for sustainable crop cycles, and other types of enhanced forest management which both increase the forest’s ability to serve a region sustainably as a carbon sink and to act as a natural buffer against heat waves and floods. Given the difficulty of separating adaptation and mitigation activities, the need for policy coherence and the mainstreaming of adaptation with other development priorities and interventions becomes more salient (see chap. IV).

Similarly, investments in infrastructure may include an energy-efficiency component which could be considered an adaptation investment; and improvements to water storage and management systems will, arguably, almost always yield a benefit for climate change adaptation as well (Christiansen, Olhoff and Traerup, 2011). The amount of the investment in adaptation in all of these situations is based on a subjective calculation and, as a secondary objective, adaptation may even be excluded from the project developer’s initial calculations.

In the lead-up to the twenty-first session of the Conference of the Parties to the Convention, the six large multilateral development banks and the International Development Finance Club adopted Common Principles for Climate Change Adaptation Finance Tracking, in a coordinated effort to establish harmonized definitions of adaptation finance for the purpose of achieving better accounting, transparency and accountability.²⁰ In support of this, OECD is undertaking efforts to fine-tune its Rio marker definitions to reflect the criteria established by the Common Principles, indicating some degree of convergence and standardization which will certainly benefit both donors and developing countries in their adaptation efforts.

Implications for adaptation

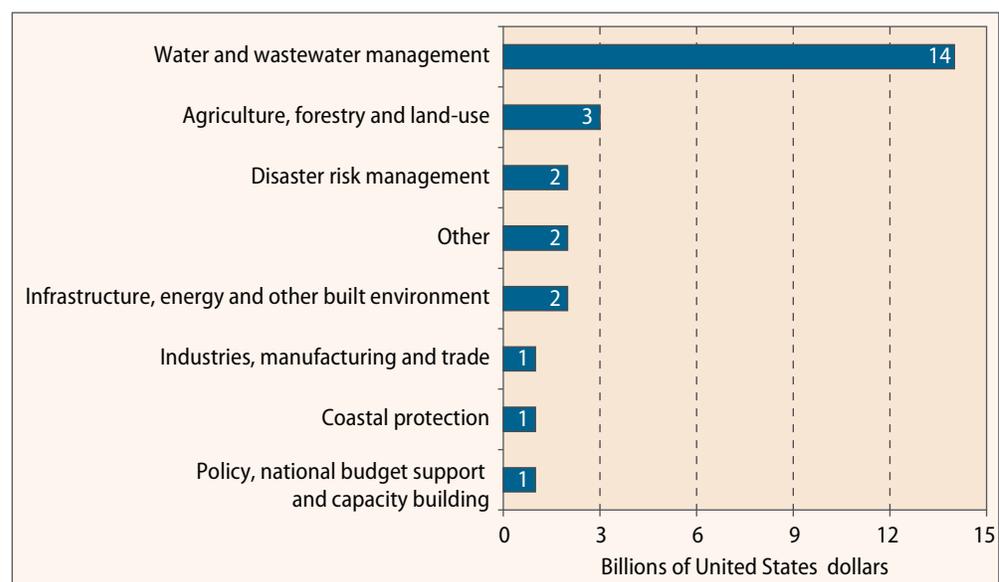
The barriers to increasing the financial resources available for adaptation are daunting, but they are not insurmountable nor do they affect all sectors of adaptation activities equally.

Adaptation and mitigation activities require coherence for effective policy implementation

²⁰ See <http://pubdocs.worldbank.org/en/222771436376720470/010-gcc-mdb-idfc-adaptation-common-principles.pdf>.

For example, the assessment by the Climate Policy Initiative of adaptation financing indicates that of the \$25 billion allocated to adaptation in 2014, \$14 billion in spending went towards water and wastewater management. The next largest sector, agriculture, forestry and land use, received just \$3 billion (figure V.3). This discrepancy in funding is worth investigating—that is to say, why is water management more appealing to donors/investors than other adaptation activities? The initial indication is that water-related management often includes a technical component, one that can be commercially viable for entrepreneurs and corporate interests. Furthermore, activities within the water sector are easily identifiable as “climate change adaptation” activities, whereas projects that enhance climate change resilience in land use and the energy sector are likely counted as mitigation activities.

Figure V.3
Total adaptation finance by sector, 2014



Source: Adapted from Climate Policy Initiative (2015).

