Annex chapter 4.

This annex describes material prepared to support Chapter 4 of the Adaptation Gap Report 2018

Annex 4.1 Updated evidence on the estimated costs of climate change and adaptation

Global estimates

- More estimates have been published of the global economic costs of climate change, with further updates to integrated economic assessment models (for example, see IWG (2016)), but also computable general equilibrium models (for example, OECD (2015)), econometric studies (for example, Burke *et al.* (2015)) and studies that combine or synthesize these estimates in new modelling analyses (for example, Ricke *et al.* (2018)). These global studies are usually presented in terms of the economic impacts expressed as an equivalent percentage of Gross Domestic Product (welfare-equivalent income loss, expressed as a percentage of income), as this provides the simplest comparable metric for aggregate damage (note that dollar values vary with year and socio-economic scenario). Recent studies generally indicate higher economic costs (as a percentage of Gross Domestic Product) compared to earlier studies (for example, see Sterner, 2015) as do recent updates to existing models (for example, Nordhaus (2017) for the DICE model). Some of the newer studies indicate significantly greater damage than other models (for example, Burke *et al.,* 2015: Burke *et al.,* 2018).
- Studies estimate that global adaptation costs up to 2040 will be broadly similar between scenarios, but diverge strongly by the end of the century. For example, Hof *et al*. (2014) reports that global adaptation costs without mitigation (>4°C) will be about five times higher than a 2°C scenario by the end of the century.
- There are strong differences in regional residual damage and adaptation costs, which are masked if global studies alone are considered. For example, De Cian *et al.* (2016) report large regional disparities. This is particularly the case in India, Africa, Southeast Asia and Indonesia, where the climate change impacts associated with a 2°C warmer climate were found to be as high as 3-4 percent without adaptation, and still 2-3 percent with adaptation. The distribution of damage and adaptation costs will therefore remain profoundly unequal, irrespective of the stringency of the mitigation effort and the possibility of adapting to climate change.
- The importance of adaptation is also much greater under the scenario without mitigation, as a failure to invest in adaptation measures will lead to much greater additional damage. Mitigation is therefore a strategy to reduce the risk of uncertain damage and the failure to invest optimally in adaptation.
- The timing of mitigation also influences adaptation costs and residual damage (Admiraal *et al.,* 2015). Global damage and adaptation costs mainly occur in the second half of the century. Between 2040 and 2100, adaptation costs and residual damage differ between mitigation scenarios as a result of their different projections of transient temperature increases. These annual costs amount to about 1 percent (range 0.2–1.5 percent) of global Gross Domestic Product in the mitigation scenarios and 3.5 percent.
- (range 0.5–5.5 percent) in the baseline. The present value of the damage and adaptation costs (for both a 2 percent and 5 percent discount rate) in the early action scenario is 10 percent lower compared to a delayed action path.
- There is very little evidence on the costs of adaptation for a 1.5°C scenario. Indeed, there are limited studies even of the economic costs of such scenarios (Burke *et al.,* 2018), though intuitively the costs of adaptation should be lower for such a scenario.

Sector estimates

- Previous global studies of adaptation have drawn on sector impact studies. There are updated sector estimates of the costs and benefits of adaptation both globally and regionally.
- In the coastal sector, new global and regional estimates are available from the DIVA model from the RISES-AM study (Hinkel, 2014). This reports global annual investment and maintenance costs of US$ 12–71 billion in 2100, finding that coastal dikes reduce impacts by two to three orders of magnitude. The study also provides new estimates of extremely high sea level rise scenarios (for example, above current IPCC estimates), which show much higher economic costs globally (up to US$50 trillion in annual flood damage under the high-end scenario without adaptation (RISES-AM, 2017)), and would increase the costs of adaptation very significantly. A larger number of more detailed national and local studies are also emerging.
- Estimates of global river flooding adaptation costs are also now available (Ward *et al.,* 2017). This study concludes that adaptation costs vary considerably according to the adaptation approach (optimized response, constant relative or constant absolute risks) and scenarios. The annual global costs of adaptation (over the period 2020–2100) are estimated at between US$27 billion per year (RCP6.0/SSP3/optimized response) to US$219 billion per year (RCP8.5/SSP5/constant absolute risk). Here to a larger number of more detailed national and local studies are emerging.

