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**Nairobi work programme on impacts, vulnerability and adaptation to climate change**

# Synthesis report on efforts undertaken to assess the costs and benefits of adaptation options, and views on lessons learned, good practices, gaps and needs

**Note by the secretariat**

*Summary*

Building upon the technical paper containing a review of the existing literature on the potential costs and benefits of adaptation options (FCCC/TP/2009/2), this report synthesizes information contained in submissions from Parties and relevant organizations, and other relevant sources, on efforts undertaken to assess the costs and benefits of adaptation options. A summary of lessons learned and good practices is provided. The report also identifies remaining gaps and needs relating both to a need for more comprehensive assessments of costs and benefits and to methodological gaps and needs encountered by adaptation researchers and planners when undertaking such assessments.

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# I. Introduction

## A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), in its conclusions at its twenty-eighth session on the Nairobi work programme on impacts, vulnerability and adaptation to climate change, requested the secretariat to prepare, by its thirty-second session, a synthesis report based on submissions from Parties and relevant organizations as well as other relevant sources on efforts undertaken, including methods used, to assess the costs and benefits of adaptation options, as well as their views on lessons learned, good practices, gaps and needs.[1]

2. At the same session, the SBSTA requested the secretariat to prepare before SBSTA 31 a technical paper reviewing the existing literature on the potential costs and benefits of adaptation options[2] and to organize, under the guidance of the Chair of the SBSTA and before SBSTA 32, a technical workshop on costs and benefits of adaptation options.[3] The workshop should be held with a view to facilitating the identification of appropriate adaptation practices and measures and avoiding maladaptation, taking into account the information in this synthesis report.

## B. Scope of the note

3. This document synthesizes the views and information submitted by Parties and organizations as invited by the SBSTA. Submissions were received from two Parties (the Russian Federation, and Sweden on behalf of the European Community, now the European Union (EU), and its member States), representing the views of 32 Parties, and two non-governmental organizations (the Indian Youth Climate Network and Population Action International).[4]

4. Other relevant sources considered in this paper include assessments undertaken for the UNFCCC National Economic, Environment and Development Study for Climate Change (NEEDS) project,[5] the United Nations Development Programme (UNDP) global project "Capacity Development for Policy Makers to Address Climate Change"[6] and the Regional Economics of Climate Change Studies (RECCS).[7] These assessments and studies became available after the publication of the technical paper referred to in paragraph 2 above on the potential costs and benefits of adaptation options (FCCC/TP/2009/2). This synthesis report is intended to complement the technical paper, in particular in the areas of lessons learned and good practices, gaps and needs. In contrast to the technical paper, which considered assessments at global, national and subnational level, this document focuses on the sectoral level to reflect the content of the submissions.

## C. Background

5. The overall objective of the Nairobi work programme is to assist all Parties, in particular developing countries, including the least developed countries and small island developing States, to improve their understanding and assessment of impacts, vulnerability and adaptation, and to make informed decisions on practical adaptation actions and measures to respond to climate change on a sound

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[1] FCCC/SBSTA/2008/6, paragraphs 51 and 52.
[2] FCCC/SBSTA/2008/6, paragraph 50. The technical paper is contained in document FCCC/TP/2009/2.
[3] FCCC/SBSTA/2008/6, paragraph 53.
[4] The submissions from Parties are compiled in document FCCC/SBSTA/2009/MISC.9/Rev.1. The submissions from non-governmental organizations are available at <http://unfccc.int/3689.php>.
[5] Information on the UNFCCC NEEDS project is available at <http://unfccc.int/2807.php>.
[6] Information on the UNDP project is available at <www.undpcc.org>.
[7] The Regional Economics of Climate Change Studies are commonly referred to as 'mini-Sterns', as many of them were inspired by the publication of the Stern Review. At present, RECCS have been undertaken in Latin America, the Caribbean, Asia and Africa.

scientific, technical and socio-economic basis, taking into account current and future climate change and variability.[8]

6. The Nairobi work programme comprises nine work areas through which it aims to achieve its objectives. This document is prepared under the fifth work area, "Socio-economic information", which seeks to advance the sub-theme stated in paragraph 3 (a) (v) of the annex to decision 2/CP.11, "Promoting the availability of information on the socio-economic aspects of climate change and improving the integration of socio-economic information into impact and vulnerability assessments".

