

Financing Mechanisms for Climate Change Adaptation in Developing Countries: Issues and Possibilities

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Abstract: The article discusses climate change adaptation, issues and opportunities in financing climate change adaptation in developing countries. Climate change risks in developing countries are higher than developed countries. The former have fewer resources to cope with the impact of climate change, or to reduce such impact through adaptation. For adaptation, the fundamental ethical issue is one of distributive justice, in regards to the allocation of funding responsibilities from richer countries to poorer countries in supporting adaptation efforts and fair participation in the distribution of burdens and benefits among different entities. Issues in funding climate change adaptation efforts are data availability, baseline development scenario, valuation techniques, uncertainty, discounting, relative prices, level, scale and boundaries of analysis, and capturing change. There are several opportunities to finance climate change adaptation in developing countries namely funds under the UNFCCC, Global Environment Facility, non-compliance fund, disaster relief and risk reduction, public expenditures including public-private partnerships (PPPs), insurance, development assistance, and foreign direct investment (FDI).

I. Introduction

The Intergovernmental Panel on Climate Change (IPCC) states the influence of regional temperature changes on many physical and biological systems, such as the increase in number and size of glacial lakes in the Arctic and Antarctic regions, has been caused by the melting of glaciers, which has also affected hydrological systems and terrestrial ecosystems, such as poleward and upward

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shifts in plant and animal ranges (IPCC, 2007). The key sectors for which general impacts are expected are freshwater resources, ecosystems, food, forests, coastal systems, low-lying areas, health, industry, settlements and society (Chambwera & Stage, 2010). Climate change risks in developing countries are higher, since agriculture, fisheries and other components are important for the livelihoods of rural populations (Adger, Huq, Brown, Conway, & Hulme, 2003). Developing countries have specific needs for adaptation due to high vulnerabilities. Developing countries will bear many of the global consequences of climate change, although the increasing atmospheric greenhouse gas concentrations are mainly the responsibility of industrialized countries (Mertz, Halsnæs, Olesen, & Rasmussen, 2009).

Dealing with the unavoidable impacts of climate change requires adaptation. Adaptation has become a focus because mitigation is already receiving a lot of attention, including private sector initiatives (Chambwera & Stage, 2010). Adaptation is defined as a way of dealing with damage as recognition of observable and irreversible change to the climate grows. Adaptation can be seen as complementary to greenhouse gas emissions reduction and is an inevitable answer to the challenge posed by climate change. The Intergovernmental Panel on Climate Change (IPCC) has defined adaptation as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Climate change adaptation efforts will create additional costs for all stakeholders. So we need to pay attention to adaptation and its potential role in modifying climate vulnerabilities in different countries and to the distribution of adaptation costs. Adaptation efforts should be done in both developed and developing countries, even though developing countries may have fewer resources to cope with the impacts of climate change or reduce such impacts through adaptation. The people most vulnerable to the adverse effects of climate change are the poor, so efforts will need to focus on helping them cope with the new climatic circumstances.

The Bali Action Plan identifies technology and finance as the key mechanisms to enable developing countries to respond to climate change. Adaptation is important in climate policies, but funding possibilities for adaptation activities are limited. Assessing the costs and the benefits of adaptation is considerably more complicated than it is for mitigation. Several aspects become issues in financing climate change adaptation, particularly in developing countries. **The aim of this article is to discuss the issues and possibilities of financing mechanisms for climate change adaptation in developing countries.** This article contains three

sections: climate change adaptation in developing countries, issues in financing climate change adaptation, and possibilities/opportunities for financing climate change adaptation.

II. Climate Change Adaptation in Developing Countries

Adaptation to climate risks is important for the following groups of stakeholders (Metroeconomica, 2004):

- Managers of businesses that are directly or indirectly affected by weather or climate
- Those making decisions with long-term consequences for land use, assets or population groups
- The stakeholders' own infrastructure and business areas that are sensitive to climate change
- Those agents who want to gain an early-mover advantage on climate change business opportunities.

The impact of climate change will be more severe in poor developing countries for several reasons. First, physical impacts are expected to be relatively large in developing countries, where increases in already high temperatures are likely to lead to large water evaporation. In many developing countries, precipitation is not likely to increase, as is expected in many high-latitude regions (Christensen et al 2007 as cited at Mertz et al. (2009)). Second, many developing countries, in terms of national income and employment, depend on agriculture that is directly affected by climatic change. Furthermore, the economic and technological capacity to adapt to climate change is often very limited in developing countries (Mertz et al., 2009). Third, the high number of poor people in these countries is generally more vulnerable and likely to feel the negative effects of climate change (Yohe & Tol, 2002).

