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### Subsidiary Body for Scientific and Technological Advice

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

### **Report on the technical workshop on costs and benefits of adaptation options**

**Note by the secretariat**

#### *Summary*

This report provides a summary of the technical workshop on costs and benefits of adaptation options, organized under the Nairobi work programme on impacts, vulnerability and adaptation to climate change. The workshop was held in Madrid, Spain, from 22 to 24 June 2010. Discussions at the workshop addressed methodologies for assessing costs and benefits of adaptation options and how these methodologies are applied in and across different sectors. Participants also considered the role of assessments in the overall adaptation planning and implementation cycle, in particular how assessments assist in identifying appropriate adaptation measures and practices and in avoiding maladaptation. The report includes a summary of recommendations and concludes with issues for follow-up and further consideration under the Nairobi work programme.

## Contents

	<i>Paragraphs</i>	<i>Page</i>
I. Introduction .....	1–6	3
A. Mandate .....	1–2	3
B. Scope of the note .....	3	3
C. Possible action by the Subsidiary Body for Scientific and Technological Advice .....	4	3
D. Background .....	5–6	4
II. Proceedings .....	7–12	4
III. Analysis of key issues addressed at the workshop .....	13–67	5
A. Introduction .....	13–15	5
B. Methodologies for assessing costs and benefits of adaptation options .....	16–29	6
C. Current experience in assessing costs and benefits of adaptation options in and across different sectors, including lessons learned and good practices identified .....	30–58	9
D. Use of assessments of costs and benefits in identifying appropriate adaptation options and avoiding maladaptation .....	59–63	14
E. Gaps and needs in assessing costs and benefits of adaptation options and in making use of such assessments .....	64–67	15
IV. Summary of recommendations .....	68–72	16
V. Issues for follow-up and further consideration .....	73–78	18
A. Current and planned actions of Nairobi work programme partners .....	73–76	18
B. Possible next steps under the Nairobi work programme .....	77–78	18

## **I. Introduction**

### **A. Mandate**

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its twenty-eighth session, requested the secretariat 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.<sup>1</sup>

2. The SBSTA indicated that the workshop should involve representatives from Parties, relevant organizations, communities and experts, with a view to facilitating the identification of appropriate adaptation practices and measures and avoiding maladaptation. The SBSTA also indicated that the workshop should take into account submissions made by Parties and relevant organizations on the subject<sup>2</sup> and the synthesis report based on these submissions and other relevant sources.<sup>3</sup> The SBSTA further requested the secretariat to prepare a report on this workshop, to be made available by SBSTA 33.<sup>4</sup>

### **B. Scope of the note**

3. This document provides information on the workshop referred to in paragraph 1 above, drawing upon the presentations and discussions that took place.<sup>5</sup> It contains:

- (a) A description of the workshop proceedings (chapter II);
- (b) An analysis of key issues addressed at the workshop, including lessons learned and gaps and needs identified (chapter III);
- (c) A summary of recommendations for further action identified by participants (chapter IV);
- (d) An overview of current and pledged actions in relation to costs and benefits of adaptation options and possible issues for follow-up and further consideration under the Nairobi work programme on impacts, vulnerability and adaptation to climate change (chapter V).

### **C. Possible action by the Subsidiary Body for Scientific and Technological Advice**

4. The SBSTA may wish to consider this workshop report at its thirty-third session as part of its consideration of the outputs of activities completed prior to that session, with a view to reviewing the effectiveness of the Nairobi work programme.

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<sup>1</sup> FCCC/SBSTA/2008/6, paragraph 53. While the workshop was originally scheduled to take place from 20 to 22 April 2010 (i.e. before SBSTA 32), it was postponed till 22 to 24 June 2010 because of the severe flight disruption caused by the volcanic ash cloud over European airspace from 14 to 21 April 2010.

<sup>2</sup> Compiled into document FCCC/SBSTA/2009/MISC.9/Rev.1.

<sup>3</sup> FCCC/SBSTA/2010/3.

<sup>4</sup> FCCC/SBSTA/2008/6, paragraph 54.

<sup>5</sup> The relevant documentation related to this workshop is available at <<http://unfccc.int/5283.php>>.

## D. Background

5. The overall objective of the Nairobi work programme is to assist all Parties, in particular developing countries, including the least developed countries (LDCs) 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 scientific, technical and socio-economic basis, taking into account current and future climate change and variability.<sup>6</sup>

6. Activities in the work area of socio-economic information under the Nairobi work programme are undertaken with a view to advancing the objective stated in the annex to decision 2/CP.11, in particular the sub-theme stated in paragraph 3 (a) (v), "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. Proceedings

7. The technical workshop on costs and benefits of adaptation options was held in Madrid, Spain, from 22 to 24 June 2010. It was organized by the secretariat, in collaboration with the Ministry of the Environment and Rural and Marine Affairs of Spain. Ms. Paz Valiente (Spain) chaired the workshop on behalf of Mr. Mama Konaté, Chair of the SBSTA, who was unable to attend.

8. Participants at the workshop comprised 66 representatives from Parties and relevant international organizations, intergovernmental organizations and non-governmental organizations that are active in the areas of adaptation planning and practices, in particular with regard to conducting economic assessments of adaptation options.

9. Discussions at the workshop were informed by the submissions and synthesis report mentioned in paragraph 2 above, a technical paper reviewing the existing literature on the potential costs and benefits of adaptation options,<sup>7</sup> summaries of relevant work undertaken by Parties and organizations,<sup>8</sup> and the reports on two related workshops under the Nairobi work programme – one on adaptation planning and practices, held in September 2007 in Rome, Italy,<sup>9</sup> and one on socio-economic information, held in March 2008 in Port of Spain, Trinidad and Tobago.<sup>10</sup>

10. The opening of the workshop on the first day was followed by an introductory session, during which two presentations were made – one on the Nairobi work programme and the scope of the workshop, and another on the review of the existing literature on the potential costs and benefits of adaptation options and the synthesis report mentioned in paragraph 9 above. Following this, participants considered methodological aspects in a plenary session. Two presentations providing an overview of methodological issues related to cost and benefits of adaptation action were made, followed by three case studies on the main approaches to appraising adaptation options.

