United Nations

FCCC/TP/2013/10

Framework Convention on Climate Change

Distr.: General
30 October 2013

English only

Synthesis of submissions on the costs, benefits and opportunities for adaptation based on different drivers of climate change impacts, including the relationship between adaptation and mitigation

Technical paper

Summary

This is the first version of a technical paper synthesizing submissions received as at 18 October 2013. It provides a summary of the contextual information provided by Parties which they considered as relevant in outlining the costs, benefits and opportunities of adaptation, including the linkages to mitigation. It elaborates on the different climatic and non-climatic drivers of climate change impacts, which is followed by an overview of issues reported under costs, benefits and opportunities of adaptation, including observed and assessed costs, methodological challenges, and benefits, opportunities and limits of adaptation. The document concludes with views submitted on the relationship between adaptation and mitigation.

Please recycle

Contents

I. Introduction

A. Mandate

1. At the first part of its first session, the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) adopted its agenda and initiated two workstreams, one addressing matters related to paragraphs 2–6 of decision 1/CP.17 (the 2015 agreement) and the second addressing matters related to paragraphs 7 and 8 of the same decision (pre-2020 ambition).

2. At the second part of its second session, in the context of its deliberations on workstream one, the ADP requested the secretariat to prepare, and to make available by 30 October 2013, a first version of a technical paper synthesizing submissions on the costs, benefits and opportunities for adaptation based on different drivers of climate change impacts, including the relationship between adaptation and mitigation.[1]

3. In response to the mandate, five Parties or groups of Parties provided targeted submissions: Canada, Japan, New Zealand, Norway and the United States of America; Bolivia (Plurinational State of) on behalf of the Like-minded Developing Countries (LMDCs) on climate change[2]; Nepal on behalf of the least developed countries; Saint Lucia and Swaziland on behalf of the African States. In addition, two groups of Parties referred to the technical paper in their broader submissions on the scope, design and structure of the new agreement: the Independent Alliance of Latin America and the Caribbean (AILAC)[3] and Lithuania and the European Commission on behalf of the European Union and its Member States[4].[5]

B. Scope of the note

4. This document constitutes the first version of a technical paper synthesizing submissions received as at 18 October 2013. It provides a summary of the contextual information contained in the different submissions. It then elaborates on the different climatic and non-climatic drivers of climate change impacts, which is followed by an overview of issues reported under costs, benefits and opportunities of adaptation. The document concludes with views submitted on the relationship between adaptation and mitigation. The annex contains a list of references included in Parties' submissions.

C. Possible action by the Ad Hoc Working Group on the Durban Platform for Enhanced Action

5. The ADP may wish to consider this technical synthesis in the context of its overall consideration of adaptation in the 2015 agreement.

---

[1] FCCC/ADP/2013/L.2, paragraph 8.

[2] Bolivia (Plurinational State of), China, Cuba, Dominica, Ecuador, Egypt, El Salvador, India, Iran (Islamic Republic of), Iraq, Malaysia, Mali, Nicaragua, Philippines, Saudi Arabia, Sri Lanka, Sudan and Venezuela (Bolivarian Republic of).

[3] Chile, Colombia, Costa Rica, Guatemala, Panamá and Perú.

[4] This submission is supported by Albania, Bosnia and Herzegovina, Iceland, the Former Yugoslav Republic of Macedonia, Montenegro and Serbia.

[5] Submissions are available at <unfccc.int/7398>.

II. Synthesis of submissions

A. Contextual information

6. In their submissions, many Parties provided contextual information which they considered as relevant in outlining the costs, benefits and opportunities of adaptation, including the linkages to mitigation. Parties elaborated on the following three distinct contexts, which provide the overall backdrop for their submissions:

(a) Relevant technical work undertaken on the costs, benefits and opportunities for adaptation based on different drivers of climate change impacts, including the relationship between adaptation and mitigation;

(b) Adaptation and sustainable development;

(c) Adaptation in the Convention and ongoing negotiations under the ADP, including the scope and structure of the 2015 agreement.

7. Many submissions stressed the need to take into account relevant technical work when discussing the topic under consideration, including relevant assessment and special reports by the Intergovernmental Panel on Climate Change (IPCC), reports prepared under the Nairobi work programme on impacts, vulnerability and adaptation, publications by the World Bank and by United Nations agencies as well as independent reports such as the Stern Review on the Economics of Climate Change.[6] In addition, Parties highlighted the upcoming contribution of Working Group II to the IPCC fifth assessment report (AR5), which includes chapters on the economics of adaptation and on climate resilient pathways, as future input into the ADP deliberations on this topic.