Societies in developing countries are also more vulnerable due to their geographical location. They are more prone to floods or drought and dependent on resources sensitive to climate change and their low adaptive capacity (Chambwera & Stage, 2010). These developing countries would also be affected sooner than richer countries, therefore intensifying the need for accelerated adaptation (Stern, 2006). Formally, the dilemma of climate change adaptation in developing countries was recognized at the Seventh Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in 2001 in Marrakesh (Adger et al., 2003). Climate change is a global problem, but

the need for adaptation is higher among developing countries ((Adger et al., 2003; Reid & Huq, 2007).

Adaptation is the adjustment of a system to moderate the impacts of climate change, to take advantage of new opportunities or to cope with the consequences (Adger et al., 2003). Adaptation also aims to build resilience, recognizing that it will be a key response to reduce vulnerability to climate change (Stern, 2006). It includes a wide range of adjustments by entities such as households, firms and other institutions in response to the effects of climate change and variability. Activities include managing natural resources and changing laws, programs, policies and investments (Chambwera & Stage, 2010).

Adaptation is increasingly seen as complementary to greenhouse gas emissions reduction and is an inevitable answer to the challenges posed by climate change (Burton, 2000; Smit, Burton, Klein, & Street, 1999). The people most vulnerable to the adverse effects of climate change are the poor; considerable effort will have to be made to help them cope with the new climatic circumstances (Mirza, 2003). Adaptation is expected to be increasingly important in future climate policies, but explicit funding possibilities for adaptation activities are limited.

Several conceptual frameworks for addressing climate change adaptation in developing countries are based on vulnerabilities and adaptive capacity (Adger et al., 2003) to address climate change vulnerabilities and adaptation as a mainstream issue (Davidson et al., 2003). Vulnerability and adaptive capacity have been discussed as key concepts for understanding how developing countries cope with and adapt to climate change and variability (Adger, 2006; Smit & Wandel, 2006). The linkages between vulnerability, adaptive capacity, and adaptation are often circular rather than linear in nature (Mertz et al., 2009). The ability of people to control the variables that determine vulnerability might be translated into their capacity to adapt (Smit & Wandel, 2006). In economic terms, adaptive capacity is defined as “a vector of resources and assets that represent the asset base from which adaptation action can be made” (Vincent, 2007). It also is described by the coping range of climate variability upon which communities or individuals are used to reacting. When extreme events or more extreme variability go beyond the coping range, the adaptive capacity might be surpassed and the system threatened (Smit & Wandel, 2006).

Mainstream issues related to vulnerability and adaptation were put on the agenda at the Conference of the Parties (COP) 7 in Marrakech, Morocco in 2001, where it was decided that special support should be given to a group of Least Developed Countries (LDCs) to the development of NAPAs (Burton and Lim 2005). COP 7

also further supported adaptation activities with a strong recognition of the special needs of developing countries (Adger et al., 2003). The NAPAs are part of the adaptation policy framework (APF) developed to aid national planning, comprising a five-step approach for studying vulnerability and developing adaptation strategies (Adger et al., 2007).

III. Issues in Financing Climate Change Adaptation in Developing Countries

Vincent (2007) gives several main factors that constitute the adaptive capacity of a country, such as economic wellbeing and stability (20 percent), demographic structure (20 percent), global interconnectivity (10 percent), institutional stability and wellbeing (40 percent) and natural resource dependence (10 percent). To have long-lasting impacts, adaptation has to address all of these factors. The issues adaptation will face include how it can be factored into costs and in what form the benefits will be observable. In most developing countries this will require greater institutional capacity. Most national policymakers are unaware of potential impacts of climate change in different sectors (Reid & Huq, 2007). Increasing developing countries' adaptive capacity through development aid is more fruitful than climate change mitigation (Tol, 2003).

The total costs of adaptation are difficult to estimate, due to the dependency of vulnerability on local characteristics and changes in vulnerability over time. Global adaptation costs are estimated only to comprise around 7 to 10 percent of the cost of total global damage due to climate change (Tol, Fankhauser, & Smith, 1998). Current adaptation frameworks do not address the investments made during development and economic transition and their potential for adaptation, since most adaptation and impact studies assume economic equilibrium now and in the future (Bouwer & Aerts, 2006).