# II. Efforts undertaken, including methods used, to assess the costs and benefits of adaptation options

## A. Introduction

7. Assessing the costs and benefits of adaptation options forms an important part of adaptation planning, allowing decision makers to make informed decisions when choosing options. The standard approach would be to compare the estimated costs of adaptation options against the expected benefits and to choose only those options where the net present value of the benefits exceeds that of the costs. Adaptation costs as defined in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change are "the costs of planning, preparing for, facilitating, and implementing adaptation measures, including transition costs", while the benefits are defined as "the avoided damage costs or the accrued benefits following the adoption and implementation of adaptation measures".[9] As adaptation measures may not always completely remove the impacts, the costs of any residual damages that remain after the implementation of the adaptation options must also be taken into account when choosing an option.

8. Although cost–benefit analysis is widely used for the allocation of public expenditure, it has limitations when applied in the context of adaptation. Issues relating to the valuation of non-monetary impacts (e.g. lives lost), in particular, make it difficult to rely exclusively on that approach. In some cases, more can be achieved by using a cost-effectiveness approach – that is, selecting the options that have the lowest cost for achieving a given physical target of supplying key services. Niue and Tuvalu, for example, have identified enhanced water supply and storage as the adaptation priority under the Pacific Adaptation to Climate Change project using such an approach.[10] The aim here is not to find alternative adaptation options that might yield a higher adaptation benefit but to find those options that ensure sufficient water quality and quantity for vulnerable communities.

9. In other cases, a risk-based approach, in which adaptation options are selected that achieve an acceptable risk level at least cost, may be more appropriate. The EU in its submission suggests that risk management approaches, including phased approaches or approaches based on no-regrets or win-win options, can be helpful in coping with uncertainty. Finally, in certain cases multi-criteria analysis may be adopted, to account for the fact that not all aspects can measured or costed. With multi-criteria analysis, a number of objectives are identified and each objective is given a weighting. Using this weighting, an overall score for each adaptation option is obtained, and the option with the highest score is selected.

10. Regardless of the selected approach, distributional effects have to be taken into account. In other words, the assessment needs to consider which sectors, groups or communities will bear the cost and which will enjoy the benefits of the adaptation option under consideration.

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[8] Decision 2/CP.11, annex, paragraph 1.

[9] Parry ML, Canziani OF, Palutikof JP, van der Linden PJ and Hanson CE (eds.). 2007. *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 and New York: Cambridge University Press.

[10] Information on the Pacific Adaptation to Climate Change project is available at <www.sprep.org/climate_change/PACC/index.asp>.

11. Although the choice of one adaptation option over another is not likely to be based on a pure cost–benefit assessment, it has been shown that an analysis of the costs and benefits, even if it is incomplete, provides important and useful information to the decision maker.

12. Many countries and regions are assessing the costs of climate change impacts, but not necessarily the costs of adapting to address those impacts. The PESETA project (Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis), which was managed by the European Commission's Joint Research Centre in 2009, assessed the climate change impacts on agriculture, river floods, coastal systems, tourism and human health that might occur in Europe without adaptation. It estimated that if the projected climate of the 2080s were experienced today, the annual damage of climate change to the EU economy in terms of loss of gross domestic product (GDP) would be between EUR 20 billion (under a scenario of a 2.5 °C temperature increase) and EUR 65 billion (under a scenario of a 5.4 °C increase and high sea level rise).[11]

13. The relative economic costs (expressed as an equivalent percentage of GDP[12]) of climate change will be higher in other regions such as Africa, which is particularly vulnerable and has a low adaptive capacity. These costs are highly uncertain, but aggregated models suggest that the main net economic costs of climate change could be equivalent to 1.5–3 per cent of GDP each year as early as 2030 in Africa.

14. The 2009 report by the United Nations Economic Commission for Latin America and the Caribbean on the economics of climate change in that region concludes that the economic costs are significant and that they have been increasing over time. As a follow-up to the study, an economic analysis of adaptation options will be undertaken.[13]

15. Of those studies that actually focus on the costs of adaptation, as opposed to the costs of impacts, many do not assess the benefits of adaptation or the residual impacts, even in qualitative terms. Before elaborating on efforts undertaken to assess costs and benefits of adaptation options at different levels and sectors (in chapter II C below), this document will consider the methods used in the section below.