8. Parties emphasized that sustainable development provides the overall context for adaptation and that poverty eradication is the overarching priority for developing countries. While some progress has been made in attaining sustainable development and, in particular, the Millennium Development Goals (MDGs), climate change impacts, including those from more frequent and severe extreme events, not only threaten the development gains made so far but also constitute obstacles to any future progress. In line with the Rio+20 Declaration[7], many Parties underlined that adaptation represents an immediate and urgent global priority as it provides an opportunity to avoid the detrimental impact of climate change in achieving sustainable development.

9. Many Parties in their submissions underscored that relevant articles of the Convention and previous decisions should guide consideration of adaptation actions. In particular, Article 2 provides for the ultimate objective of the Convention, where "dangerous anthropogenic interference" is defined on the basis of climate impacts, including the ability for ecosystems to naturally adapt, protection of food security and sustainable economic development. Many Parties also referred to Article 4, paragraphs 3, 4, 5 and 8, stressing the obligation of developed countries to assist developing countries in meeting costs of adaptation. In addition, some Parties recalled the duty of States to abide by the 'no-harm' rule in the context of the accumulation of greenhouse gases.

10. Two groups of Parties viewed this technical synthesis as a contribution to the negotiation of the scope and structure of the 2015 agreement, in particular to improving the framing of the adaptation discussion.

[6] A list of references is provided in the annex.

[7] See paragraph 190 of the outcome document of the United Nations Conference on Sustainable Development, entitled "The future we want", available at <www.uncsd2012.org/thefuturewewant.html>.

B. Different drivers of climate change impacts

11. In their submissions, Parties referred to a multitude of drivers and their interactions that determine the extent to which climate change impacts constitute risks and affect countries. These drivers can be distinguished between climatic and non-climatic drivers.

12. Climatic drivers include the exposure of a society, economy or ecosystem to climate change impacts. Some Parties stressed that this exposure has increased due to inadequate historical and current mitigation action by developed countries.

13. Non-climatic drivers referred to by many Parties and listed by the IPCC include economic, social, geographic, demographic, cultural, institutional, governance and environmental factors, which vary significantly over temporal and spatial scales. As highlighted by many Parties, overall development and adaptive capacity largely determine these drivers and thus the scale of impacts.

14. The interaction of the various climatic and non-climatic drivers determines the overall vulnerability to climate change impacts, whether at the global, regional, national or local level, and hence the risks facing each country, region or local community now and in the future. According to some Parties, referring to the IPCC Special Report "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation", high exposure and vulnerability are generally the result of non-climatic drivers, such as environmental degradation, unplanned urbanization in precarious areas, failures of governance, and scarcity of livelihood options for poor households and communities. These Parties emphasized that non-climate change-related drivers will heavily influence any cost projections of adaptation.

C. Costs, benefits and opportunities for adaptation

15. As highlighted by some Parties, the IPCC fourth assessment report (AR4) defines adaptation costs as the costs for planning, preparing for, facilitating and implementing adaptation measures, while adaptation benefits are defined as the avoided damage costs or the accrued benefits following the adoption and implementation of adaptation measures. If the economic benefits of adaptation options outweigh the costs, then there are net benefits. If not, then this potentially leads to maladaptation. While adaptation reduces impacts it does not remove them completely; hence there will be residual damage, which also carries an economic cost.

16. Parties in their submissions provided information related to:

(a) Observed impacts and associated costs;

(b) Assessments of adaptation costs and benefits;

(c) Benefits and opportunities for adaptation;

(d) Limits to, and needs for, adaptation.

1. Observed impacts and associated costs

17. One group of Parties highlighted that climate change impacts have already resulted in loss and damage with considerable costs. These economic and non-economic losses present lost development opportunities and threats to the right to development. In particular, impacts on ecosystems pose threats to indigenous peoples and local communities

and their traditional livelihoods, while impacts on water resources impose costs on farmers and farming communities as they are often dependent on rain-fed agriculture.[8]

2. Assessments of adaptation costs and benefits

18. Parties in their submissions reported on different assessment methodologies, results of assessments undertaken, methodological challenges and on how these results could or could not be applied to adaptation planning. In addition, one group of Parties proposes a methodology to arrive at the global costs of adaptation and another group calls for undertaking further assessments.