Overcoming barriers: policy scenarios for scaling up adaptation finance

Adaptation financing requires more resources from the public sector

Climate-resilient investments, such as in coastal protection efforts and other forms of disaster risk management, are often characterized by steep upfront costs, long investment timelines and low private returns to investment, making them prime candidates for public funds. There are some adaptation measures—the introduction and dissemination, for example, of adaptation technologies such as those involving drought-resistant seeds and solar-powered cooling systems for the home that expand access to electricity by reducing dependency on electrical grids while also reducing emissions—that align themselves well with business interests. However, in practice, kick-starting such adaptation measures requires a boost from the public sector. This being the case, the focus of the first policy scenario for increasing adaptation financing should simply be: more resources from the public sector.

Yet, no matter how active the public sector might be in the field of adaptation, participation of all levels of this sector is required to meet the scale of the adaptation challenge and should range from private financial institutions to small-scale entrepreneurs. Three major types of policy interventions can help in redesigning the landscape of adaptation financing prospects so as to render it more hospitable to private interests.

International and donor-level initiatives

The international agreement achieved at the twenty-first session of the Conference of the Parties to the Convention indicates that a coherent and coordinated international climate regime will exist far beyond 2020. Hence, the potential for establishing international policy leadership for the improvement of adaptation-related financial flows is high. Indeed, a clear example of regulatory action designed to increase funding for adaptation is provided by the Green Climate Fund, which is mandated to allocate 50 per cent of its funds towards adaptation.

Government regulation, in addition to effecting the direct financing of adaptation efforts, can also play a deciding role in the leveraging of private finance for adaptation measures. For example, the European Union Water Framework Directive²¹ imposes legally binding requirements with respect to adaptation-relevant investments on private sector actors engaged in water-related development efforts.

Regulation can also create markets from the ground up, as was the case with the flexible market mechanisms for greenhouse gas emissions under the Kyoto Protocol. As noted above, the Paris Agreement promises an enhanced role for utilization of market mechanisms for payment of environmental services; and the next generation of market tools for sustainable development could make adaptation deliverables a focus (Persson, 2011).

Government regulation can also play a deciding role in the leveraging of private finance for adaptation measures

International and developed-country support for enabling institutions

International and national government intervention plays a pivotal role in transforming adaptation investment barriers into private sector opportunities (Dzebo and Pauw, 2015). For example, investments in infrastructure and early warning systems must precede the delivery of some adaptation measures such as improved crop distribution, enhanced delivery of medical services during a heat wave and rapid response to extreme weather events. It would be impossible for the private sector to implement crop insurance systems without there being weather monitoring stations in operation; however, the act of setting up such stations historically falls within the purview of the public sector.

International and national development banks are capable of reducing adaptation activities-related risk and leveraging large amounts of private sector financing. In recent years, development banks have facilitated increased levels of participation of the private sector in financing their adaptation portfolios (Climate Policy Initiative, 2015).

Targeted domestic policy incentives

Developing countries can catalyse private investment for specific adaptation interventions, e.g., by reducing import tariffs on adaptation-friendly technologies and equipment, such as irrigation systems. In addition to providing incentives, Governments can regulate private sector participation in sustainable environmental practices that support adaptation.

²¹ Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy, adopted on 23 October 2000.

Regulation need not be punitive over the long term, particularly if it includes feedback mechanisms that ultimately protect a sustainable resource base. Payment-for-ecosystem services schemes which generate revenue and then redistribute that revenue to vulnerable populations constitute one example of regulatory measures that provide incentives to protect natural resources. National authorities are favourably positioned to implement “benefit transfer” and “Nexus approach” solutions, terms that speak to a policy’s ability to distribute gains throughout a community and to simultaneously consider multiple priority areas (such as water, food security, energy and health).²²

Data and statistics for climate resilience

Improved capacities for producing and using complex sources of information to monitor progress towards climate-resilient development is imperative

The need to generate large, stable sources of financing for climate-resilient development is an issue that without doubt ranks high in the international agenda. A second focus of international attention is the imperative need to improve capacities for producing and using the large and complex sources of information required to monitor progress towards achieving climate-resilient development.

Pursuant to the adoption of the 2030 Agenda for Sustainable Development, the international community has turned its attention towards identifying the indicators that will support the follow-up and review of the 17 Sustainable Development Goals and 169 targets set therein. At its forty-sixth session, held from 3 to 6 March 2015, the Statistical Commission endorsed the formation of the Inter-agency and Expert Group on Sustainable Development Goal Indicators, which consists of 28 representatives of national statistical offices and includes, as observers, representatives of regional commissions and regional and international agencies.²³ The Inter-Agency and Expert Group was tasked to develop an indicator framework for the goals and targets under the 2030 Agenda for Sustainable Development at the global level. At its forty-seventh session, held from 8 to 11 March 2016, the Commission agreed on a global indicator framework for monitoring progress towards achieving the Sustainable Development Goals, which includes 230 global indicators, as proposed by the Inter-Agency and Expert Group.²⁴ It is a framework intended for follow-up and review of progress at the global level towards achieving the 17 Sustainable Development Goals. The Inter-agency and Expert Group will continue its technical work on reviewing and refining the indicators, as needed, and on further developing the methodologies for estimation, also as needed.