11. The second day was organized into three breakout groups: group 1 focused on agriculture, and ecosystems and biodiversity; group 2 discussed water resources and health; while group 3 discussed coastal zones, settlements and infrastructure. Following

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<sup>6</sup> Decision 2/CP.11, annex, paragraph 1.

<sup>7</sup> FCCC/TP/2009/2/Rev.1.

<sup>8</sup> These summaries are available at <<http://unfccc.int/5691.php>>.

<sup>9</sup> FCCC/SBSTA/2007/15.

<sup>10</sup> FCCC/SBSTA/2008/2.

presentations in each group on relevant case studies, participants exchanged experiences with regard to ongoing assessments of adaptation options, and identified lessons learned, good practices and further needs. Key discussion points and conclusions from the breakout groups were presented and discussed at a subsequent plenary session.

12. A panel discussion was held on the third day, during which panelists discussed the role of assessments of costs and benefits in facilitating the identification of appropriate adaptation practices and measures and the avoidance of maladaptation. In the final session, Parties and organizations made recommendations for possible next steps and follow-up action under the Nairobi work programme. In addition, they were invited to make new action pledges, provide updates on existing pledges and share information on relevant activities, with a view to addressing the challenges in assessing the costs and benefits of adaptation options that had been identified during the workshop. The workshop concluded with a chair's summary.

### III. Analysis of key issues addressed at the workshop

#### A. Introduction

13. Evaluating the costs and the benefits of adaptation options constitutes an important part of the adaptation policy cycle as it can facilitate the identification of appropriate adaptation practices and measures and the avoidance of maladaptation. Despite the importance of such assessments, the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) concluded that the literature on adaptation costs and benefits is quite limited and fragmented.<sup>11</sup> Since the publication of that report, more assessments of the costs and benefits of adaptation options have been started, with some results already published and others expected to be published throughout 2010. The increasing importance of such assessments in the overall adaptation planning and implementation process will be captured in the IPCC AR5, which will devote an entire chapter to the economics of adaptation.<sup>12</sup>

14. Assessments of the costs and benefits of adaptation options are undertaken at different levels depending on the policy questions that they are supposed to address. Assessments at the global level address the question of the scale of and the financial resources needed for adaptation, whereas assessments at the national level seek to determine national financing needs for adaptation and to facilitate the overall planning and prioritization of adaptation. Assessments at the subnational or local levels assist in the design and prioritization of specific adaptation policies, options and measures, and are thus closer to traditional economic appraisals.

15. Existing assessments at different levels have so far applied a wide range of methodologies, including economic integrated assessment model analysis, computerized general equilibrium (CGE) model analysis, investment and financial flow (IFF) analysis, bottom-up impact assessments and economic appraisal methods, including cost-benefit analysis (CBA), cost-effectiveness analysis (CEA) and multi-criteria analysis (MCA).<sup>13</sup> While the diversity of the approaches taken makes it difficult to compare their results, some

<sup>11</sup> 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.

<sup>12</sup> See <[www.ipcc.ch/pdf/ar5/wg2-outline.pdf](http://www.ipcc.ch/pdf/ar5/wg2-outline.pdf)>.

<sup>13</sup> A discussion of the strengths and limitations of these methodologies is included in document FCCC/TP/2009/2/Rev.1, chapter V.

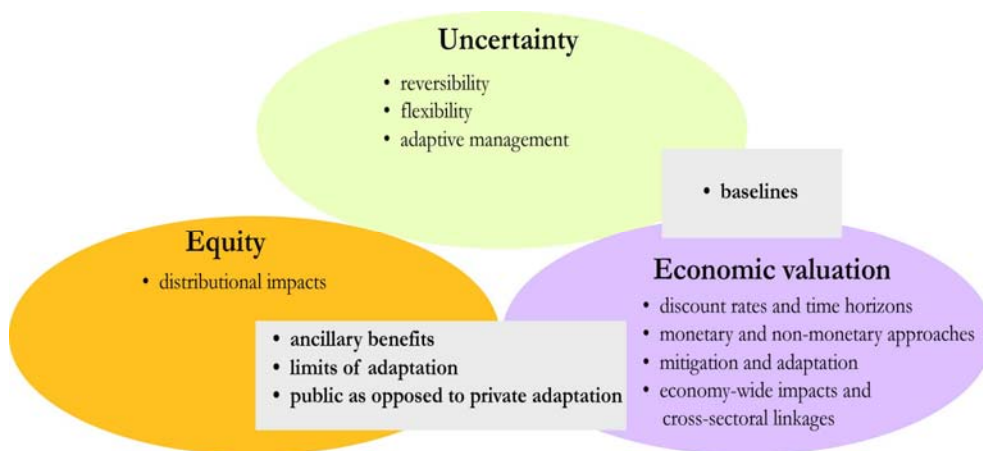
conclusions can be drawn from reviewing the existing assessments. The high adaptation costs reported in national and subnational studies suggest that the global adaptation costs previously reported may be too low. Given these differences in approach at the various assessment levels, there is potential for using a combination of approaches and assessment levels in order to establish evidence and validate existing results.

## B. Methodologies for assessing costs and benefits of adaptation options

16. In principle, an economic assessment of adaptation options entails estimating the benefits of options relative to a baseline scenario, projected climate change impacts and the costs of the options. After comparing the options, those with the highest estimated net benefits are selected. Adaptation costs are defined in the IPCC AR4 as “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”. As adaptation measures may not always completely remove the impacts of climate change, the costs of any residual damages that remain after the implementation of the adaptation options must also be taken into account when choosing them.