19. Several Parties in their submissions referred to a variety of publications, which provide details on impacts of climate change, different assessments of costs and benefits of climate change impacts and adaptation and on different methodologies (see the annex for a list of references). In terms of assessments undertaken, the table below provides some estimates from global assessments, which Parties referred to in their submissions.

Estimated annual costs of adaptation for developing countries
(*billions of United States dollars*)

Study	*Timeframe*	*Annual costs*	*Sectors/areas*
Stern 2007	Present	4–37	Unspecified
UNFCCC 2007	2030	28–67	Agriculture, forestry, fisheries, water supply, health, coastal zones, infrastructure
World Bank 2010a	2010–2015	70–100	Agriculture, forestry, fisheries, infrastructure, water resources, health, ecosystem services, coastal zones, extreme weather events

20. Some Parties also highlighted outputs of regional and sectoral assessments. For example, a 2011 report of the African Development Bank concluded that adaptation costs in Africa could be in the region of USD 20–30 billion per annum over the next 10 to 20 years (AfDB 2011). In terms of adaptation costs for the Latin America and the Caribbean, region, Parties refer to Agrawala et al (2010), who estimate annual adaptation costs of up to USD 98.4 billion, and to the Economics of Climate Change in the Caribbean project. Finally, Parties also report on outputs of sectoral assessments. For example, one assessment of the economic costs of a high end sea-level rise scenario of over 1.5m by 2080 could be in the region of USD 1 trillion per year (Downing and Butterfield 2012).

21. Highlighting the spread of results of the various assessments of costs and benefits, Parties reported on methodological challenges, which can be grouped under the broad themes of uncertainty and valuation:

(a) Uncertainty, including as it relates to quality of available data and socio-economic and emissions scenarios used, including assumptions about future economic growth, population change, technological development and infrastructure investments;

(b) Valuation, including types of assessment methodology; geographical and sectoral scope of the assessment; chosen time frame and discount rate; and the difficulty of assigning monetary values to non-market benefits (e.g. human health and life, and environmental services).

22. Given these methodological challenges and the fact that the sensitivity of assumptions has a strong bearing on the projected adaptation costs, some Parties

[8] For examples of specific costs incurred from climate change impacts, in particular extreme events such as droughts and floods, see the submission of the LMDCs.

emphasized the difficulty of comparing existing global, top-down estimates of adaptation costs.

23. Regarding the applicability of assessment results, some Parties underscored that global, top-down estimates, typically based on global datasets and projections, do not help policymakers and decision makers in understanding adaptation costs and benefits at the national and subnational levels. Global estimates can, however, make the case for mitigation action as well as inform the scope of adaptation action in the near-, medium- and long-term. According to these Parties, assessments of costs and benefits of adaptation for the purposes of making decisions about when and how to adapt should therefore ideally be derived from local analyses, which use methodologies that are most appropriate for a given location and issue.

24. In addition, some Parties, taking into account the different contexts and assumptions, pointed to the difficulty of aggregating estimates of local costs into a meaningful regional or global total. As such, these Parties called on all countries to continue to improve their understanding of the costs and benefits of adaptation at the local level so that they can make more informed decisions to improve their climate resilience.

25. One group of Parties, stressing advances in the scientific understanding of dealing with the complexity in the computation of adaptation costs, proposed a specific methodological approach for determining adaptation needs and costs (see box below). According to the proposed approach, annual global adaptation costs for the developing country regions would be determined ex ante based on the impacts of long-term global temperature increase.

Four-step methodological approach proposed for determining adaptation needs and costs for any commitment cycle

1. Based on an ensemble of regionally downscaled models, project the probability of incidence of climate impacts consistent with a representative concentration pathway scenario for 0°C, 1°C, 2°C and 3°C in the developing country regions of the world.
2. Compute probability density curves for the impacts under each of the temperature scenarios for the duration of the commitment period, as such reflecting the median magnitude of impacts during that period.
3. From records, establish average costs per disaster for specific regions. In association with the probability density curves present a cost curve, of which the sum of costs for the impacts for a region/country during a commitment cycle reflect incremental adaptation needs.
4. The difference in median costs from 0°C for the resultant temperature scenarios based on commitments for a commitment period therefore reflects the global goal on adaptation for the commitment period, which is a global obligation in respect to supporting developing country adaptation action.