Meeting the new demands for data under the sustainable development agenda is a highly challenging task, which requires greater harmonization and integration among a wide range of data programmes across the economic, social and environmental domains, as well as improved analytical capacities for understanding the meaning of the intersections that occur across a multiplicity of disciplines. The present section discusses, within this larger framework, the challenge of producing the statistics and indicators required by

²² For more details on the Water-Energy-Food Security Nexus approach, see chap. III.

²³ See the report of the Statistical Commission on its forty-sixth session (*Official Records of the Economic and Social Council, 2015, Supplement No. 4 (E/2015/24)*), chap. I, sect. C, decision 46/101.

²⁴ See the report of the Statistical Commission on its forty-seventh session (*Official Records of the Economic and Social Council, 2016, Supplement No. 4 (E/2016/24)*), chap. I, sect. B, decision 47/101. See also the report of the Inter-Agency and Expert Group on Sustainable Development Goal indicators (E/CN.3/2016/2/Rev.1), in particular annex IV containing the final list of proposed Sustainable Development Goal indicators.

countries to identify population groups vulnerable to climate hazards, including through the use of the integrated assessments needed to inform policymakers (see chap. III).

International cooperation on the development of data and statistics needed to implement the 2030 Agenda builds on the experience of successful cooperation over the last 15 years. Implementation of the Millennium Development Goals agenda brought international attention and resources to bear on improving the methodologies and information systems that supported Millennium Development Goal monitoring and policy implementation. The Millennium Development Goals Report 2015, while confirming that there have been significant improvements in country coverage of core human development indicators, also recognizes that large gaps remain in respect of ensuring the quality and timely availability of data, including data disaggregated by geographical region, ethnicity, disability and other socioeconomic attributes, which are critical to the understanding of inequalities and vulnerability.

Erecting the statistical architecture that will help identify population groups vulnerable to climate hazards is a challenge in its own right, but it is even more of a challenge considering the gaps remaining in basic statistics. A World Bank study cited in *The Millennium Development Goals Report 2015* found that almost half of 155 countries examined lacked adequate data for monitoring poverty. And in sub-Saharan Africa, where poverty is most severe, 61 per cent of countries lacked data for monitoring poverty trends. Vital statistics disaggregated by geographical region, ethnicity, disability and other characteristics are also lacking. Overall, in spite of progress made in the last 15 years, systematic statistics are lacking on the size, geographical distribution and characteristics of vulnerable populations in developing regions. Such statistics, produced on a regular and coordinated basis, are essential for monitoring populations at risk and informing integrated climate impact assessments.

Missing data on vulnerable population groups

Public perceptions of climate change are largely conditioned by extreme events and the resulting disasters, whether or not they can be individually linked to climate change. In the case of weather events, for example, linkage is difficult to establish but there is currently considerable progress being made in attribution research (Cornwall, 2016; Solow, 2015). The international definition of disaster for statistical purposes has been established by the International Federation of Red Cross and Red Crescent Societies, in cooperation with the Centre for Research on the Epidemiology of Disasters (CRED) based in Louvain, Belgium. A “common accord” classification of disasters for operational purposes was published by CRED and the Munich Reinsurance Company (Munich RE) in 2009 (Below, Wirtz and Guha-Sapir, 2009). By compiling and analysing extensive data from its EM-DAT/International Disasters Database covering the period 2005-2014, CRED was able to prepare tables on disasters for the *World Disasters Report 2015* (International Federation of Red Cross and Red Crescent Societies, 2015) presenting data by number, continent, phenomenon, numbers of people reported killed and affected, estimated damage and level of human development of the countries of occurrence.