### B. Methods used to assess costs and benefits of adaptation options

16. When undertaking an assessment of the costs and benefits of adaptation options, adaptation planners can consider either the economic or the financial costs and benefits. Economic assessments consider the wider costs and benefits to the national economy as a whole. In contrast, financial costs are typically assessed within the budgetary framework of each of the options under consideration. For example, in its submission, the Russian Federation reported on its assessment of the financial costs of enhancing systematic observation in the country. It considered the efficiency of its hydrometeorological services by assessing the costs of producing relevant hydrometeorological data and the benefits in terms of avoided damage achieved by preparatory measures that were made possible by the availability of high-quality, timely forecasts.

17. Besides financial and economic assessments, social appraisal is crucial in any assessment of costs and benefits of adaptation options, because the impacts of climate change often disproportionately affect the most vulnerable communities and groups. The EU, in its submission, calls for decision makers to take into account broader environmental, economic and social considerations, including preserving cultural values and ensuring equity and long-term sustainability.

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[11] Ciscar JC (ed.). 2009. *Climate Change Impacts in Europe. Final Report of the PESETA Research Project.* Available at <http://peseta.jrc.ec.europa.eu>.

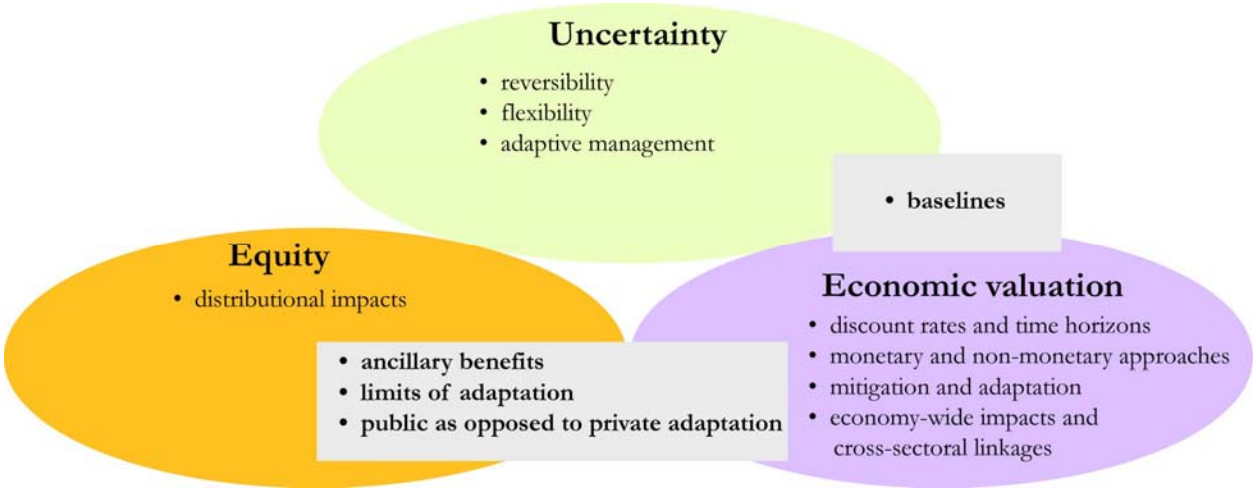
[12] These include both market and non-market costs, but are expressed as an equivalent percentage of GDP.

[13] United Nations Economic Commission for Latin America and the Caribbean. 2009. *Economics of Climate Change in Latin America and the Caribbean*. *Summary.* Available at <www.cepal.org/publicaciones/xml/3/38133/02_Economics_of_Climate_Change_-_Summary_2009.pdf>.

18. Existing assessments of the costs of adaptation generally fall into two broad groups: those that adopt an aggregated approach (usually applied at global, regional and sometimes national level) and those that use a more disaggregated approach and work up to an overall estimate (usually applied at national and subnational level). The aggregated approach is more basic and relies on a number of assumptions that are difficult to substantiate, including by estimating a level of 'climate-sensitive' investment and then applying a 'mark-up' to account for the additional costs of climate change. The disaggregated approach provides more accurate estimates at the sectoral level. However, when implementing this approach, planners and practitioners face considerable uncertainty over future developments in the economy as a whole and the likely impacts from climate change.

19. During any assessment, a number of methodological issues need to be taken into account, which can be grouped under the broad themes of uncertainty, economic valuation and equity as shown in the figure below.

**The main methodological issues involved in assessing costs and benefits of adaptation**




*Source*: FCCC/TP/2009/2. Refer to chapter III of the technical paper for detailed discussion of the concepts included in the figure.