Some issues on the valuation of climate change in developing countries include: (Chambwera & Stage, 2010)

1. Data availability

The first issue is available data. Adaptation is an issue because it has associated costs, which can be properly established by data (Stern, 2006). Data is required for several purposes, including raising resources for adaptation and determining whether or not it is worthwhile to undertake adaptation, how much to invest, the most cost-effective methods, and so on. The IPCC's Fourth Assessment also recognizes the need for a good

understanding of the costs, barriers and limits to adaptation, which are not well established at the moment. Stern (2006)

2. Baseline development scenario

Any effort to estimate economic impacts of climate change needs to consider that physical impacts of climate change can occur only with considerable time lags. It will be difficult to compare the “no climate change” scenario with the “climate change but no adaptation” scenario or the actual “climate change and adaptation” scenario (Chambwera & Stage, 2010).

3. Valuation techniques

Adaptation economics generally need the valuation and quantification of key inputs and outputs of adaptation, such as the impacts of climate change and the costs and benefits of adaptation. In developing countries, valuation is more complex because of the interrelatedness and multi-use attributes of some factors. The use of the benefit transfer approach, which transfers values from existing studies to the climate change context (Metroeconomica, 2004) to identify the costs and time involved in carrying out primary studies for non-market values, can introduce errors, especially for developing countries. Benefit transfer from one country to another (or even within a country) needs to be done with great care, given how many other factors are likely to vary. Valuation is an issue that has especially confronted the field of environmental economics, and it inevitably confronts climate change adaptation economics.

4. Uncertainty

One of the barriers to adaptation is uncertainty (Stern, 2006). Uncertainty about future climate scenarios and their impacts is a major challenge to any economic analysis due to the long-term nature of climate change. It presents difficulties in determining the types of adaptation required and when they will be required. The issue that uncertainty raises is the extent to which economics remains a reliable decision tool. Capturing uncertainty in economic analyses is complicated by the fact that uncertainty is inherent in the science of climate change. This implies using scientific assumptions in addition to economic assumptions, which may undermine the reliability and robustness of the estimates. Temporal uncertainty is compounded by spatial differences in the impacts of climate change that are inadequately understood. The impacts of climate change vary from one location to another, even in the same country (Chambwera & Stage, 2010).

5. Discounting

The costs of climate change and the benefits of adaptation are related to the causes and effects that occur in very different time periods. These all need to be considered in the analyses. Economic analysis uses discounting to address benefits and costs that occur in different time periods. Discounting gives current decision makers a limited ability to decide the state of the world in periods that they may not live in. There is no consensus in the scientific community on the appropriate discount rate to use. Most analyses that employ discounting choose a rate through a combination of theoretical objectivity and ethical discretion. There is no universal discount rate, and assumptions about discount rates differ from country to country, considering the time period involved and whether a study is local, national or global. Most benefit/cost analyses are criticized for the discount factor used. The key issue is to use a discount rate that makes reasonable assumptions that are likely to be accepted by other economists and that give plausible results (Chambwera & Stage, 2010).

6. Relative prices

Relative price changes are linked to income elasticity. The income increases in the different scenarios studied will have equilibrium effects and lead to different relative prices for many goods. Furthermore, climate change also causes the loss of land, particularly productive land, which will lead to additional relative price changes (Sterner & Persson, 2008).

7. Level, scale and boundaries of analysis

The economic data on climate change and adaptation are difficult to reconcile at a single level. The structures of analytical units are different at all levels. Global data do not represent the lower levels, and local-level data do not add up to higher-level. National-level climate change economic analyses usually deal with sectors, which do not obtain data at the local level. This challenges the ability to extend higher-level analysis downwards or use local-level case studies at higher levels. It is, however, important that higher-level analyses match the reality on the ground; the challenge is to use suitable structural units that can be linked across all scales. Related to the scales, climate change affects large scales that surpass national boundaries. Its impacts, such as nature and intensity, are locally specific. This complicates economic analysis, which should be aligned with relevant decision-making structures that operate within different boundaries. Economic boundaries such as sectors (for example, the health sector) do not correspond with geographical boundaries such as ecosystems or ecological zones (Chambwera & Stage, 2010).

8. Capturing change

Technical, socioeconomic, political and environmental changes will occur during the long-term horizons of climate change, and such horizons also influence adaptation (European Environment Agency, 2007). Although there is a perceived positive correlation between economic development and adaptive capacity, this will be difficult to forecast into the future, especially in developing countries. The pattern of development will also differ from country to country, so that aggregated analyses will not capture these changes accurately. Changes in factors such as the populations and demographic structures of different countries challenge the reliability of economic analyses if not captured. As the need for adaptation changes, so will the costs and benefits. To give accurate estimates, economic models need to capture these expected changes (Chambwera & Stage, 2010).