26. In a similar way, another group of Parties, called for undertaking new assessments of current and likely climate change impacts with corresponding costs, including investments and financial needs for adaptation and the overall costs of residual damages and resulting needs, taking into account various levels of temperature increase.

27. In order to provide Parties to the UNFCCC with useful cost estimates, the group recommended that adaptation costs and residual damages be assessed for four different emissions scenarios:

(a) Scenario under business-as-usual (non-mitigation) assumptions (e.g. representative concentration pathway (RCP) 8.5 scenario used in IPCC AR5) leading to a

global mean temperature increase above 4°C relative to pre-industrial level by 2100 (Alexander et al 2013);

(b) Scenario with implementation of current pledges and proposals on the table leading to a global mean temperature increase of about 3.5–4°C relative to pre-industrial level by 2100 (UNEP 2012);

(c) Scenario consistent with a warming staying below 2°C relative to pre-industrial level (e.g. RCP 2.6 scenario used in IPCC AR4, Alexander et al 2013);

(d) Scenario consistent with 1.5°C warming pathways (UNEP 2012).

28. In addition, the group suggested that the costs of residual damages be assessed for the above emissions scenarios in cases of "under-adaptation", that is where adaptation measures fall short or are not fully implemented.

3. Benefits and opportunities for adaptation

29. Parties emphasized that adaptation actions whose benefits are greater than the costs can help protect development gains. While adaptation involves costs, initial levels of adaptation can be achieved at a low cost relative to the avoided costs of climate change impacts. According to many, economically optimal adaptation is achieved through early, coherent, integrated planning and action at all levels. Specific benefits and opportunities as reported by Parties relate to:

(a) Integration and alignment of adaptation with sustainable development planning and policies;

(b) Enhancing adaptive capacity, including through economic diversification;

(c) Engaging in disaster risk reduction and management.

30. One Party listed additional areas, which offer benefits and opportunities, including enhancing resilience of infrastructure in coastal zones; supporting water resources conservation and management; strengthening the national policy, legislative and institutional framework; undertaking public education and outreach; enhancing research and systematic observation, including data and information acquisition and knowledge management; and capacity-building.

31. Many Parties pointed to the benefits and opportunities created by integrating and aligning adaptation with national and sub-national development planning. For some Parties, adaptation and sustainable development are, and should be, inextricably linked: while adaptation is essential for sustainable development as it increases resilience it is also an extension of good development practice. Other Parties cautioned that while there are important benefits of adaptation when aligned with development priorities, it cannot be assumed that one can be replaced with the other.

32. Some Parties underlined the need for all countries and communities to make development decisions that factor in the wide array of risks, including those associated with climate change. Assessments of costs, benefits and opportunities of adaptation should be undertaken from a systems perspective that recognizes the complexity of interactions between stressors and that responses to stressors, including climate ones, should be integrated into the relevant decision-making processes. According to these Parties, fragmentation and lack of coherence can render actions ineffective.

33. Several Parties also pointed to the importance of adaptive capacity. Economic diversification was highlighted as key to supporting adaptation and actions that build and increase a country's adaptive capacity, according to some Parties, should be showcased, encouraged and supported under the Convention.

34. According to one group of Parties, adaptation could also offer opportunities for the private sector, for example in areas such as microfinance and microinsurance, housing, off-grid energy services, information and communication technologies, waste management, water and irrigation or costal management. The private sector could reach new markets with tailored products and services. The group calls for assessing such opportunities in developed and developing countries.

35. In addition, several Parties stressed the benefits and opportunities offered by disaster risk reduction. According to these Parties, the costs of disaster preparedness and risk management, for instance, can be far less than the costs of disaster relief and recovery.

4. Limits to, and needs for, adaptation

36. Some Parties, acknowledging existing opportunities for pursuing sustainable development and adaptation, cautioned against overstating opportunities given that appropriate and adequate financial and technological support is needed in line with the Convention and subsequent decisions. Otherwise the cost of adaptation would detract from other development priorities.