20. As pointed out by the EU, those issues, including the choice of the discount rate used in the assessment, the uncertainties surrounding climate variables, how residual damage and externalities (e.g. co-benefits and co-costs at various levels) are treated and which approach is selected, need to be transparently reflected in any assessment. This will facilitate a comparison between adaptation options in the wider context of budget allocations.

21. The technical paper on the potential costs and benefits of adaptation options concluded that in order to allow for the issue of uncertainty, the ranges of possible values for the physical impacts of climate change as well as for the economic costs associated with those impacts have to be taken into account. Caution should be taken in expressing estimates of the costs and benefits of adaptation as single values.

22. In addition to the above, the technical paper and other current assessments suggest that adaptation planners could consider the following issues prior to undertaking adaptation assessments:

(a) The **objectives of the assessment**. Does the assessment seek to identify the scale of the adaptation issue and raise awareness (i.e. overall costs), or does it aim to provide sufficient information to allow decision makers to choose between adaptation options (i.e. detailed costs and benefits)?

(b) The **type of adaptation options to be assessed**. Should the adaptation options focus on preventing or reducing physical impacts or should they focus on reducing vulnerability? Should the adaptation options meet short-term priorities, including no-regrets measures and addressing current climate variability, or should they respond to longer-term concerns, including enhancing resilience to future climate change? The RECCS economics of climate change studies undertaken in Kenya and Rwanda, for example, focused on development-related adaptation strategies (accelerating development and increasing social protection) and climate change specific strategies (building adaptive capacity and enhancing resilience);[14]

(c) The **objectives of the adaptation options to be assessed**. Are they aimed at avoiding all damages, at returning levels of welfare to pre-climate change levels, at maintaining current levels of risk or at reducing them cost-effectively within agreed budgets or pre-defined acceptable levels? Germany, for example, is currently evaluating principles and criteria for defining and evaluating adaptation options to be included in its 2011 Action Plan for Adaptation. One principle under consideration is an agreement that irreversible changes are the most important changes to avoid.

## C. Assessments at various levels and in various sectors

### 1. Overview

23. Whereas earlier assessments of the costs and benefits of adaptation options focused on the global level, there are a growing number of studies, particularly in developing countries, undertaken at the national, subnational and sectoral level. National and subnational assessments employ a range of methods, including investment and financial flow analyses, integrated assessment models, computable general equilibrium models and sectoral impact assessment modelling.[15]

24. The technical paper found that existing assessments at the national level vary with regard to the time frames and metrics used, and that their results are not easily comparable. Nonetheless, many of them report high costs of adaptation, which implies that previously estimated global costs of adaptation may be too low.

25. Since the publication of the technical paper, a number of new assessments have been concluded, including assessments under the UNFCCC NEEDS, UNDP capacity development and RECCS projects. Many assessments start at a sectoral level and are then aggregated to provide cost and benefit estimates at the national level. In the UNDP and UNFCCC NEEDS projects, Parties focused on their most vulnerable sectors and estimated the additional investment and financial flows needed in those sectors to address climate change. For each chosen sector the investment costs were calculated for a baseline scenario, reflecting a continuation of current policies and plans; and for an adaptation scenario, reflecting changed

[14] The full reports of the studies and additional material are available at <http://kenya.cceconomics.org> and <http://rwanda.cceconomics.org>.

[15] A discussion of the strengths and limitations of those methodologies is included in the technical paper, chapter V.

and additional measures to address climate change impacts. The difference in cost between the baseline and the adaptation scenario represents the sector-specific adaptation investment needs.

26. In its NEEDS report, the Philippines announced that adaptation planning processes are under way and that adaptation strategies are being developed at national level, which will eventually be consolidated, integrated and costed. As part of that effort, the Philippines is assessing the financial flows needed for national adaptation-related expenditure, including for disasters caused by extreme weather events such as floods and droughts.

27. Italy, in its contribution to the submission from the EU, acknowledges the need to account for interactions between sectors and repercussions of climate change on the whole economy, in addition to simply aggregating separate sector estimates, so as to assess the total costs of adaptation.