17. However, assessments of the costs and benefits of adaptation options are not straightforward, owing to methodological shortcomings related to uncertainty, economic valuation and equity, as shown in the figure below.

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



Source: FCCC/TP/2009/2/Rev.1. Refer to chapter III for a detailed discussion of the concepts included in the figure.

#### 1. Uncertainty, economic valuation and equity

18. In addition to the uncertainty of the timing and magnitude of climate change impacts, assessments need to account for socio-economic uncertainties, since they can influence the outcome of assessments more than climate signals. For example, while climate change has played a part in the increase in insured losses as a result of extreme weather events since the 1950s, this increase in losses is due mainly to increases in population, welfare and settlements in vulnerable areas. Aside from climate-related and socio-economic uncertainties, there are policy-related uncertainties (i.e. uncertainties

regarding the objectives of the adaptation measures or practices to be assessed). These may include questions as to whether welfare should be restored to pre-impact levels, whether a certain degree of risk or residual damage should be maintained, or whether risks should be reduced within agreed budgets.

19. Some workshop participants pointed out that dealing with uncertainty when making decisions is not unique to the field of adaptation, and they highlighted the importance of sensitivity analyses. The suggestion was made to evaluate how results of assessments are affected by different climate-related and socio-economic assumptions, in order to select those measures that perform satisfactorily under a range of possible outcomes. In addition, participants suggested that adaptation measures be designed so that they can be modified in the light of new information. One way of incorporating such an approach is through the use of option values or real options, particularly in cases where adaptation options have long lifespans.

20. In terms of economic valuation, participants noted the difficulty of estimating the monetary benefits of adaptation measures. One of the reasons for this is the absence of a common metric for adaptation, unlike in the case of mitigation, where the benefits are measured in terms of the reduction in greenhouse gas emissions (measured in tonnes of carbon dioxide). The benefits of adaptation differ between and within sectors depending on the specific climate change impact to which a measure is responding. For example, the PESETA project (Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis) used welfare as a proxy for benefits rather than gross domestic product (GDP) when assessing measures to adapt to increasing floods. As a measure of consumption, GDP tends to increase after a flood has occurred; however, while people consume goods and services in order to overcome the damage from the flood, this does not necessarily mean that they are better off. Other difficulties highlighted by participants included: quantifying costs and benefits occurring in the informal economy, which usually supports the poorer and more vulnerable segments of society; quantifying ancillary benefits of adaptation measures, such as increased capacity or raised awareness; and quantifying the value of life.

21. In terms of equity, many participants highlighted the need to consider distributional impacts of costs and benefits of adaptation options and to give due consideration to measures that benefit the vulnerable segments of society, namely the poor, the elderly and women. For example, the United Kingdom of Great Britain and Northern Ireland applies an equity weighting to ensure that the benefits to poorer people are valued higher than those to people who are better off. With regard to ensuring equity between different generations, the United Kingdom applies a discount rate of 3.5 per cent, which declines after 30 years. For large-scale, irreversible decisions, there is also the option of using lower discount rates.

## **2. Appraising adaptation practices and measures**

22. Participants discussed a number of ways of appraising adaptation options, including CBA, CEA and MCA. CBA is designed to show whether the total advantages (benefits) of an adaptation measure exceed the disadvantages (costs), which essentially involves calculating in monetary terms all of the costs and benefits of the measure/option as adjusted over time using discount rates to yield a net present value (NPV). An adaptation option would represent a good investment if the aggregate benefits exceed the aggregate costs. By monetizing the benefits of the adaptation measure, CBA allows for many different categories of benefits to be compared with one another.

23. For example, the United Kingdom applies CBA to the appraisal of adaptation options, as all government spending decisions are appraised in the same way.<sup>14</sup> A recent analysis of options to address increased flooding showed that the option with the highest NPV was the one that increased flood investments by 80 per cent, with an overall benefit–cost ratio (BCR) of 7:1. Mali has estimated that training farmers to carry out rainfall measurements and phenological observations has resulted in reducing seed loss from 40 to 5 per cent and in increasing crop yield. The cost avoided for loss of millet, sorghum and maize seeds is estimated at EUR 5 million/year. The positive BCR of 7:1 has helped make a clear economic case for improving weather information availability.

24. Many participants highlighted that CBA works best when all costs and benefits can be quantified in monetary terms and when the necessary data are available. CBA has difficulties accounting for costs and benefits that cannot be reflected easily in monetary terms, such as ecological or cultural values, as well as accounting for the distribution of the costs and benefits of adaptation options.

25. In the light of these shortcomings, participants stressed the role of alternative appraisal tools, such as CEA and MCA. CEA seeks to find the best adaptation option that minimizes the costs of achieving a desired outcome; for example, the lowest possible cost option that does not exceed a predefined acceptable level of risk. Given that CEA is performed when the objectives of the adaptation measures have been identified and the remaining task is to find the lowest-cost option for meeting these objectives, it does not evaluate whether the measure is justified (i.e. by generating a certain BCR or internal rate of return).

26. Participants stressed that CEA is applied in assessments of adaptation options for health, freshwater systems, extreme weather events, and biodiversity and ecosystem services; for example, in the context of assessing adaptation options to address water scarcity in Nauru, Niue, Tonga, Marshall Islands and Tuvalu. Given the necessity of water, the aim of the assessment is not to find alternative adaptation options that might yield higher adaptation benefits but to find those options that ensure sustainable water quality and quantity for vulnerable communities.