The rural populations of the poorer developing countries in low-elevation coastal areas and deltas, including small island developing States, and people living in drylands and in mountainous and other remote areas, seem generally to be the populations most vulnerable to climate change. As noted in chapter I, those populations predominantly and

The Millennium Development Goals helped improve country coverage of human development indicators, but large gaps remain

more specifically include small-scale agricultural, pastoral, fishing and forest households and workers, who depend mainly on their own production for basic food security, water supply and housing and whose livelihoods are centred around climate-sensitive resources. These populations have been studied by the Food and Agriculture Organization of the United Nations (FAO) (2010; 2015a; 2016a) and the International Food Policy Research Institute (IFPRI) (Reij, Tappan and Smale, 2009; Spielman and Pandya-Lorch, 2009), but the data compiled have been limited. More generally, even though “three out of four poor people in developing countries live in rural areas...over the last two decades the quantity and quality of agricultural statistics have undergone a serious decline” and “(m)any countries, especially in the developing world, lack the capacity to produce and report even the minimum set of agricultural statistics required to monitor national trends” (FAO, World Bank and United Nations Statistical Commission, 2012, p. XI).

In addition, “(r)apid urbanization and the growth of megacities...have led to the emergence of highly vulnerable urban communities, particularly through informal settlements and inadequate land management”, with vulnerable populations also including “refugees, internally displaced people, and those living in marginal areas” (IPCC, 2012, p. 8). These important factors relate to the mega-trends discussed in chapter I of this *Survey*, where the point was clearly made that those trends interact closely with climate change.

While much progress has been made in the production of the basic statistics needed to capture the impact of extreme climate hazards, as reported in chapter I, the statistics available on the basic characteristics of vulnerable population groups remain rough estimates. There are no systematic data available on the size of the population groups most vulnerable to climate hazards, including on their demographic characteristics and their livelihoods. The acquisition of a better understanding of the impact of climate hazards and policies effective in reducing people’s vulnerability to them, for example, through the integrated climate impact assessments discussed in chapter III and other methodologies, urgently requires well-established information systems, based on systematic information derived from standardized data-collection processes (CRED, 2015).

There are no systematic data on the size of the population groups most vulnerable to climate hazards, including their demographic characteristics and livelihoods

Improving statistics and indicators for addressing climate change vulnerability

In every area of data analysis on populations vulnerable to climate hazards, researchers have cited critical gaps in data sources and methods as impediments to compilation of reliable data series consistent over time and comparable across domains of research. While there are a large number of research projects and ongoing analysis focused on the wide range of topics related to the impact of climate change, the data sources generated by those projects, albeit useful for meeting the specific research objectives of those projects, do not, taken all together, offer complete systematic information on vulnerable populations. This patchwork of information on vulnerable populations, including indicators, derived from the results of those projects has gaps and possesses very limited geographical detail, frequency and continuity.

As the process of producing reliable and continuous statistics and indicators on the impact of climate hazards is at an early stage of its development, it requires considerable additional research, practical testing and development of capacities through advanced training on basic data sources and methods of compilation of statistics related to several fields including, among many others, hydrology, fisheries, forests and ecology, along

International organizations can play a key role in development of guidelines and recommendations on how to improve data availability through coordinated technical cooperation

with reliable disaggregated sociodemographic information. International organizations with responsibilities in those fields can play a key role through development of guidelines and recommendations and through partnerships, provision of training materials on methods and coordinated technical cooperation. For example, the Statistics Division of the Department of Economic and Social Affairs of the United Nations, in response to increased demands for climate change statistics and indicators, prepared, in collaboration with the Economic Commission for Europe (ECE), the report of the Secretary-General on climate change statistics, for submission to the Statistical Commission at its forty-seventh session (United Nations, Economic and Social Council, Statistical Commission, 2015).²⁵ In decision 47/112, adopted at its forty-seventh session on 11 March 2016 (see E/2016/24, chap. I, sect. B), the Commission requested the Statistics Division to review the set of climate change-related statistics and indicators being developed by ECE and to consider it as a basis for developing a global set of climate change statistics and indicators, applicable to countries at various stages of development (para. (h)).²⁶

Harmonization and integration of data sources, concepts and methods

Basic data in countries, developed according to national circumstances and priorities, provide the foundation for indicator compilation, in particular for rural and urban populations susceptible to climate change impacts. As noted, population groups particularly vulnerable to climate hazards, as identified in this *Survey* (i.e., people in low-elevation coastal zones, floodplains, deltas, dryland zones, and mountainous and remote areas), are largely rural and rely to a great extent on subsistence production for food security, energy, water and sanitation, and shelter. Further, climate change impacts stemming from rising sea levels and extreme temperature events are compounded by pressures stemming from population growth, rapid urbanization, water shortages and pollution.