28. In terms of selecting adaptation options, the assessments undertaken in Kenya and Rwanda concluded that the total adaptation costs are strongly influenced by the logic of what problems and what options are included in, or excluded from, the definition of 'adaptation to climate change'. While lower estimates assume that only the 'additional' costs needed to address future climate change should be counted, which covers options such as climate-proofing future investments, higher estimates are derived when accelerated development and social protection costs are included to address the current shortfall in adaptive capacity, or 'adaptation deficit', that exists in these countries, although these are caused by the existing climate variability and should be covered by development policy.

29. For Rwanda, for example, the immediate needs (for the year 2012) for building adaptive capacity and addressing early priorities in preparation for future climate change are estimated at USD 50 million per year, which is a significant increase from the current estimate of USD 8 million identified in its national adaptation programme of action. However, if the categories of social protection and accelerated development (to address the current adaptation deficit) are included, the adaptation costs for Rwanda could be as high as USD 300 million a year.

30. Ghana, in its NEEDS report, estimates that it would require about USD 700 million by 2020 to implement adaptation measures to reduce the effects of climate change (mainly in agriculture, health and coastal zones). Ghana acknowledges that those adaptation costs are uncertain because of the uncertainties associated with any readily available method to estimate adaptation costs and the existence of an adaptation deficit, as well as the fact that most adaptation activities will not have the sole purpose of adapting to climate change.

### 2. Sectoral assessments

31. In terms of sectoral coverage, the EU reported that the costs and benefits of adaptation options are better understood in some sectors (agriculture, water resources management and coastal zone management) than in others. Existing sectoral assessments are diverse; they cover different time frames, different adaptation options and different levels of adaptation, making it difficult to compare results between countries.

32. A study by the International Food Policy Research Institute (IFPRI)[16] assessed the costs of adaptation in the **agriculture sector** by focusing on child malnutrition. Adaptation options considered include agricultural research, expanding and enhancing irrigation, and improving rural roads. IFPRI estimated the global additional annual investment needed to return child malnutrition numbers to the numbers expected in a scenario of no climate change to be USD 7.1 billion under a wetter scenario and USD 7.3 billion under a drier scenario. Needs of sub-Saharan Africa dominate the adaptation costs, making up about 40 per cent of the total.

[16] International Food Policy Research Institute. 2009. *Climate Change: Impact on Agriculture and Costs of Adaptation*. Available at <www.ifpri.org/publication/climate-change-impact-agriculture-and-costs-adaptation>.

33. While the IFPRI study regarded irrigation as an efficient option, Brazil, in its RECCS economics of climate change assessment, concluded that irrigation has a lower overall benefit/cost ratio than other adaptation options. The most efficient option identified is genetic modification, requiring 1 billion Brazilian reais (USD 560 million) a year in research investment.[17]

34. In terms of **water resources**, the Netherlands, in its contribution to the submission from the EU, reported that assessments of costs and benefits have often facilitated decisions on the country's flood protection strategy. A recently conducted assessment on flood protection and flood risk management in the Netherlands estimates that the implementation of a comprehensive set of adaptation measures will cost EUR 1.2–1.6 billion per year up to 2050 and EUR 0.9–1.5 billion per year during the period 2050–2100. Those cost estimates are based on risk assessments and probabilities and are expressed as market values. They are additional to the costs already budgeted for bringing the flood defences into compliance with present flood safety standards.

35. While the Netherlands assessment focused on adapting to a certain flood risk, Turkmenistan, under the UNDP project, considered only those adaptation options that could eliminate the general risk of an expected water deficit of 5.5 $km^3$ by 2030, following a cost-effectiveness approach. In Turkmenistan, 90 per cent of the total water resources are used for irrigation in agriculture, so the adaptation options assessed include improving water resources management, optimizing agricultural production and increasing the efficiency of irrigation systems. The total cost of adaptation options was calculated to be USD 16.1 billion between 2009 and 2030.

36. Costa Rica, in its UNDP assessment, considered a wider range of aspects of water resources, covering generation of hydropower, water for human consumption, water for agricultural production, water discharges and flood control. Identified adaptation options include improving infrastructure to enhance water quantity and quality, improving storm and sanitary sewers, domestic and industrial wastewater treatment, raising public awareness and integrated watershed management. Options were categorized as policies, strategies, planning or operations. While the first two groups of options are assumed to have minimal costs and to be part of the regular budget, the second two are expected to have considerable costs in the short, medium and long term. The costs of immediate actions to enhance integrated water resources management are estimated to total USD 8.4 million over five years. Infrastructure costs are expected to total USD 6.3 billion by 2030.