27. Many participants underlined that MCA offers a good alternative for the appraisal of adaptation options when data are only partially available, when cultural and ecological considerations are difficult to quantify and when the monetary benefits are only some of the criteria used. In addition, it allows for direct stakeholder engagement; the beneficiaries of the adaptation measures are involved in choosing them, which is crucial for their subsequent implementation. Participants from the LDCs stressed that MCA was the most frequently used approach during the preparation of their national adaptation programmes of action (NAPAs). For example, Mali, in prioritizing its adaptation activities, took into account the following five criteria: impact on vulnerable groups and resources; impact on the rate of economic growth for poor people; losses avoided for people; synergy with multilateral environmental agreements and national projects and programmes; and monetary costs.

28. Risk management approaches, which may be more appropriate for long-term planning, were also highlighted by participants. In Spain, assessments are undertaken that involve optimization processes; for example, the identification of the optimal water policy to satisfy irrigation needs for rice agriculture in the Ebro delta in times of drought.

29. With regard to choosing methodologies and appraisal tools, participants recommended selecting the approach that performs best under given constraints, such as

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<sup>14</sup> Guidelines for conducting CBA of adaptation options are available at <[www.defra.gov.uk/environment/climate/documents/adaptation-guidance.pdf](http://www.defra.gov.uk/environment/climate/documents/adaptation-guidance.pdf)>.



lack of data. In addition, it was stressed that methodologies cannot be addressed in isolation, but need to be considered within the broader socio-economic context (i.e. be consistent with methodologies that are normally used to appraise policy options in the public sector). Participants recalled the SustainabilityA-Test project, which evaluated existing decision-supporting tools by applying a consistent and comprehensive evaluation framework.<sup>15</sup> Other participants highlighted the need to consider the complete life cycle of adaptation measures in order to evaluate their direct and indirect costs and benefits and to avoid a bias for adaptation options which may be easy to assess but not necessarily effective.

### **C. Current experience in assessing costs and benefits of adaptation options in and across different sectors, including lessons learned and good practices identified**

30. Using presentations on case studies as a starting point, participants exchanged their experiences in undertaking assessments of costs and benefits of adaptation options in a number of sectors, including agriculture, ecosystems and biodiversity, water resources, human health, coastal zones, infrastructure and settlements. Assessments discussed ranged from quantitative, model-based assessments, such as CGE models, IFF analyses and CBAs, to more qualitative, participatory assessments, such as Participatory Rural Appraisal (PRA) and other MCAs. Many of the assessments discussed are still under way, and the results are often preliminary. Nonetheless, participants were able to identify lessons learned and good practices, which can be applied across sectors.

#### **1. Agriculture**

31. Climate change is expected to have an impact on agriculture in a multitude of ways. An increase in temperatures and a change in precipitation patterns will directly affect crops' growth and need for water, soil fertility, the performance and carrying capacity of animals and feed supply, water supply for irrigation, the prevalence of pests and the occurrence of extreme weather events; and indirectly affect market prices, owing to the different regional effects of climate change. While many adaptation measures are being taken by the farmers themselves, it is important to assess the costs and benefits of adaptation options for agriculture taking an economy-wide approach, as markets and trade play important roles.

32. For example, an assessment of the agriculture sector in Mozambique undertaken as part of the World Bank's Economics of Adaptation to Climate Change (EACC) project<sup>16</sup> combined climate with crop and dynamic CGE models to evaluate which adaptation strategy has the greatest potential to offset expected losses in GDP as a result of climate change impacts. Given the close links between agriculture and other economic sectors, potential adaptation measures were considered for hydropower, agriculture, transportation and coastal infrastructure. Of the evaluated adaptation scenarios, investing in agricultural research and extension services as well as in primary education performed best, since they were projected to almost completely offset the expected losses.

33. While the assessment undertaken in Mozambique looked primarily at the benefits of the different adaptation strategies in terms of absorbed losses, other economy-wide assessments undertaken in other countries focused more on the costs of adaptation options.

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<sup>15</sup> More information is available at <[www.ivm.vu.nl/en/projects/Archive/SustainabilityA-test/index.asp](http://www.ivm.vu.nl/en/projects/Archive/SustainabilityA-test/index.asp)>.

<sup>16</sup> More information is available at <<http://beta.worldbank.org/climatechange/content/economics-adaptation-climate-change-study-homepage>>.

For example, as part of a larger project<sup>17</sup> of the United Nations Development Programme (UNDP), five Latin American countries, namely Colombia, Ecuador, Paraguay, Peru and Uruguay, estimated the additional investment flows for physical assets and the financial flows for programmatic measures that would be needed to implement identified adaptation measures, such as planting new crop varieties, enhancing agroforestry systems and land-use planning, installing early warning systems and investing in education. The benefits of these measures were only assessed qualitatively.

34. Brazil, in the assessment for its agriculture sector, went one step further and appraised different adaptation options using CBA. On the basis of climate risk zoning and crop vulnerability, it estimated financial losses of 7.4 billion Brazilian reais (BRL) in 2020 – and up to BRL 14 billion in 2070 – stemming from a reduction in suitable crop areas. Of the considered adaptation measures, genetic modification was identified as highly effective at minimizing impacts, requiring BRL 1 billion/year in research investments. Irrigation was also considered, but had a lower overall benefit–cost ratio.

35. In addition to macroeconomic assessments, participants also shared their experiences in assessing options at a microeconomic level, such as at the levels of villages and households, using more participatory approaches. For example, in the Autonomous Region of Ningxia in China, adaptation options were appraised through PRA using eight criteria on a 1–4 scale, in order to reflect the perceived effectiveness and practical feasibility of each option. Criteria included win-win options, consistency with existing risk management activities, cost-effectiveness, adaptive flexibility, potential negative spin-off impacts, practicality and feasibility of implementation, certainty in predicting a particular change in hazard and its impact, and policy coherence with local and national disaster risk reduction and adaptation plans.

## 2. Ecosystems and biodiversity

36. Participants highlighted that climate change impacts on ecosystems are expected to be significant and irreversible in many cases and that adaptation is needed. Yet the economic assessment of adaptation options for ecosystems and biodiversity has been very difficult owing to the uncertainty of climate change impacts and the difficulty of evaluating the benefits of adaptation measures in monetary terms.