- In the agricultural sector a larger number of studies have been produced, including inter-comparison global analyses. There has been more work on adaptation globally and regionally for both trade (autonomous market) and planned adaptation. These studies report significantly higher costs than the earlier Economics of Adaptation to Climate Change: for example, Ignaciuk and Mason-D'Croz (2014) estimated OECD adaptation costs at between US$16 and US$20 billion per year by 2050, while Mosnier *et al.* (2014) estimated global adaptation costs of between US$12 and US$ 19 billion per year in 2050. Computable general equilibrium modelling assessments of autonomous trade adaptation (Szewczyk *et al.,* 2016) and planned adaptation (Parrado *et al.,* 2016) have also been conducted.
- In the energy sector, there are now more studies of global energy demand (including cooling demand; for example, De Cian and Sue-Wing, 2017; Hasegawa *et al.,* 2016; Labriet *et al.,* 2015). These indicate large increases in cooling demand and autonomous adaptation costs (for example, rising household cooling demand in warmer countries). Note that, even though globally the changes in energy demand are moderate (between heating and cooling), the additional adaptation costs of cooling fall primarily on developing countries and represent additional adaptation costs for the countries affected. This is because there are no transfers between reduced heating demand in some countries and higher cooling in others. These adaptation costs are not included in previous global studies (such as Economics of Adaptation to Climate Change) and would increase country and regional estimates (notably in Africa and Asia) very significantly. There are also now studies of energy supply adaptation costs, for example, Van Vliet *et al.* (2016).
- In the health domain previous estimates have been updated, but there has also been more focus on labour productivity impacts (occupational health) and adaptation responses (for example, OECD, 2015; Lloyd, 2016).
- Coverage of the costs of adaptation in other sectors is less developed, being particularly low for business and industry, and biodiversity and ecosystem services. The latter is a particular omission. While there is some literature on the costs and benefits of ecosystem-based adaptation, there is almost no literature on the costs of actions to ensure that ecosystems adapt.
- There are now some inventories of adaptation costs that collate bottom-up studies (see ECONADAPT inventory[4]).
- There is relatively little literature on the potential co-benefits of adaptation. Certain types of adaptation (for example, climate-smart agriculture, ecosystem-based adaptation) do have potentially large co-benefits, but there are no aggregated estimates of their potential. There have also been some studies that have started to look at the adaptation economy, stressing that adaptation might generate new growth and employment opportunities, though to date these have focused on the national or city scale (Georgeson *et al.,* 2016).

Annex 4. 2. Major multilateral climate change funds supporting adaptation

Major multilateral climate change funds supporting adaptation

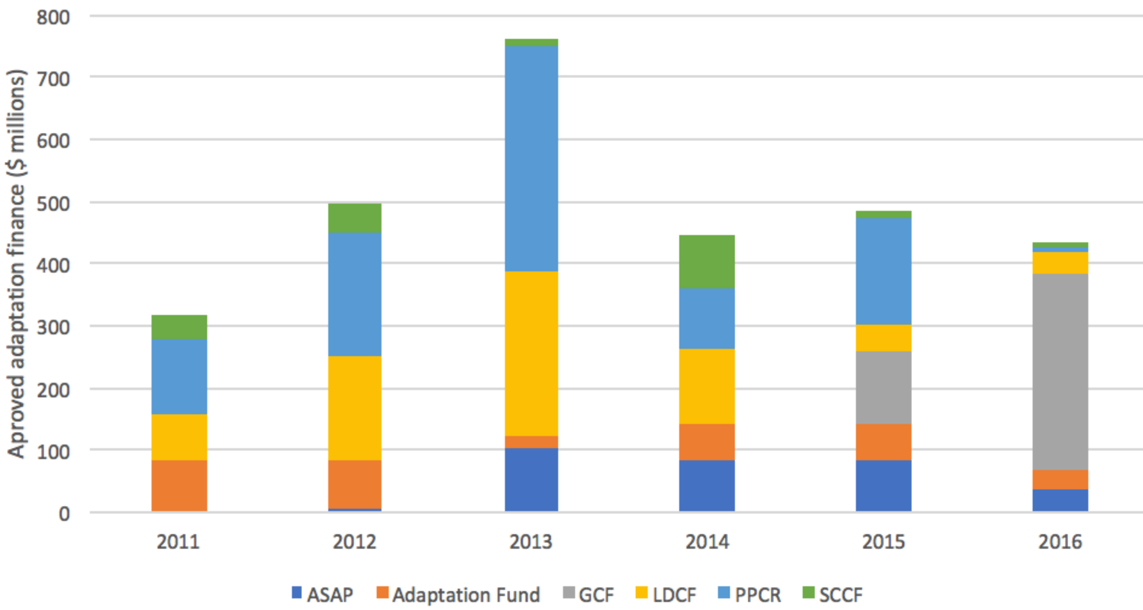
Multilateral climate funds pool contributor finance and spending to focus on specific climate objectives, operating through multilateral, regional or national organizations. Finance is highly concessional, often Official Development Assistance provided in the form of grants, concessional loans and more recently as guarantees and equity. The funds are in theory able to take on more risk than development finance institutions in order to stimulate further climate finance. Many, however, operate with or are implemented by Multilateral Development Banks.

There are five multilateral climate funds within the United Nations Framework Convention on Climate Change (UNFCCC). The Green Environment Facility manages the Least Developed Countries Fund and the Special Climate Change Fund, both of which are adaptation focused. The Global Environment Facility also manages a trust fund on climate change as a focal area, although this is more broadly targeted on mitigation activities. The Adaptation Fund, which operates under the Kyoto Protocol rather than the Financial Mechanism of the UNFCCC, like the other funds mentioned here, is a legal entity in its own right, with the World Bank as the interim Trustee. The Green Climate Fund, the newest and largest multilateral fund dedicated to climate change, became operational in 2015. Although supporting adaptation and mitigation, it aims to budget 50 percent of its resources for adaptation (Schalatek *et al.,* 2017).

Multilateral climate funds that focus on adaptation outside the UNFCCC include the Pilot Program Climate Resilience and the Adaptation for Smallholder Agriculture Programme. The former is an adaptation targeted program of the Climate Investment Funds that aims to pilot and demonstrate ways in which climate risk and resilience may be integrated into core development planning, provide incentives for scaled-up action and initiate transformational change. The Adaptation for Smallholder Agriculture Programme is a special fund of the International Fund for Agricultural Development designed to channel climate and environmental finance to smallholders and to scale up climate change adaptation in rural development programmes.

[4] Available at: www.econadapt.eu/

Figure 4.1: Adaptation finance approved through key multilateral climate funds



Source: *CFU, 2018.*

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