37. Regarding **coastal zones**, the Kenyan RECCS study shows that adaptation has the potential to deliver significant benefits through reducing coastal erosion and inundation. The number of people that could be affected by flooding would be dramatically reduced by one to two orders of magnitude, to between 2,000 and 11,000 people per year in 2030 depending on the adaptation scenario. The cost of adaptation in 2030 is estimated at USD 28–56 million per year depending on the sea level rise scenario. These costs could rise to USD 80 million per year by 2050 and higher still after that if unabated climate change continues. The study acknowledges that some residual damage will occur in spite of adaptation. But it concludes that coastal protection is expected to substantially reduce the threat imposed by sea level rise at a relatively low cost, and that the benefits of adaptation far outweigh the costs.

38. In preparation for the Pacific Adaptation to Climate Change project, the Federated States of Micronesia assessed the costs and benefits of climate-proofing some of its coastal road infrastructure in the state of Kosrae.[18] Taking into account a projected increase in rainfall due to climate change, a climate-proof road design providing enhanced drainage was prepared and costed. The incremental cost of design and construction is approximately USD 511,000. Although the capital cost would be higher

[17] Brazil. 2009. *The Economics of Climate Change in Brazil: Costs and Opportunities. Executive Summary*. Available at <www.economiadoclima.org.br/files/biblioteca/Executive%20Summary.pdf>.

[18] Federated States of Micronesia. 2006. *Pacific Adaptation to Climate Change. Federated States of Micronesia, Kosrae State. Report of In-country Consultations*. Available at <www.sprep.org/att/publication/000661_Kosrae_FSM_NationalPACCReport_Final.pdf>.

than for a road built following the established design, repairs, maintenance and other accumulated costs would be lower after only about 15 years. Further analyses revealed that it is more expensive to climate-proof existing roads (USD 243,000 per km) than to build new climate-proofed roads (USD 77,000 per km). Nonetheless, even retroactive climate-proofing is still a cost-effective investment, with an internal rate of return of 13 per cent.

39. Another sector that will require adaptation is the **health sector**. Ghana, in its NEEDS study, assessed how to reduce the burden of climate-sensitive health determinants and outcomes and how to reduce the risk of heat stress. Adaptation options considered include improved monitoring systems to detect the arrival or presence of infectious diseases, and warning systems to warn the population about heatwaves. The study estimates the incremental cost of adaptation in the health sector to be USD 350 million by 2020 and USD 352 million by 2050. In addition, Ghana assessed public and private expenditure for malaria treatment, which forms about 50 per cent of all outpatient care in public hospitals. Health expenditure on malaria in Ghana comes from both the public and the private sectors: while public expenditure is used to run health facilities that treat malaria, private expenditure covers the cost of treatment. The additional investment in controlling malaria that will be required is estimated to be USD 7.6 million in 2020 and USD 7.54 million in 2050. These estimates do not include the costs of setting up new infrastructure (such as new hospitals).

40. Italy, in its contribution to the EU submission, pointed to a study[19] that also considered the costs of reducing heat stress. Following a series of serious heatwaves in 2003, several Italian cities adopted a heat health warning system (HHWS) similar to systems implemented in the United States of America. Assuming that Rome were to experience a heatwave equal in severity to the 2003 event and using estimates of the effectiveness of HHWS in saving the lives of people aged 65 and over, the adaptation strategies would save the lives of 81 people. Using existing estimates for the value of a statistical life, the benefits of adopting the HHWS system in Rome are estimated at around EUR 135 million for one summer. The cost of implementing the HHWS is unknown, but the authors suggest it would be significantly lower than EUR 135 million.

41. **Biodiversity and ecosystems** is one area where consideration of externalities and non-monetary values is paramount in an assessment of costs and benefits. According to Wetlands International, for example, an extensive study in Mali has shown that while the construction of dams does bring significant benefits to communities living upstream, such dams constrain the development opportunities for communities living in wetlands downstream of the dams owing in part to their effects on local ecosystems. Once all projected costs (losses in fisheries habitat, in agricultural land and in water purification capacity downstream) and benefits (irrigation and hydropower generation upstream) were taken into account, some dams were shown to have a net economic cost.[20]

42. Similarly, an international Economics of Ecosystems and Biodiversity study concluded that a cost-effective adaptation strategy will take into account broader investments in ecological infrastructure, such as nature's capacity to provide freshwater, climate regulation, soil formation, erosion control and natural risk management. Investing in the restoration and protection of mangroves in Viet Nam, for example, has significantly reduced the potential for damage from storms, coastal and inland flooding and landslides. Planting and protecting nearly 12,000 hectares of mangroves cost USD 1.1 million but saved annual expenditure on dyke maintenance of USD 7.3 million.[21]

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[19] Carraro C and Sgobbi A. 2008. *Climate Change Impacts and Adaptation Strategies in Italy: An Economic Assessment*. Available at <www.feem.it/userfiles/attach/Publication/NDL2008/NDL2008-006.pdf>.