37. Early assessments used CEA to evaluate the costs of achieving a certain target, such as an increase in protected areas or in the number of species conserved as a result of different adaptation measures. Costa Rica, for example, is already firmly committed to protecting biodiversity and ecosystems. By undertaking an IFF analysis for selected adaptation measures, such as strengthening protected areas, increasing control of land-use change and illegal tree felling, conserving and restoring ecosystems, monitoring climate change impacts and setting up education programmes, it was able to identify the associated costs.

38. Participants noted that adaptation options for some ecosystems, such as forests, are easier to assess than those for other ecosystems, such as wetlands, since assessments for forests, for example, can benefit from earlier valuation work. India, for example, concluded that for its forests the adaptation costs will be in the range of USD 193–335 million/year by 2085, depending on the adaptation scenario. The Netherlands has developed ways of quantifying items that cannot be easily monetized – for example, it has been able to express loss of biodiversity and ecosystems in percentages – and it is currently devising ways of quantifying the cultural and historical value of landscapes.

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<sup>17</sup> More information on the Capacity Development for Policy Makers to Address Climate Change project is available at <[http://www.undpcc.org/content/inv\\_flows-en.aspx](http://www.undpcc.org/content/inv_flows-en.aspx)>.

### 3. Water resources

39. Participants noted the difficulty of assessing adaptation options for the water sector in isolation. Owing to its many and different uses, water links to all sectors of the economy: for example, water resources used for electricity generation link to the energy sector, while water used for irrigation links to agriculture. Water also links to health as well as to settlements and infrastructure. As such, assessments of adaptation options tend to focus on specific aspects of the water sector. The Netherlands and the United Kingdom are assessing adaptation options for the water sector with a view to minimizing the risk of floods, whereas countries facing water scarcity focus on adaptation options for irrigation agriculture.

40. Turkmenistan uses 90 per cent of its surface water for agriculture, which is an important contributor to its GDP. Given that there are no viable alternatives to irrigation agriculture, Turkmenistan used an IFF analysis to assess the costs of adaptation measures that would result in a decrease of the projected water deficit. The adaptation measures to be assessed were chosen based on their previous performance and included improving water management, optimizing agricultural production and increasing the efficiency of irrigation. The measures included in the baseline and adaptation scenarios were similar, but the scenarios differed in terms of the scale and timing of reducing the water deficit. In a second step, Turkmenistan seeks to better assess the benefits of the various adaptation measures and to investigate their cost-effectiveness (i.e. cost/m<sup>3</sup> water saved). In addition, there is a need to better understand how the introduction of new technologies affects investment and operating costs.

41. Participants pointed out that, apart from accounting for cross-sectoral measures, there is a need to assess transboundary adaptation measures, as river basins do not necessarily coincide with national boundaries. However, some participants pointed out that, while desirable, it may not always be politically feasible to undertake this type of assessment.

42. Participants also stressed that, so far, assessments have predominately looked at the supply side of water resources and that more effort needs to be directed at assessing the demand side. In this respect, the need to integrate hydrological supply models with socio-economic demand models and projections was highlighted.

### 4. Human health

43. Climate change will have an impact on human health in a number of ways, including in relation to morbidity and mortality owing to extreme temperatures, effects associated with air pollution, impacts of extreme weather events, malnutrition, and water-borne (e.g. diarrhoea, cholera and typhoid), food-borne (e.g. salmonella) and vector-borne (e.g. malaria and dengue) diseases.

44. The assessment of adaptation options in the health sector has been undertaken by estimating damage costs, for example by establishing the economic burden of malaria and dengue, and by estimating adaptation costs, for example the additional costs of treating incidences of climate-related diseases. In terms of metrics, disability-adjusted life year (DALY) and value of life year (VOLY) have proven helpful when undertaking CBA and CEA in some countries. Options are chosen if the cost per DALY or VOLY is less than an agreed amount. However, as a result of data requirements and cultural differences, DALYs and VOLYs are not applied in all countries.

45. Ghana conducted an IFF analysis for its health sector as part of the National Economic, Environment and Development Study (NEEDS) for Climate Change Project

under the UNFCCC,<sup>18</sup> with a view to estimating the costs of addressing malaria and health in general. No further disaggregation was possible owing to lack of data. Adaptation measures, including improved monitoring systems to detect the arrival or presence of infectious diseases and investment in heat-watch warning systems to warn the population about heat waves, were compared on the basis of their NPV.

46. Participants identified a number of challenges in assessing adaptation options in the health sector, such as the lack of socio-economic information. For example, it is important to know that treating patients for malaria or dengue can be more cost-effective than testing for the diseases. Participants also underlined that, although it is assumed that households' expenditure on health will increase with an increasing standard of living, it is not a given that everyone will have a bed net. There is also a need to be aware of what adaptation measures are socially acceptable among different population groups.

47. Furthermore, participants pointed out that there is a need to better understand the epidemiology of specific diseases in order to design and assess targeted policies rather than just general health policies. It was suggested that a typology of climate trends and expected health impacts be developed in order to facilitate planning.

48. In terms of the most appropriate method of appraisal, participants concluded that each tool has specific strengths and weaknesses, but CEA tends to be more useful for confined health issues, such as vector-borne diseases, and less successful when it comes to health issues that are linked to other sectors, such as water-borne diseases.

## **5. Settlements and infrastructure**

49. Climate change impacts will necessitate changing the design of settlements and infrastructure, such as roads, rail systems and power plants, through so-called 'climate proofing'.