37. One group of Parties proposed to highlight how much funding is required to meet adaptation needs under different temperature increase scenarios and by how much developed country Parties would need to scale up their support to developing countries compared with current contributions.

38. Besides support, some Parties further pointed out that the level of required adaptation depends on the level of mitigation, in particular by developed countries who have a historic responsibility. Otherwise physical limits of adaptation could be reached, that is territories becoming uninhabitable and unproductive leading to permanent loss of livelihoods and culture. According to one group of Parties, adaptation options may not be technically and/or financially feasible when global mean temperature reaches 3°C or 4°C above pre-industrial level, in particular in areas exposed to sea-level rise (Schellnhuber et al 2013). Based on the existing scientific literature, including the upcoming contribution of Working Group II to IPCC AR5, the group proposed to highlight sectors and areas where adaptation to climate change is projected to become unmanageable, infeasible or uneconomical for temperature increase levels of 1.5°C, 2°C, 3°C and 4°C.

39. Some Parties also cautioned against building on results-based approaches for the monitoring and evaluation (M&E) of adaptation. Given the long-term nature of adaptation, they argued that such approaches are inappropriate as they focus on short-term projects or programmes. In their view, M&E of adaptation requires an adequate conceptual framework and they proposed to focus first on the M&E of support, in particular the compliance of developed country Parties with support commitments made.

D. Relationship between adaptation and mitigation

40. Many Parties stressed that global mitigation efforts will affect the rate of climate change and its impacts and thus have a bearing on the extent and timing of adaptation required. Some Parties also pointed out that even with strong mitigation action by all major emitters, climate change is impacting, and will continue to impact, all countries. Hence all countries need to prepare for the unavoidable impacts of climate change and enhance resilience in the face of future uncertainties.

41. Some Parties also stressed the responsibility of Parties included in Annex I to the Convention in undertaking mitigation action, including as it relates to fulfilling existing mitigation commitments, increasing ambition and acknowledging historic responsibility.

42. Many Parties emphasized that while adaptation is not a substitute for mitigation, the two are complementary and, if well designed, can be undertaken in an integrated manner to support overall low-carbon and climate-resilient development, including in areas such as agriculture and food security; forests; health; and water and coastal management. One Party specifically highlighted the area of renewable energy in which adaptation projects/programmes can be implemented while simultaneously benefiting from reduced greenhouse gas emissions and reduced fuel import costs.[9]

43. Some Parties referred to the IPCC, which indicated that further exploitation and promotion of synergies between mitigation and adaptation could also advance sustainable development, economic diversification and resilience. Parties underlined that the priority of any integrated action should be sustainable development and poverty eradication taking into account the need to avoid any negative social or economic impacts to developing countries specifically.

44. Many Parties suggested that the 2015 agreement provides for early and ambitious global mitigation action and provisions to facilitate adaptation, while promoting an integrated approach to climate action that is well embedded in low carbon, climate resilient sustainable development processes. Some Parties further suggested that understanding the linkages between adaptation and mitigation should not impose any conditions on, or limit opportunities arising from, mitigation or adaptation. At the same time, adaptation and its support should not be conditioned on mitigation ambition.

45. In addition, one group of Parties proposed a way to operationalize the relationship between adaptation and mitigation in the 2015 agreement. They recalled decision 1/CP.16, paragraph 4, in which Parties committed to urgent action towards a long-term goal of holding the increase in global average temperature to below 2°C above preindustrial levels, with provisions for reviewing that goal, including towards 1.5°C. The group stressed that the agreed temperature goal has a concomitant level of climate impacts and costs and that the resultant temperature scenario depends on the level of mitigation effort by Parties for each commitment period under the 2015 agreement. According to the group, the concomitant adaptation costs (see para. 25 and box above) should therefore constitute the Global Goal for Adaptation (GGA), whereby developed countries, taking into account their obligations under the Convention, would provide the necessary financial and technological resources to address these adaptation costs.

[9] Areas include solar, wind and geothermal energy as well as waste-to-energy. For more information see the submission of Saint Lucia.

Annex

List of references included in Parties' submissions

Adger WN, Agrawala S, Mirza MMQ, Conde C, O'Brien K, Pulhin J, Pulwarty R, Smit B and Takahashi K. 2007. Assessment of adaptation practices, options, constraints and capacity. *In*: ML Parry, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanson (eds.). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press. pp 717–743.