[20] Zwarts L, van Beukering P, Kone B and Wymenga E (eds.). 2005. *The Niger, a Lifeline: Effective Water Management in the Upper Niger Basin.* Available at <www.wetlands.org/LinkClick.aspx?fileticket=KYnlSeF0qE8%3d&tabid=56>.

[21] Information on the Economics of Ecosystems and Biodiversity study is available at <www.teebweb.org>.

43. In terms of **data and systematic observation** as a cross-sectoral activity, the Russian Federation, in its submission, reported on a multi-year cost-and-benefit assessment of hydrometeorological information provision. The modernization of Roshydromet (the Russian Federal Service for Hydrometeorology and Environmental Monitoring), which included the development of a monitoring system to improve the quality of weather and climate forecasts and the expansion of user-tailored products, cost USD 80 million. It is estimated that the economic benefit from improving long-term weather and climate forecasts could exceed USD 7 billion per year.

# III. Lessons learned, good practices, gaps and needs

44. Even though the various national and sectoral studies considered in this report have different methodological frameworks and produced different outputs, which constrains their comparability, they significantly add to the knowledge in this field and allow for the identification of lessons learned, good practices, gaps and needs in the assessment of adaptation options. Nonetheless, despite the publication of new assessments under the UNDP, RECCS and UNFCCC NEEDS projects, the conclusion of the technical paper remains valid: that there is a need for more careful and detailed analyses of the economic costs and benefits of adaptation options. Important gaps in knowledge remain, and there is considerable scope for improving the economic assessment of adaptation options.

## A. Lessons learned and good practices

45. Whereas earlier assessments of adaptation options were undertaken at one level (e.g. at the global or national level), recent studies acknowledge the benefits of considering multiple levels and approaches. The World Bank's "Economics of Adaptation to Climate Change" study, for example, is being conducted at both global and national level.[22] Likewise, the Rwandan and Kenyan studies adopted three aggregation levels and suites of methods and models: (1) top-down aggregated economic analysis; (2) bottom-up sectoral impact assessment, and estimating the costs and benefits of adaptation, where possible; and (3) local-level assessments, using case studies to test the validity of the national assessments or to provide information on vulnerability and livelihoods for both impacts and adaptation, focusing on areas that would otherwise be missed by an aggregate or economic assessment.

46. These combinations of levels and methods have been proven useful in building up a comprehensive evidence base for policymakers. They allow studies to cross-reference model-derived aggregations with national and sectoral economic studies and local experiences, and to use complementary information from the various approaches for iterative analysis, whereby information from one method informs another.

47. Besides the choice of methods and levels, other studies point to the need for political consensus on the criteria and levels of uncertainty to be chosen to feed into the assessment. For example, a 2006 assessment of the incremental costs and benefits associated with adaptation options in the Netherlands highlighted the fact that cost–benefit analysis requires consensus, at least to some extent, about the (un)certainty with which climatic impacts will take place, as different probabilities may lead to substantially different conclusions on what would be the best option to implement.[23] When the uncertainties are considerable, it recommends that adaptation planners and practitioners regularly update climate scenarios and consult scenario experts for further analysis of the implications. In addition, the study notes that there might be other values in addition to economic values, such as landscape, natural, cultural and social values. A final weighing up of adaptation options needs to be undertaken by society at large, considering all of these cost-benefit aspects in a transparent, participatory process.

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[22] <www.worldbank.org/eacc>. National reports could not be considered in this report as they were not available at the time of writing.

[23] The full report is available at <http://www.rivm.nl/bibliotheek/rapporten/500102003.pdf>.