IV. Possibilities/Opportunities to Financing Climate Change Adaptation in Developing Countries

Adaptation measurements can be financed in many ways. Available international financial resources for adaptation include UNFCCC funds and other resources, including public expenditures, official development assistance (ODA) and development bank loans. Current and potential future sources of funding for climate change adaptation include funds under the UNFCCC, the Global Environment Facility (GEF), non-compliance funds, disaster relief and risk reduction, public expenditures including public-private partnerships (PPPs), insurance and disaster pooling, development assistance and foreign direct investment (FDI) (Bouwer & Aerts, 2006). Several funding options are described below.

Funds Under the UNFCCC

Several financial mechanisms to support adaptation exist under the UNFCCC and the Kyoto Protocol, particularly in developing countries. The following four funds contain a total of over US\$310 million to date (Reid & Huq, 2007):

1. The Least Developed Countries Fund supported the development of National Adaptation Programs of Action (NAPAs) and will likely assist the Least Developed Countries (LDCs) to implement their NAPA projects. It is based on voluntary contributions from wealthy countries. The Least Developed Countries Fund, implemented through the GEF supports developing countries in preparing and implementing NAPAs (Bouwer & Aerts, 2006).

2. The Special Climate Change Fund is for all developing countries and covers adaptation and other activities. It is also based on voluntary contributions. The fund aims to support adaptation, energy, forestry, industry, technology transfers, transport, waste management and activities to assist developing countries in diversifying their economies (Bouwer & Aerts, 2006).
3. The Adaptation Fund is meant to support “concrete adaptation” activities. It is based on private sector replenishment through the 2 percent levy on Clean Development Mechanism projects (which channel carbon-cutting energy investments financed by companies in developed countries into developing countries), plus voluntary contributions. Adaptation Fund (AF) became a trust fund under the GEF. It will finance implementation of concrete adaptation projects in non-annex I countries, including activities aimed at avoiding forest degradation and combating land degradation and desertification (Bouwer & Aerts, 2006). AF was established in 2001 and is supervised and managed by the Adaptation Fund Board (AFB). The AFB is composed of 16 members and 16 alternates and meets at least twice a year (Membership of the AFB) (http://unfccc.int/cooperation_and_support/financial_mechanism/adaptation_fund/items/3659.php)
4. The Strategic Priority on Adaptation contains US\$50 million from the Global Environment Facility’s own trust funds to support pilot adaptation activities.

A number of bilateral funding agencies in countries including Canada, Germany, the Netherlands, Japan, the United Kingdom and the United States allocate funding for adaptation activities, including research and some pilot projects. To date, bilateral donors have provided around US\$110 million for over 50 adaptation projects in 29 countries (Reid & Huq, 2007). Canada, the European Union (EU), Iceland, New Zealand, Norway and Switzerland together reconfirmed the earlier pledge of US\$410 million by 2005 (UNFCCC decision 7/CP.7) at COP9, for the Special Climate Change Fund and the Least Developed Countries Fund. The Marrakech Accords (adopted at COP9) include a capacity-building framework (extending earlier capacity-building activities in developing countries) and a technology transfer framework (Bouwer & Aerts, 2006).

Adaptation Fund at COP21 was specifically referenced in the decision adopting the new agreement. During COP21, the fund also received new pledges totaling about US\$75 million from Sweden, Germany, the Wallonia region of Belgium and first-time donor Italy. The language accompanying the new COP21 agreement included the following references to the Adaptation Fund (AF):

60. Recognizes that the Adaptation Fund may serve the Agreement, subject to relevant decisions by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol and the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;

61. Invites the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol to consider the issue referred to in paragraph 60 above and make a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

(<https://www.adaptation-fund.org/cop21/>)

Global Environment Facility

The Global Environment Facility (GEF) is the institution assigned with the operation of the financial mechanism of the UNFCCC, and as such provides the instruments for the transfer of financial resources from developed to developing countries. The instruments for adaptation funding via the GEF are the GEF Trust Fund, the Least Developed Countries Fund and the Special Climate Change Fund. The GEF is funded by donor countries, some of which are also recipients, who commit resources every four years through a replenishment process. Related to climate change, GEF supports projects related to biodiversity, international waters, land degradation, the ozone layer and persistent organic pollutants. The GEF implements COP decisions, operates the financial instruments by establishing operational programs, providing programming documents and allocating resources. Developing countries can further pursue their interest in adaptation funding and further negotiate operational modalities at meetings of the GEF Council, which take place twice a year to decide on the operation of the financial instruments. Once a financial instrument is operational, eligible countries can propose projects based on their adaptation needs through one of the three IAs of the GEF: the United Nations Development Program (UNDP), the United Nations Environment Program (UNEP) and the World Bank. Seven additional executing agencies, including regional development banks, contribute to the implementation of GEF projects (Möhner & Klein, 2007).