AfDB (African Development Bank). 2011. *The Cost of Adaptation to Climate Change in Africa*. Available at <www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Cost%20of%20Adaptation%20in%20Africa.pdf>.

Agrawala S and Fankhauser S (eds.). 2008. *Economic Aspects of Adaptation to Climate Change. Costs, Benefits and Policy Instruments*. Paris: OECD.

Agrawala S, Bosello F, Carraro C, de Bruin K, De Cian E, Dellink R and Lanzi E. 2010. Plan or *React? Analysis of Adaptation Costs and Benefits using Integrated Assessment Models*. OECD Available at <www.oecd-ilibrary.org/environment/plan-or-react_5km975m3d5hb-en>.

Alexander L, Allen S, Bindoff NL, Bréon FM, Church J, Cubasch U, Emori S, Forster P, Friedlingstein P, Gillett N, Gregory J, Hartmann D, Jansen E, Kirtman B, Knutti R, Kanikicharla KK, Lemke P, Marotzke J, Masson-Delmotte V, Meehl G, Mokhov I, Piao S, Plattner GK, Dahe Q, Ramaswamy V, Randall D, Rhein M, Rojas M, Sabine C, Shindell D, Stocker TF, Talley L, Vaughan D and Xie SP. 2013. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Summary for Policymakers.* IPCC. Available at <http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf>.

Boko M, Niang I, Nyong A, Vogel C, Githeko A, Medany M, Osman-Elasha B, Tabo R and Yanda P. 2007. Africa. *In*: ML Parry, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanson (eds.). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press. pp 433–467.

de Bruin K, Dellink R and Agrawala S. 2009. *Economic Aspects of Adaptation to Climate Change: Integrated Assessment Modelling of Adaptation Costs and Benefits*. OECD. Available at <www.oecdilibrary.org/content/workingpaper/225282538105>.

Downing TE and Butterfield R. 2012. *Extreme Outcomes: Prospects for Major Tipping and Socially Contingent Events and Associated Economic and Social Costs*. Stockholm Environment Institute. Available at <www.sei-international.org/mediamanager/documents/Publications/SEI-PolicyBriefingNote-ExtremeOutcomes-2012.pdf>.

EEA (European Environment Agency). 2007. Climate Change: the Cost of Inaction and the Cost of Adaptation. EEA. Available at <http://www.eea.europa.eu/publications/technical_report_2007_13>.

Field CB, Barros V, Stocker TF, Qin D, Dokken DJ, Ebi KL, Mastrandrea MD, Mach KJ, Plattner GK, Allen SK, Tignor M and Midgley PM (eds.). 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of*

Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University.

Global Leadership for Climate Action. 2009. *Facilitating an International Agreement on Climate Change: Adaptation to Climate Change.* UN Foundation and Club of Rome. Available at <www.unfoundation.org/assets/pdf/adaptation_to_climate_change.pdf>.

Hof AF, de Bruin KC, Dellink RB, den Elzen MGJ and van Vuuren DP. 2009. The effect of different mitigation strategies on international financing of adaptation. *Environmental Science and Policy*. 12(7): pp. 832–843.

Hope C. 2009. The Costs and Benefits of Adaptation. *In*: M Parry, N Arnell, P Berry, D Dodman, S Fankhauser, C Hope, S Kovats, R Nicholls, D Satterthwaite, R Tiffin and T Wheeler. *Assessing the Costs of Adaptation to Climate Change: A Review of the UNFCCC and Other Recent Estimates*. IIED and Grantham Institute for Climate Change. Available at <http://pubs.iied.org/pdfs/11501IIED.pdf>.

Levina E. 2007. *Adaptation to Climate Change: International Agreements for Local Needs*. OECD. Available at <www.oecd.org/env/cc/39725521.pdf>.

Mullan M, Kingsmill N, Kramer AM and Agrawala S. 2013. National Adaptation Planning: Lessons from OECD Countries. OECD. Available at <http://www.oecd-ilibrary.org/environment/national-adaptation-planning_5k483jpfpsq1-en>.

Ngwadla X, Engelbrecht F, Landman W, Bopape M and Muckandal, J. 2013. *A Conceptual and Methodological Approach to a Global Goal for Adaptation*. Council for Scientific and Industrial Research of South Africa. Technical Working Paper in Progress. (unpublished report).