48. Finally, it is important to distinguish adaptation action for different time periods. The Kenyan and Rwandan studies, for example, first considered the effects of current climate variability and any adaptation deficit, especially in the context of immediate vulnerability (2012); second, adaptation options were considered for short-term policymaking, consistent with a 2030 timescale; and finally, both studies then looked at longer-term aspects (2030–2050). Such time differentiation is essential to capture all impacts, to consider the long lifetimes involved (e.g. for infrastructure) and to consider whether short-term actions increase or decrease future resilience or harm the potential for flexibility and different options in the future.

## B. Gaps and needs

49. A number of gaps and needs remain, concerning not only a need for more assessments of the costs and benefits of adaptation options but also methodological gaps and needs encountered by adaptation researchers and planners when undertaking such assessments.

50. With regard to **the need to increase the number of assessments and share the knowledge that is acquired**, the EU white paper on adapting to climate change[24] outlines efforts under way to improve the dissemination of knowledge on methods and approaches to establish the costs and benefits of adaptation options. This includes the establishment of a new European clearing house as an information technology tool and database on climate change impacts, vulnerability and best practices on adaptation, including cost and benefits of adaptation measures. According to the white paper, the EU will ensure the provision of adequate resources for efficient and cost-effective adaptation action.

51. More assessments are also under way at the national level in the EU. Finland, in evaluating its National Adaptation Strategy of 2005,[25] concluded that the average level of adaptation in Finland is still relatively low (level 2, on a one to five scale, where five is the highest level). Level 2 implies that the need for adaptation measures has been recognized to some extent, that the impacts of climate change are known to some extent and that adaptation measures have been identified, that plans have been made for their implementation and that some have been launched. The study calls for an investigation of the cost/benefit ratio and the cost-effectiveness of the adaptation measures, to support decision-making. Likewise, Spain, as part of the second work programme of the Spanish Climate Change Adaptation Strategy, will assess costs and benefits of adaptation options, including the costs of inaction, in a number of priority sectors and at various scales. The United Kingdom of Great Britain and Northern Ireland, meanwhile, will complete an economic analysis of adaptation options as part of a Climate Change Risk Assessment by mid-2012. The study is expected to provide monetary values for potential benefits of adaptation options where possible.

52. With regard to **methodological difficulties encountered during assessments**, Italy mentioned a number of gaps in information which led to an underestimation of the total costs of climate change in the country. These include a lack of accurate projections about the likely physical impacts of climate change, in particular at the national and regional level, and difficulties in translating physical impacts into monetary values, especially for non-market environmental goods and services, such as biodiversity or the cultural heritage. Italy indicated that integrated climate models are needed that allow for downscaling of global climate change scenarios, and that impact analyses should be focused on future impacts of climate change rather than on the assessment of past events.

53. In its submission, Population Action International pointed out gaps in the coverage of certain sectors and areas in adaptation assessments. It highlighted the importance of considering policies and

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[24] European Commission. 2009. *Adapting to Climate Change: Towards a European Framework for Action*. Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF>.

[25] Ministry of Agriculture and Forestry (Finland). 2009. *Evaluation of the Implementation of Finland's National Strategy for Adaptation to Climate Change 2009*. Available at <www.mmm.fi/attachments/mmm/julkaisut/julkaisusarja/2009/5IEsngZYQ/Adaptation_Strategy_evaluation.pdf>.

measures that address demographic trends, including interventions aimed at slowing the rate of population growth.

54. All of the recent national assessments cover only a selection of sectors and do not account for interaction between sectors. More comprehensive, cross-cutting studies are therefore needed to estimate the total costs of adaptation.

# IV. Issues for further consideration

55. In view of the information in this document and the conclusions of the technical paper, it is clear that knowledge on the costs and benefits of adaptation options is still evolving and that a number of issues for further consideration need to be investigated. Parties may wish to consider the following:

(a) To increase the evidence base of assessments of costs and benefits: How can more assessments, particularly those that are comprehensive and cross-cutting, be encouraged?

(b) To enhance the methodological understanding of assessments of costs and benefits:

(i) How could approaches be better combined and methodologies enhanced in order to improve the validity and value of assessments of costs and benefits for decision makers?

(ii) How do different objectives and time frames of adaptation influence the selection, design and outcome of assessments of costs and benefits of adaptation options?

(c) To enhance understanding of the potential role of assessments of costs and benefits in the overall adaptation planning and implementation process: To what extent can assessments of costs and benefits facilitate the identification of appropriate adaptation measures and practices, and assist in avoiding maladaptation?

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