Basic planning to enable anticipation of and adaptation to climate change impacts requires basic indicators on populations in vulnerable zones, which meet international criteria for standardized sources and methods, frequency and continuity and are easy to understand. Much of the information available thus far is derived from the work of those in academia and specialized researchers and has been prepared through the use of varied and often inconsistent concepts, methods and classifications. This work covers only periods of a few years and the years chosen differ among researchers. The research does provide a basic foundation for continuing work on concepts and methods, and for benchmark approximations. However, the data and information underpinning the research must, for official monitoring and policy purposes, become part of official national and international programmes, compiled and issued on a regular basis by or in association with official specialized services. Consequently, harmonization and integration are required among a wide range of data programmes, including official statistics of populations and their main characteristics and distribution by ecozones and by urban/rural, and extensive data on water and oceans and weather. Such statistics—with indicators to be specified within the technical context of the Sustainable Development Goals indicators programme—and produced on a regular, internally consistent and coordinated basis—are essential for

Harmonization and integration among a wide range of data programmes, including official statistics of population and its main characteristics, are needed

²⁵ Available at <http://unstats.un.org/unsd/statcom/47th-session/documents/2016-15-Climate-change-statistics-E.pdf>.

²⁶ Available at <http://unstats.un.org/unsd/statcom/47th-session/documents/Report-on-the-47th-session-of-the-statistical-commission-E.pdf>.

routine monitoring of populations at risk and for supporting assessments of policy options for addressing exposure, impact and adaptation at national, subnational and local levels.

The need to harmonize and integrate the variety of data sources through common concepts and methodologies has been well recognized. Recommendations have been endorsed under the Sendai Framework for Disaster Risk Reduction 2015-2030²⁷ on the need to establish international standards and harmonize definitions and classifications relating to vulnerable ecozones and regions and their vulnerabilities in and among countries. Also important is the need to ensure the capacity to “layer” detailed data on population and population characteristics, including occupation, urban/rural area of residence and poverty levels in small administrative areas so that population can be placed in the appropriate geographical ecozones and regions. The development of these data requires greater efforts to establish national capacity to compile time series on vulnerable populations from national and international sources.

Based on current information, it is difficult to assess populations at risk. In his study of coastal populations, for example, Woodroffe (2010) argues that “the population data are not at sufficient resolution for detailed hazard analysis” and that “(s)uch vulnerability analyses should be focused on detailed local topography and integration with other variables such as flood level, land use, and other relevant factors”. Specifically with respect to the “poorest and hungry”, a study issued by IFPRI (Ahmed, Hill and Wiesmann, 2007) concluded that “without context-specific and timely information it is *difficult* to design programs that fit their needs”. On a limited scale, FAO (2015a) reported on two case studies, in Ecuador and Malawi, where vulnerability of mountain peoples to food insecurity was assessed from household surveys specifically designed to verify the results obtained in a modelling exercise. This kind of information could be obtained at a much greater scale if geo-referenced households were available for all countries.

Official national statistics including geospatial information are critical to the production of integrated data series

Interfacing data sources, especially official national statistics containing global geospatial information, is needed critically for the production of integrated data series, which must rely on substantially different collection methods. An illustration of the difficulties involved is provided in the case of compilation of water statistics in the United States of America. Currently, comprehensive and detailed national statistics on water are compiled every five years, but cover information for only one year, as they must be derived from hundreds of independent entities, with their own mandates and responsibilities, which use a multiplicity of concepts, methods and microdata sources (Fishman, 2016). In the Seoul Declaration on Global Geospatial Information Management issued at the first High-level Forum on Global Geospatial Information Management, held in Seoul from 24 to 26 October 2011, Forum participants recognized “the need for full interoperability of multidimensional geospatial information and integration with other data sources at national, regional, and global levels, in order to provide an effective information base for the resolution of global and local issues”.

Complex statistical sources and methods, notably population censuses and surveys, are indeed widely used in all countries to measure population, and its social and economic characteristics and growth, and for regional and international comparisons and analyses. However, in general, they cannot be integrated easily with the wide variety of sources and methods used for linking geospatial measurement and environmental conditions. This is

²⁷ Adopted by the Third World Conference on Disaster Risk Reduction, held in Sendai City, Miyagi Prefecture, Japan, from 14 to 18 March 2015, and endorsed by the General Assembly in its resolution 69/283 of 3 June 2015, and contained in annex II of that resolution.

due, among many other factors, to incompatible definitions and classifications for, e.g., subnational administrative boundaries and ecozones, and for geospatial identification of large cities and other urban and rural areas, and the varying and irregular time periods covered. Intensive collaboration among data producers across a range of disciplines, including water management, ecology, agronomy, forestry, meteorology and demography, is essential for establishing officially recognized and compatible guidelines and recommendations.