Nicholls RJ, Wong PP, Burkett VR, Codignotto JO, Hay JE, McLean RF, Ragoonaden S and Woodroffe CD. 2007. Coastal systems and low-lying areas. *In*: ML Parry, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanson (eds.). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press. pp 315–356.

Schellnhuber HJ, Hare B, Serdeczny O, Schaeffer M, Adams S, Baarsch F, Schwan S, Coumou D, Robinson A, Vieweg M, Piontek F, Donner R, Runge J, Rehfeld K, Rogelj J, Perette M, Menon A, Schleussner CF, Bondeau A, Svirejeva-Hopkins A, Schewe J, Frieler K, Warszawski L, Rocha M. 2013. *Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience*. World Bank. Available at <http://documents.worldbank.org/curated/en/2013/06/17862361/turn-down-heat-climate-extremes-regional-impacts-case-resilience-full-report>.

Stern N. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge: Cambridge University Press.

UNECLAC (United Nations Economic Commission for Latin America and the Caribbean). 2011. *The Economics of Climate Change in the Caribbean. Summary Report*. UNECLAC Caribbean Regional Office. Available at <http://www.eclac.org/cgi-bin/getProd.asp?xml=/portofspain/noticias/paginas/0/44160/P44160.xml&xsl=/portofspain/tpl-i/p18f.xsl&base=/portofspain/tpl/top-bottom.xsl>.

UNEP (United Nation Environment Programme). 2008. Climate Change in the Caribbean and the Challenge of Adaptation. UNEP Regional Office for Latin America and the Caribbean. Available at <www.pnuma.org/deat1/pdf/Climate_Change_in_the_Caribbean_Final_LOW20oct.pdf>.

UNEP. 2012. *The Emissions Gap Report 2012*. A UNEP synthesis report. UNEP. Available at <http://www.unep.org/pdf/2012gapreport.pdf>.

UNFCCC. 2007. *Investment and Financial Flows to Address Climate Change*. UNFCCC. Available at <unfccc.int/files/cooperation_and_support/financial_mechanism/application/pdf/background_paper.pdf>.

UNFCCC. 2009. *Potential Costs and Benefits of Adaptation Options: A Review of Existing Literature*. UNFCCC. Available at <http://unfccc.int/resource/docs/2009/tp/02r01.pdf>.

UNFCCC. 2011. *Assessing the Costs and Benefits of Adaptation Options. An Overview of Approaches.* UNFCCC. Available at <unfccc.int/resource/docs/publications/pub_nwp_costs_benefits_adaptation.pdf>.

World Bank. 2010a. *Economics of Adaptation to Climate Change. Synthesis report*. World Bank. Available at <http://documents.worldbank.org/curated/en/2010/01/16436675/economics-adaptation-climate-change-synthesis-report>.

World Bank. 2010b. *The Cost to Developing Countries of Adapting to Climate Change: New Methods and Estimates*. World Bank. Available at <http://siteresources.worldbank.org/EXTCC/Resources/EACC-june2010.pdf>.

World Bank. 2010c. *Adaptation to Climate Change Vulnerability Assessment and Economic Aspects: Plurinational State of Bolivia*. World Bank. Available at <http://documents.worldbank.org/curated/en/2010/01/16441371/adaptation-climate-change-vulnerability-assessment-economic-aspects--brplurinational-state-bolivia>.

World Bank. 2010d. *Ethiopia: Economics of Adaptation to Climate Change. Main Report*. World Bank. Available at <http://documents.worldbank.org/curated/en/2010/01/16279299/economics-adaptation-climate-change-ethiopia>.

World Bank. 2010e. *Ghana: Economics of Adaptation to Climate Change. Main Report*. World Bank. Available at <http://documents.worldbank.org/curated/en/2010/01/17486030/ghana-economics-adaptation-climate-change-eacc-vol-1-2-main-report>.

World Bank. 2010f. *Samoa: Economics of Adaptation to Climate Change*. World Bank. Available at <http://documents.worldbank.org/curated/en/2010/01/16441128/samoa-economics-adaptation-climate-change>.

World Bank. 2012. *Turn Down the Heat: Why a 4°C Warmer World Must Be Avoided*. World Bank. Available at <http://documents.worldbank.org/curated/en/2012/11/17097815/turn-down-heat-4%C2%B0c-warmer-world-must-avoided>.