Non-Compliance Fund

This fund comes from fees collected from countries in noncompliance with their obligations regarding greenhouse gas emissions reduction under the UNFCCC. The funds would be used for clean development and financing adaptation measures. However, funds based on noncompliance with obligations concerning greenhouse gas emissions reduction have to be negotiated through the UNFCCC

process. Scientific difficulties such as estimating the impact of the emissions of individual countries on the global climate (Rosa, Ribeiro, Muylaert, & de Campos, 2004), direct coupling of noncompliance and payments for adaptation would prove problematic in the negotiation process, as this would imply acknowledgement of responsibility for damages (Bouwer & Aerts, 2006).

Disaster Relief and Risk Reduction

There is increasing awareness that reduced vulnerability and increased preparedness are ways forward in terms of diminishing the long-term impact of natural disasters, while simultaneously decreasing demand for foreign aid and relief and reconstruction resources (Bouwer & Aerts, 2006). Funding of disaster risk reduction mainly takes the form of Official Development Assistance (ODA) and development bank initiatives, as well as efforts at the national government level. Disaster risk reduction reduces vulnerability to climate variability, once risk management strategies are incorporated into development projects; various institutions acknowledge this (Sperling & Szekely, 2005).

Public Expenditures Including Public–Private Partnerships (PPPs)

Activities based on public expenditures can be complemented by efforts within PPPs. PPPs are partnerships between public institutions, private companies and nongovernmental organisations (NGOs), which have the potential to strengthen public (sustainable development) goals by harnessing private efficiency and resources. If funds for PPPs are partly derived from development bank loans, regulations can be set with respect to the characteristics and objectives of PPP efforts. However, most research on PPPs is limited to activities that reduce greenhouse gas emissions; options for adaptation efforts still need to be explored (Bouwer & Aerts, 2006).

Insurance

Insurance-related instruments are a strategy proposed for supporting developing country adaptation and satisfying the intent of Article 4.8 of the United Nations Framework Convention on Climate Change (UNFCCC). In its first stage, a climate insurance program would be developed for risks of sudden- and slow-onset weather-related disasters. This program could take the form of an independent facility or partnership of donor organizations, or it could be mainstreamed into the operations of a multi-purpose disaster risk management facility. Its main purpose would be to enable the establishment of public/private safety-nets for stochastic climate-related shocks by assisting the development of insurance-related instruments that are affordable to the poor, coupled with actions and incentives for proactive preventive (adaptation) measures. A second stage

would provide disaster relief contingent on countries taking credible risk management efforts. The main advantage of this strategy is it can demonstrate feasibility, since it would be based on important precedents of donor-supported insurance systems in developing countries. Other advantages include its potential for linking with related donor initiatives, providing incentives for loss reduction (adaptation) and targeting the most vulnerable (Linnerooth-Bayer & Mechler, 2006).

Development Assistance

The objectives of climate change adaptation can be incorporated into development activities funded through ODA (African Development Bank, 2003). Risk assessments, vulnerability assessments and environmental impact assessments as part of ODA-funded projects can help to reduce the vulnerability of these projects to climate change. Globally, the amount of development assistance is decreasing, making ODA an increasingly limited funding source for adaptation. Furthermore, some part of ODA takes the form of loans, adding to national debt. Donor governments have frequently focused on multiple interests in development assistance, including their own economic and political goals, which have not always been consistent with the sustainable development objectives of host countries (Bouwer & Aerts, 2006).

Foreign Direct Investment (FDI)

FDI flows are potentially important for adaptation. One reason is that the amount of FDI in many countries is some orders of magnitude larger than the quantity of funds available for ODA. Ways can be found to influence investments and make them relevant to adaptation, most notably through national policy. For instance, climate risk can be reduced if government applies building codes and land-use regulations for real estate, including hotel resorts in the coastal zone. An increasingly attractive scenario for investors is if small subsidies, provided through loans from development banks, for example, complemented such regulations, compensating for the extra investment costs (Bouwer & Aerts, 2006).