50. The Russian Federation, through its Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet), has prepared an assessment report on climate change and its consequences, in which it considers impact indices for infrastructure in terms of frequency, intensity and duration of extreme weather events and anomalous climate conditions. Each type of infrastructure is assigned a level of acceptable risk, which is lowest in the case of nuclear power plants. As the level of risk to infrastructure built on permafrost in Siberia becomes unacceptable owing to decreases in the bearing capacity of permafrost soils as a result of global warming, unique building techniques are necessary to ensure the long-term viability of the infrastructure in that region.

51. In addition to ensuring that infrastructure and settlements withstand slow-onset events, such as thawing of permafrost or sea level rise, they also need to withstand the impacts of extreme weather events, such as floods or hurricanes. Saint Lucia, for example, is currently revising its building codes to take into account an increase in the frequency and intensity of hurricanes. Quantifying the costs of revising the codes is not straightforward since it relates not only to the actual technical analysis and revision of the legislation but also to the subsequent enforcement of these codes when building new houses and retrofitting old ones. Likewise, the benefits are difficult to quantify since they relate not only to the avoided damage to settlements and populations but also to increased public awareness.

## **6. Coastal zones**

52. Climate change is expected to have a significant impact on many coastal zones owing to sea level rise and an increase in the frequency and intensity of hurricanes,

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<sup>18</sup> More information on the NEEDS project is available at <<http://unfccc.int/5630.php>>.

affecting freshwater resources, agriculture, ecosystems, health, settlements and infrastructure. Generic adaptation options identified can be described as: retreating, accommodating and protecting.

53. Colombia, in its Integrated National Adaptation Pilot Project, has followed a ‘what if ...’ type of scenario in order to estimate the vulnerability of its coastal zone, identify critical areas and prioritize adaptation options. One of the prioritized measures includes rainwater harvesting for the Caribbean Insular Area in order to ease pressure on the island aquifers. This measure was assessed using CBA, whereby the benefits were calculated as the difference between the opportunity cost of desalinating water and the cost of alternative ways of supplying water. In the CBA process, the costs were those of supplying the collected and recovered water to each household by the rainwater harvesting system, including investment and maintenance costs. A comparison of the benefits and costs of the proposed rainwater harvesting system shows that it is worthwhile to collect rainwater, with a benefit–cost ratio of 2.44.<sup>19</sup>

54. The Caribbean Community Climate Change Centre (CCCCC) reported on a two-step approach to assessing the costs and benefits of adaptation measures addressing the impacts of climate change on biodiversity and land degradation along coastal and near-coastal areas in the Commonwealth of Dominica, Saint Lucia and St. Vincent and the Grenadines. In the first step, a financial analysis will be conducted as part of the selection process for site-specific pilot adaptation measures. During project implementation, data will be gathered to assess the actual benefits and costs of pilot measures, which will allow for a more comprehensive economic analysis in the second step once measures are expanded to other areas.

## 7. Lessons learned and good practices identified across sectors

55. The first step in assessing the costs and benefits of adaptation options in and across different sectors is to identify the options to be assessed. Participants agreed that adaptation options should be chosen based on the results of previous impact and vulnerability assessments, selecting those options that address adaptation in sectors that are socio-economically important and vulnerable to the adverse impacts of climate change. The selected options should be consistent with national and sectoral development priorities and socio-economic contexts, meaning that they should be socially acceptable and politically feasible.

56. Many participants pointed to the need to address cross-sectoral linkages and establish priorities across sectors, which can only be made possible by multi-sectoral, multi-ministerial, stakeholder-driven processes. In this regard, many participants stressed that designing an overarching adaptation policy or framework through a multidisciplinary process can give direction and guidance and allow for identifying a desired adaptation level and prioritizing within and across sectors. Once such priorities have been decided at a political level, planning and economic assessments are facilitated at the sectoral level.

57. Participants identified a number of good practices and lessons learned in relation to assessing adaptation options. Assessments and their underlying methodologies should be:

- (a) Practical (i.e. they have to work in a given cultural and socio-economic setting and take into account data constraints);
- (b) Relevant (i.e. results should be presented in a timely manner and in a format that is compatible with existing decision-making);

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<sup>19</sup> More information is available at [www.gefonline.org/ProjectDocs/Climate%20Change/Colombia%20Integrated%20National%20Adaptation%20Plan/Colombia%20INAP%20GEF%20Project%20Document.doc](http://www.gefonline.org/ProjectDocs/Climate%20Change/Colombia%20Integrated%20National%20Adaptation%20Plan/Colombia%20INAP%20GEF%20Project%20Document.doc).

(c) Robust (i.e. they should be transparent and consistent within and across sectors regarding the underlying climatic and socio-economic assumptions, expert judgments and uncertainties). For example, in its assessment, Ghana applied a discount rate of 10 per cent, whereas the World Bank, in its assessment in Mozambique, chose a lower rate of 5 per cent. Such information is crucial for understanding the final results;

(d) Comprehensive (i.e. they should assess a wide range of options, including inaction, and action outside sectoral boundaries, as well as ancillary impacts).

58. Another aspect highlighted by many participants concerned monitoring and evaluation. Sometimes the initial costing is lower than the real costs that are eventually incurred. In this regard, pilot projects and ex post evaluations can be helpful in identifying not only the real costs but also the range of direct to more indirect benefits.

#### **D. Use of assessments of costs and benefits in identifying appropriate adaptation options and avoiding maladaptation**

59. Participants stressed that adaptation to climate change should be seen as a comprehensive, iterative process of social, institutional and organizational learning, and not just a one-off outcome, after which technical solutions are implemented. Within such a process, assessments of the economic, environmental and social costs and benefits of options can play an important role in supporting decisions on adaptation. Economic analyses can inform when and where to act and how to prioritize and allocate scarce resources. Economic assessments can also ensure transparency and consistency during the identification of adaptation measures, as each evaluated adaptation option is subject to the same assumptions regardless of the approach chosen.