Geospatial information for building climate resilience

Geospatial information is a powerful tool for exhibiting the interconnections among land, oceans, atmosphere and human activities; it supports the development of plausible climate change scenarios and their impact on specific geographical locations. To the extent that geospatial information originates mainly from satellite observations, making it available to developing countries—especially those in special situations (i.e., least developed countries, landlocked developing countries and small island developing States), which are the most vulnerable to the impact of climate hazards—requires strong mechanisms of international cooperation and capacity development.

Through the use of geospatial information, for example, it is possible to assess the adverse impact of climate change due to sea-level rise along the coasts of small island developing States. Geospatial information includes profiles of the land, natural hazards, exposure of livelihoods and the location of vulnerable populations (United Nations, Economic and Social Council, Statistical Commission, 2015). Remote monitoring of the Earth by satellite can provide crucial data on deforestation and crop patterns which may indicate potential food shortages, and early warning on climate hazards (United Nations, Economic Commission for Latin America and the Caribbean, and European Union, 2011).

The Committee of Experts on Global Geospatial Information Management²⁸ is the intergovernmental mechanism that has been established to set the direction for the production and use of geospatial information within national and global policy frameworks. International cooperation on satellite imagery, in particular, has already supported capacity development efforts in different countries. For example, in Thailand, regional cooperation for sharing satellite data and survey measures of poverty levels, together with local placement rules for protected green areas, had a positive impact on reforestation, consumption and poverty reduction. The intervention also increased local revenues from ecotourism (Greenstone and Jack, 2015). Along similar lines, in a study by Scaria and Vijayan (2012) of India, the importance was underscored of international cooperation on spatial information technology for the country's rural development, including delivery of reliable baseline information on natural resources at the regional and micro levels, together with support for an integrated analysis of the natural resources inventory and management as well as a strategic plan for sustainable rural development.

While geospatial information is used in some developing countries, additional international cooperation is needed to expand timely access to information; to build the computation and storage capacity in those countries; and to strengthen technical capacity for using this technology effectively in supporting quantitative and qualitative assessments which inform policy decisions on climate-resilient development.

There are a number of public-private partnership initiatives to build from, including those being undertaken at the African Climate Policy Centre and the International

Making geospatial information available to developing countries requires strong mechanisms of international cooperation and capacity development

²⁸ See ggim.un.org.

Research Institute for Climate and Society at Columbia University, New York City, which are linking climate satellite information with demographics in order to build vulnerability maps that layer physical and social sources of vulnerability. Other successful partnerships reveal the potential for strengthening collaboration among international organizations, large data providers and national Governments, as illustrated in box V.I with respect to the improved monitoring of forests in tropical countries. Information and expertise, are still disseminated, however, in multiple centres with limited coordination and harmonization of concepts and data-collection processes.

Strengthened collaboration across disciplines and across borders

Institutional experience and capacity to monitor climate change and impacts in exposed populations are dispersed across Governments and international organizations

Institutional experience, capacity and responsibility for the statistics needed to monitor and analyse climate change, exposed populations and impact are widely dispersed across Governments and international organizations and their collaborating institutions, as well as among and within governments; and frequently, there is little communication among the different specialties. In the developing regions, only a few Governments have adequate capacities for the needed data collection and analysis; and often, they continue to lack strong mechanisms for essential national and international collaboration in many instances.

Box V.1

Monitoring of forests in tropical countries

The experience of monitoring forests in tropical countries offers an illustration of effective multilateral cooperation in support of national capacity development efforts and resilience-building. The monitoring of forest cover and forest functions provides information crucial to the sustainable protection and management of forests, which is particularly important for tropical countries and populations whose livelihoods depend on forests. National forest monitoring systems estimate forest coverage, forest cover change and carbon stock change.

Romijn and others (2015) assessed the status of and changes in national forest monitoring and reporting capacities in 99 tropical countries using FAO Global Forest Resources Assessment data for 2015, complemented by data for 2010 and 2005 (FAO, 2016a). Forest area change monitoring and remote sensing capacities improved considerably between 2005 and 2015. For 54 of the 99 countries, the total tropical forest area that was monitored with good forest area change monitoring and remote sensing capacities increased from 69 per cent (1,435 million hectares) in 2005 to 83 per cent (1,699 million hectares) in 2015). This positive development has been the result of effective use of internationally free and open-source high-resolution satellite (remote sensing) data such as Landsat and of other available techniques for assessing historical forest cover change and improving countries' national forest monitoring.