References

- Adger, W. N. (2006). Vulnerability. *Global Environmental Change*, 16(3), 268-281.
- Adger, W. N., Agrawala, S., Mirza, M. M. Q., Conde, C., O'Brien, K., Pulhin, J., . . . Takahashi, K. (2007). Assessment of adaptation practices, options, constraints and capacity. In: Parry, M.L. Canziani, O.F., Palutikof, J.P., Hanson, C.E., van der Linden P.J., (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 University Press: Cambridge, pp. 719-743.
- Adger, W. N., Huq, S., Brown, K., Conway, D., & Hulmea, M. (2003). Adaptation to climate change in the developing world. *Progress in Development Studies*, 3(3), 179-195.
- African Development Bank. (2003). *Poverty and climate change: reducing the vulnerability of the poor through adaptation*: World Bank.
- Bouwer, L. M., & Aerts, J. C. (2006). Financing climate change adaptation. *Disasters*, 30(1), 49-63.
- Burton, I. (2000). Adaptation to climate change and variability in the context of sustainable development. *Climate Change and Development, Yale School of Forestry and Environmental Studies & UNDP: New Haven and New York*.
- Chambwera, M., & Stage, J. (2010). *Climate change adaptation in developing countries: issues and perspectives for economic analysis*: Iied.
- Davidson, O., Halsnæs, K., Huq, S., Kok, M., Metz, B., Sokona, Y., & Verhagen, J. (2003). The development and climate nexus: the case of sub-Saharan Africa. *Climate Policy*, 3(sup1), S97-S113.
- European Environment Agency. (2007). Climate Change: The Cost of Inaction and the Cost of Adaptation. *EEA Technical Report No. 13/2007. Copenhagen*.
- Linnerooth-Bayer, J., & Mechler, R. (2006). Insurance for assisting adaptation to climate change in developing countries: a proposed strategy. *Climate Policy*, 6(6), 621-636.
- Mertz, O., Halsnæs, K., Olesen, J. E., & Rasmussen, K. (2009). Adaptation to climate change in developing countries. *Environmental Management*, 43(5), 743-752.
- Metroeconomica. (2004). Costing the impacts of climate change in the UK: overview of guidelines: UKCIP Technical Report. UKCIP, Oxford, July 2004.
- Mirza, M. M. Q. (2003). Climate change and extreme weather events: can developing countries adapt? *Climate Policy*, 3(3), 233-248.

- Möhner, A., & Klein, R. J. (2007). The Global Environment Facility: Funding for adaptation or adapting to funds. *Stockholm, Stockholm Environment Institute*.
- Reid, H., & Huq, S. (2007). How we are Set to Cope with the Impacts. *IIED Briefing. London: International Institute of Environment and Development*.
- Rosa, L. P., Ribeiro, S. K., Muylaert, M. S., & de Campos, C. P. (2004). Comments on the Brazilian Proposal and contributions to global temperature increase with different climate responses—CO 2 emissions due to fossil fuels, CO 2 emissions due to land use change. *Energy Policy*, 32(13), 1499-1510.
- Smit, B., Burton, I., Klein, R. J., & Street, R. (1999). The science of adaptation: a framework for assessment. *Mitigation and Adaptation Strategies for Global Change*, 4(3-4), 199-213.
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16(3), 282-292.
- Sperling, F., & Szekely, F. (2005). *Disaster risk management in a changing climate: Vulnerability and Adaptation Resource Group*.
- Stern, N. H. (2006). *Stern Review: The economics of climate change* (Vol. 30): HM treasury London.
- Stern, T., & Persson, U. M. (2008). An even sterner review: Introducing relative prices into the discounting debate. *Review of Environmental Economics and Policy*, 2(1), 61-76.
- Tol, R. S. (2003). Is the uncertainty about climate change too large for expected cost-benefit analysis? *Climatic change*, 56(3), 265-289.
- Tol, R. S., Fankhauser, S., & Smith, J. B. (1998). The scope for adaptation to climate change: what can we learn from the impact literature? *Global Environmental Change*, 8(2), 109-123.
- Vincent, K. (2007). Uncertainty in adaptive capacity and the importance of scale. *Global Environmental Change*, 17(1), 12-24.
- Yohe, G., & Tol, R. S. (2002). Indicators for social and economic coping capacity—moving toward a working definition of adaptive capacity. *Global Environmental Change*, 12(1), 25-40.