60. Participants also suggested making use of existing sectoral decision-making frameworks in order to avoid developing parallel processes. Participants agreed that the value of economic assessments goes beyond the development of figures on costs and benefits – assessments stimulate debate among stakeholders on the overall objective of adaptation and underlying climate-related and socio-economic assumptions and value judgments.

61. Participants highlighted the differing needs of local and national governments in terms of justifying policy decisions. Whereas decisions at the national level need to take the economic valuation fully into account, decisions at the local level need increasingly to be the result of participatory decision-making, which can include economic valuation, in order to facilitate implementation. Participants agreed that, regardless of the political level, there is a need to make adaptation measures ‘politically attractive’ by combining long- and short-term actions which can be shown to have economic and social benefits.

62. Furthermore, participants discussed enhancing the usefulness of assessments in supporting decision makers by being explicit about inherent uncertainties. Assessments should include sensitivity analyses to show the relative importance of not only climate but also socio-economic scenarios and assumptions. For example, in Ghana’s assessment for its health sector, household expenditure depends largely on whether or not the National Health Insurance Scheme can be sustained. In addition, the timing of implementing measures is important – sometimes it can be beneficial to take adaptation measures in phases in order to allow for a high degree of flexibility so as to prevent maladaptation when decisions are taken too early.

63. At the same time, participants acknowledged that, in a number of cases, there is already enough evidence to warrant the implementation of adaptation actions. Therefore, the absence of economic assessments should not be a reason for delaying adaptation

activities. Implementing adaptation options and assessing their costs and benefits can and must happen in parallel so as to develop and apply new information and knowledge in order to improve adaptation planning and implementation continuously. Participants agreed that priority should be given to advancing on-the-ground evidence and analysis, for example through ongoing and ex post evaluations (i.e. learning by doing rather than learning by thinking).

## **E. Gaps and needs in assessing costs and benefits of adaptation options and in making use of such assessments**

64. Participants identified a wide range of gaps, needs and challenges, including with regard to methodologies and the capacity for undertaking and making use of assessments. While some gaps and needs, such as dealing with non-market values, are common to most economic assessments, other challenges are unique to assessments of adaptation options, including dealing with the large range of uncertainties in climate and socio-economic scenarios.

65. With regard to the **methodologies and approaches to assessments**, participants identified the following gaps, needs and challenges:

(a) The need to arrive at common definitions, concepts and assumptions at the national level, relating to the objective of adaptation options, the underlying baselines and scenarios and the applied discount rates within a country, so as to ensure consistency and transparency;

(b) The challenge of quantifying and monetizing adaptation benefits. Participants highlighted the difficulty of translating physical impacts into monetary values. In many instances, the costs of implementing adaptation options and their benefits are only described in a qualitative way. Some participants argued for expressing benefits in terms of damages and losses avoided;

(c) The lack of adequate climate-related and socio-economic data. Data are often missing, incomplete or unreliable, and difficult to access or acquire. Participants pointed out that data on the same topics can vary depending on the source and that, in many cases, data are not sufficiently downscaled or disaggregated to allow for a meaningful assessment. Developing and collecting data is time and resource intensive and can take up a large part of an assessment's budget. Acknowledging that data collection is often not included in the cost of assessments, participants indicated the need to make it more explicit;

(d) The challenge of dealing with uncertainty and of projecting the range of adaptation options needed to respond to multiple scenarios. Some participants suggested learning from the stock market on how it deals with uncertainty by using real options and portfolio analyses;

(e) The need to better link climate and socio-economic modelling in order to identify climate change signals and to distinguish them from non-climate signals such as policies or infrastructure developments;

(f) The challenge of choosing an appropriate method of appraisal. Participants highlighted the need to better understand the different strengths, weaknesses and requirements of CBA, CEA, MCA and other approaches, how they fit into specific national decision-making frameworks and how they can be used in combination to facilitate the identification of appropriate adaptation measures.

66. In terms of the **capacity to undertake assessments**, the following gaps, needs and challenges were identified by participants:

(a) The need for financial and technical support and assistance in order to build up in-country capacity, including through education, training and creating institutional networks. Many participants from developing countries pointed out that economists with expertise in undertaking evaluations of adaptation options are rare and that more effort is needed to raise awareness on the importance of economic valuations for adaptation;

(b) The need to reduce the complexity of the assessment process, which tends to inhibit stakeholders when undertaking economic assessments. Participants highlighted the need to develop toolkits or guidelines exemplifying good practices;

(c) The need to provide information and guidance in languages other than English, particularly in local languages.

67. Finally, gaps, needs and challenges were identified in relation to **making use of the process of and results from assessing** the costs and benefits of adaptation options, including:

(a) The challenge of choosing the right options to be evaluated, particularly in the absence of an overarching adaptation policy framework. Participants recognized the difficulty of selecting and assessing sectoral measures without creating competition between ministries and the challenge of sustaining multi-ministerial processes in the light of competing priorities and budgets;

(b) The challenge of ensuring consistency and comparability when adaptation options from different sectors are being assessed and common metrics are lacking. Some participants pointed out that the lack of common metrics is not unique to adaptation and that prioritization needs to be transparent, sound and defensible;

(c) The challenge of presenting the results of assessments in a format that can be understood and used by decision makers. Some participants pointed to a lack of understanding of probabilistic tailored information;

(d) The need to better understand the role of economic assessments in the decision-making process. Some participants highlighted that sometimes economic analysis is a formality, and that decisions are made based on other political considerations. Other participants cautioned that economic analysis has a preference for considering investment measures and that other ways of reducing risk and building adaptive capacity, which may not be easily assessed, are being sidelined.

#### IV. Summary of recommendations

68. Based on the presentations and discussions at the workshop, participants identified a range of priority activities to be undertaken in order to advance the undertaking and use of assessments of the costs and benefits of adaptation options.