Moreover, the total tropical forest area that was monitored with good "forest inventory capacities" increased for 40 countries, from 38 per cent (785 million hectares) in 2005 to 66 per cent (1,350 million hectares) in 2015. That "carbon pool reporting capacities" did not display as much improvement indicates the need for greater support for production of accurate emission factors and improved greenhouse gas reporting. The study also revealed that there was a positive adjustment in the net change in forest area in cases where countries with lower capacities had had the tendency in the past to overestimate areas of forest loss. The results underlined the effectiveness of capacity-building programmes such as those led by FAO and the multi-lateral initiative REDD+, which rewards developing countries financially for their verified efforts to reduce emissions and enhance removals of greenhouse gases through a variety of forest management options.^a

Source: UN/DESA, based on Romijn and others (2015).

^a REDD+ is a set of guidelines established for developing countries on how to report on forest resources and forest management strategies and their results in terms of reducing emissions and enhancing removal of greenhouse gases. See also footnote 16 above.

Few among the least developed countries, landlocked developing countries, small island developing States and other countries in special situations, such as conflicts, have such capacities.

These challenges are being taken up by the Statistical Commission and the Statistics Division, FAO, UNEP, the United Nations Office for Disaster Risk Reduction, the World Bank, the World Water Assessment Programme and the International Federation of Red Cross and Red Crescent Societies, and under the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa.²⁹ Specific programmes supported by international organizations, including the Partnership in Statistics for Development in the 21st Century (PARIS21), bilateral technical assistance and data development programmes and non-governmental organizations such as Open Data Watch,³⁰ are also making an important contribution to the strengthening of the statistical capacity of countries in need. Box V.II provides examples of significant global and regional experiences within the framework of emerging new mechanisms for data sharing. However, policies designed to build resilience across the wide range of vulnerable population groups requires unprecedented levels of new forms of data development, integration and analysis to support the demanding goal of achieving sustainable development in a context of continuous population growth, rapid urbanization and climate change.

Systematic official statistics, for all countries, are needed at least in the areas listed below (the names of the international institutions that bear responsibility for the development of those statistics in each area are given in parentheses):

- a. Population and demography, including income, occupation and poverty, education and health (Statistics Division and Population Division, both of the Department of Economic and Social Affairs of the United Nations; the International Labour Organization (ILO); the United Nations Children's Fund (UNICEF); the United Nations Educational, Scientific and Cultural Organization (UNESCO); the World Bank; and WHO);
- b. Economic activity in agriculture, fishing and forestry (Statistics Division, FAO and ILO);
- c. Cartography and geographic information systems (Statistics Division, Committee of Experts on Global Geospatial Information Management, FAO and UNEP);
- d. Meteorology (World Meteorological Organization);
- e. Geology and land use, hydrology and ecology (Statistics Division and FAO);
- f. Disasters (United Nations Office for Disaster Risk Reduction, International Federation of Red Cross and Red Crescent Societies and national emergency management offices).

Foundations for partnerships going forward

This chapter has discussed two critical areas where international cooperation for climate resilience needs to be strengthened. International cooperation is needed to generate stable and large sources of financing for climate-resilient development. At the same time, it is

²⁹ United Nations, *Treaty Series*, vol. 1954, No. 33480.

³⁰ See opendatawatch.org.

Box V.2

International cooperation efforts towards data sharing

Various public and private organizations are developing new partnerships to facilitate data sharing, with different degrees of open access. The Megacities Carbon Project, for example, is developing and testing methods for monitoring greenhouse gas emissions from megacities and their impact on people. The project, which operates under the principle of open and transparent data sharing, encompasses collaborative research of several partners. It is anticipated that the Los Angeles component of the data portal will be ready for public access in 2016. The Los Angeles component of the project is jointly funded by the US National Institute of Standards and Technology (NIST), the National Aeronautics and Space Administration (NASA), the National Oceanographic and Atmospheric Administration (NOAA) and the Keck Institute for Space Studies (KISS). The California Air Resources Board and the University of California Discovery programme provide in-kind contributions.

Along similar lines, the Open Data for Africa platform portal, created by the African Development Bank under its statistical capacity-building programme, provides free online data for monitoring development indicators at national and subnational levels. The portal provides data derived from national, international and other sources. Users can disseminate data and share data content directly with others through social media. All African countries and nine regional institutions contribute to this platform, which also offers data users the capability to access data in machine-readable format under Statistical Data and Metadata eXchange (SDMX) standards.^a The African Development Bank and the International Monetary Fund (IMF) have partnered to standardize and streamline the data submission process through a leveraging of the platform across different agencies (e.g., national statistical offices, central banks and ministries of finance) in all African countries.