69. With regard to **assessments in general and their use in the overall adaptation policy cycle**, participants recommended that:

(a) Country-led analyses of costs and benefits of adaptation options be enhanced using methodologies tailored to national circumstances in order to support decision-making on adaptation;

(b) Methodologies be chosen pragmatically, taking into account the need to ensure the robustness of the methodology, compatibility with other decision-supporting methodologies employed, and proportionality (i.e. the depth and pace of the assessment should be driven by the decisions to be made and not by the aim for the perfect decision);



(c) Previously undertaken economic assessments be reviewed, including as to how they influenced policy outcomes, in order to increase understanding of the role of assessments in the adaptation policy cycle;

(d) NAPA-like processes be promoted for non-LDC developing countries that wish to implement them.

70. In terms of **advancing methodologies**, participants proposed:

(a) To build up data sets, including of downscaled social, economic and climate data and locally collected data, in order to validate global models and data. In addition, research needs to be undertaken and data collected, including through ex post evaluations of projects and programmes, in order to further increase the evidence base in relation to the costs and benefits of adaptation options;

(b) To advance the development of common definitions, concepts and methodologies to the extent feasible in order to ensure comparability of processes and results and to provide guidance;

(c) To further analyse how to address the issues of uncertainty and flexibility (i.e. by considering the timing of implementing measures and how such timing can influence the costs and benefits). Other areas in need of further research include co-benefits, trade-offs and cross-sectoral linkages;

(d) To investigate how to take more advantage of the strengths of the different appraisal techniques and how MCA and CBA could be used more effectively. Some participants called for further investigation into the potential of MCA, in particular how it can be used to address economic, social, cultural and environmental costs and benefits of adaptation options while allowing for a high degree of stakeholder involvement.

71. **The sharing of knowledge and information** could be enhanced through:

(a) Web-based information tools, including clearing houses, such as the planned Adaptation Clearing House Mechanism of the European Union, and other databases;

(b) Reviewing previous assessments, including NAPAs, the NEEDS project, the UNDP IFF project and the World Bank's EACC project, in order to take stock of technical attributes and policy impacts and to identify lessons learned and good practices, which can be shared with other stakeholders;

(c) Regional networking, including through regional organizations such as the Pacific Regional Environment Programme and CCCCC, or topical centres such as the Consultative Group on International Agricultural Research, in order to share good practices and create communities of practice in areas where a regional approach to adaptation is needed, such as in relation to water resources and fisheries;

(d) Promoting traditional and local knowledge and decision-support tools.

72. Finally, in terms of **capacity-building** and **awareness-raising**, participants proposed:

(a) To prepare guidelines, toolkits or handbooks on assessing the costs and benefits of adaptation options, building upon existing work. Some participants highlighted that, while guidelines and tools are necessary, they are not sufficient, and that an enabling environment which is conducive to adaptation needs to be created;

(b) To develop training programmes in developing countries on using and applying economic assessments;

(c) To build awareness of the value of undertaking economic analyses using a variety of communication tools.

## V. Issues for follow-up and further consideration

### A. Current and planned actions of Nairobi work programme partners

73. Through interventions made during the workshop, Parties, organizations and experts indicated possible ways of addressing the identified gaps and needs and of implementing the recommendations made at the workshop, especially in the area of capacity-building. A number of organizations made statements on how they wish to continue to support the Nairobi work programme in assessing the costs and benefits of adaptation options. In addition, action pledges were made by these organizations, expressing their commitment to contributing to the implementation of the recommendations.<sup>20</sup>

74. In terms of **advancing assessment methodologies**, Environmental Development Action (ENDA) updated participants on its work in the area of promoting knowledge-sharing and learning in sub-Saharan Africa. ENDA pledged to further develop assessment methodologies, building upon the NAPA process, and to share information. The Institute for Environmental Studies of VU University Amsterdam pledged to continue research on the economics of water management issues. The United Nations Environment Programme (UNEP) updated participants on a new project, MCA4climate, which has the aim of developing a multi-criteria analysis framework to guide sound, long-term policy planning in the area of climate change.<sup>21</sup>

75. With regard to **knowledge-sharing and capacity-building**, the Inter-American Development Bank (IADB) pledged to enhance its support for the sharing of lessons learned and experiences, to build capacity and to develop toolkits. Similarly, UNDP pledged to continue its capacity-building and outreach activities, including in collaboration with the global adaptation network of UNEP and its own adaptation-related learning mechanism, and to review its IFF project and share lessons learned. The Instituto Torcuato di Tella offered technical assistance and training, including in the identification and prioritization of measures and the development of instruments and tools to inform decision makers.

76. Finally, regarding the **use of assessments in the overall adaptation policy cycle**, IADB pledged to build capacity in ministries of finance in order to mainstream adaptation. The World Health Organization pledged to build on its existing pledge and further mainstream adaptation in health operations and to organize a workshop in November 2010 to look at costs and benefits of adaptation options in the health sector in more detail.

### B. Possible next steps under the Nairobi work programme

77. The recommended activities can be undertaken by Parties, relevant organizations and other stakeholders engaged in the Nairobi work programme in order to address the needs and gaps identified during the workshop. These recommendations could also be used by the SBSTA at its thirty-third session to inform its review of the effectiveness of the outcomes of the activities under the Nairobi work programme.

78. Participants at the workshop proposed a set of activities to be undertaken under the Nairobi work programme, including: to organize regional-level workshops on assessing the costs and benefits of adaptation options, in particular on underlying methodologies; and to facilitate further sharing of knowledge and expertise through publications on good practices

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<sup>20</sup> Relevant action pledges related to this workshop are available at <<http://unfccc.int/5283.php>>.

<sup>21</sup> More information will be made available at <[www.MCA4climate.info](http://www.MCA4climate.info)>.

and by encouraging regional centres and networks to advance their South–South and South–North cooperation on economic assessments.

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