The Africa Platform for Knowledge and Data Sharing on Earth Observation disseminates free maps, geographic information system (GIS) data sets and satellite images to assist in the monitoring and management of natural resources and agriculture.

Sources: African Development Bank Group (2011); and Megacities Project website (<https://megacities.jpl.nasa.gov/portal/collection-network/>).

^a SDMX is an initiative sponsored by seven international organizations aimed at developing standards for the exchange of statistical information. These organizations are the Bank for International Settlements (BIS), the European Central Bank, the Statistical Office of the European Union (EUROSTAT), IMF, OECD, the United Nations and the World Bank.

Increased funding from public domestic and international efforts are required to fill the gap in areas in which the private sector is unlikely to invest

imperative that the capacities be strengthened for developing and using the large and complex sources of information and data needed to guide policymaking for climate resilience.

Given that many adaptation efforts, such as the creation of levies and the installation of weather monitoring systems, support the public good, there is a strong case to be made for support from the public sector. Increased funds from public domestic and international efforts are required to fill the gap in areas in which the private sector is unlikely to invest adequately, in particular in projects aimed at the most marginalized areas and population groups. Adaptation efforts are successful only when they integrate the needs of the disenfranchised into a given policy's central goals and are responsive to the existence of inequalities that determine exposure and vulnerability (see chap. I). While in some cases (such as that of philanthropy), the private sector will aim for redistributive outcomes, in most, an adaptation agenda will require public funding.

Notwithstanding, the private sector does have a wider role to play; and in order to support private sector participation, public institutions can create enabling environments for the transformation of some of the challenges associated with adaptation financing into economic possibilities for the private sector. And what does the creation of such enabling environments entail? As noted in this chapter, the vigorous participation of national and

international public agencies is a prerequisite for success. In addition, creating incentives for private sector participation may help catalyse and redirect private sector support.

This chapter's exploration of the adaptation financing landscape indicates that there is no single, universal adaptation measure which is applicable to every context and every financing structure. This insight can be of particular use to policymakers in helping them direct limited adaptation funds to the areas of greatest need, while allowing other types of adaptation (e.g., improved seed dissemination and improved irrigation technologies) to reach scale in relation to the policy levers discussed above. Clearly, careful assessments of the different policy options most suitable to the areas of highest need are a necessity.

To respond to this challenge, the Third International Conference on Financing for Development adopted the Addis Ababa Action Agenda. Heads of State and Government and High Representatives, who gathered for the Conference in Addis Ababa from 13 to 16 July 2015, committed to the realigning of financial flows with public goals, the drawing upon all sources of finance, technology and innovation, the promotion of trade and debt sustainability, the harnessing of data and the addressing of systemic issues. The Addis Ababa Action Agenda, which establishes a strong foundation for support of the implementation of the 2030 Agenda for Sustainable Development, provides:

- A comprehensive set of policy actions aimed at financing sustainable development, transforming the global economy and achieving the Sustainable Development Goals
- A framework for financing sustainable development which aligns all financing flows and policies with economic, social and environmental priorities and ensures that financing is stable and sustainable

Mobilization of public and private sector action to build resilience and adaptive capacity will also entail meeting the challenge of identifying those vulnerable to climate hazards, understanding the risk they incur, and monitoring the effect of interventions in reducing that vulnerability. The level of complexity associated with the production of the consistent statistics needed to achieve this is much higher than that associated with efforts to strengthen the human development statistics required to reach the Millennium Development Goals. Production of statistics on the impact of climate hazards requires the development of consistent concepts and classifications as a component of official national and international programmes for the establishment of officially recognized and compatible guidelines. Understanding the interlinkages between vulnerability and climate hazards requires intensive collaboration, harmonization and integration among a wide range of data programmes and across a range of disciplines, including official statistics of population, its main characteristics and its distribution by ecozones.

A wide range of official data developers beyond the national statistical offices, including national and subnational government agents across sectors (including agriculture, water, sanitation, energy, mining and environment) will need to work together within a framework of intensive collaboration and adequate coordination. At this point in time, not only are institutional experience, capacity and responsibility—with respect to statistics for monitoring and analysing climate change and hazards, exposed populations, impacts and policy responses—widely diffused across Governments and international organizations, but there is often very little communication among the different specialities within governments.

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These challenges have been recognized in the 2030 Agenda for Sustainable Development and are being taken up by international organizations, led by the Statistical Commission. Efforts in this direction will require unprecedented levels of cooperation at the global and national levels. Strengthened international cooperation needs to be the foundation for a new form of data development and for support of the building of capacity to use those data effectively, including within the context of integrated climate impact assessments.