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# Slow onset events

## Technical paper

*Summary*

This technical paper aims to generate a knowledge base on slow onset events and on approaches to address loss and damage associated with the adverse effects of slow onset climate change events in developing countries that are particularly vulnerable to the adverse effects of climate change. The technical paper discusses slow onset events in the context of climate change, identifies and analyses approaches to addressing loss and damage associated with slow onset events and takes into consideration the outcomes of the three regional expert meetings (for Africa, Asia and Eastern Europe, and Latin America) and the expert meeting for small island developing States and draws some observations with regard to gaps, challenges and lessons learned.

# Contents

# I. Executive summary

1. By decision 1/CP.16, the Conference of the Parties (COP) established a work programme under the Cancun Adaptation Framework to consider approaches to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change.[1]

2. Thematic area 2 of the work programme on loss and damage calls for "a range of approaches and tools to address loss and damage associated with the adverse effects of climate change, including impacts related to extreme weather events and slow onset events, taking into consideration experience at all levels".

3. Slow onset events were identified to include "sea level rise, increasing temperatures, ocean acidification, glacial retreat and related impacts, salinization, land and forest degradation, loss of biodiversity and desertification".[2]

4. At its seventeenth session, the COP requested the secretariat, within the context of Thematic area 2 of the work programme on loss and damage, to prepare a technical paper on slow onset events, taking into consideration the outcomes of the three expert meetings held at the regional level (for Africa, Asia and Eastern Europe, and Latin America) and the expert meeting for small island developing States (SIDS) under the same thematic area.

5. The objective of this technical paper is to generate a knowledge base on approaches to address loss and damage associated with slow onset events in developing countries that are particularly vulnerable to the adverse effects of climate change.

6. The paper provides an overview of climate-related slow onset processes, outlines a variety of approaches and tools that could help to reduce loss and damage associated with slow onset events, discusses needs, gaps and challenges related to implementation and enabling environments, and presents case study findings.

7. The key findings of this technical paper, also reflecting the outcomes of the expert meetings, include the following:

(a) The negative effects of slow onset events are already affecting developing countries and the resulting loss and damage associated with slow onset events is likely to increase significantly, even assuming that appropriate mitigation and adaptation action is undertaken;

(b) Vulnerable developing countries will be the hardest hit due to their low adaptive capacity;

(c) There exists a wide disparity in capacity between countries and regions to respond to slow onset events;

(d) Several approaches exist for addressing loss and damage associated with slow onset events, but there is a need for better communication to decision-makers about slow onset events and risk management options;

(e) There is a need to support vulnerable developing countries in developing and implementing risk management options appropriate to addressing loss and damage associated with slow onset events;

(f) There are important synergistic interactions between rapid onset and slow onset events that increase the risk of loss and damage, emphasizing the relevance of

[1] Decision 1/CP.16, paragraph 26.
[2] Decision 1/CP.16, paragraph 25.

integrated risk management approaches as well as the necessity to develop both short- and long-term planning;

(g) There is a need for sustainable financial instruments that are appropriate for addressing loss and damage associated with slow onset events, including residual risk in developing countries that are particularly vulnerable to the adverse effects of climate change;

(h) The management of slow onset risks will require strong and reliable institutional arrangements and governance structures; countries need to develop a forward-looking climate change policy with specific goals and priorities, that takes into account slow onset climate change and its impacts. Integration of the management of slow onset risks into national development planning, poverty reduction strategies and other relevant policy frameworks will help to coordinate actions across sectors;

(i) The greater uncertainty associated with the long-term nature of slowly evolving risks compared to rapid onset events emphasizes the need for flexible, iterative approaches that can be built into long-term planning processes;

(j) The emergence of a focus on non-economic losses and the ability to both assess and address these in terms of climate change is a significant component of the discussion on loss and damage;

(k) Further emerging issues that warrant increased attention include health impacts, issues concerning food and water security, and impacts on ecosystem resilience due to the adverse effects of slow onset events and processes; another area to take into account is the difference in slow onset impacts between urban and rural contexts.

# II. Introduction

## A. Mandate

8. By decision 1/CP.16, the COP established a work programme under the Cancun Adaptation Framework to consider approaches to address loss and damage[3] associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change.[4]

9. Decision 1/CP.16, paragraph 25, recognized "the need to strengthen international cooperation and expertise in order to understand and reduce loss and damage associated with the adverse effects of climate change, including impacts related to extreme weather events and slow onset events".

10. Slow onset events are identified to include "sea level rise, increasing temperatures, ocean acidification, glacial retreat and related impacts, salinization, land and forest degradation, loss of biodiversity and desertification".[5]

[3] The Convention does not define the term "loss and damage" as used by the work programme on loss and damage. A number of recent documents have explored the conceptual meaning of the term (e.g. Hoffmaister et al., 2012; Hoffmaister and Stabinsky, 2012; Stabinsky and Hoffmaister, 2012; Kreft and Warner, 2012; Siegele, 2012). In addition, the Loss and Damage in Vulnerable Countries Initiative is engaged in a number of activities to improve the understanding of loss and damage in the context of slow onset events. Available at <www.loss-and-damage.net>.

[4] Decision 1/CP.16, paragraph 25.

[5] Decision 1/CP.16, paragraph 25.

11. At the thirty-fourth session of the Subsidiary Body for Implementation (SBI), Parties agreed on three broad thematic areas in the implementation of the work programme on loss and damage:[6]

(a) Thematic area 1: assessing the risk of loss and damage associated with the adverse effects of climate change and the current knowledge on the same;

(b) Thematic area 2: a range of approaches to address loss and damage associated with the adverse effects of climate change, including impacts related to extreme weather events and slow onset events, taking into consideration experience at all levels;

(c) Thematic area 3: the role of the Convention in enhancing the implementation of approaches to address loss and damage associated with the adverse effects of climate change.

12. At COP 17, Parties agreed on activities to be undertaken in the course of 2012, including the development of a technical paper on slow onset events, taking into consideration the outcomes of three regional expert meetings and the expert meeting for SIDS.[7]

## B. Objective

13. The objective of this technical paper is to generate a knowledge base on approaches to address loss and damage associated with slow onset events in developing countries that are particularly vulnerable to the adverse effects of climate change.

## C. Scope of the paper

14. This paper focuses on approaches and tools to address loss and damage associated with slow onset climate change events, including conventional, non-conventional and innovative instruments to address specific types of loss and damage, especially those driven by the intensifying effects of climate change at all levels.

## D. Structure of the paper

15. The paper is organized as follows:

(a) Chapter I contains an executive summary;

(b) Chapter II provides an introduction;

(c) Chapter III provides an overview of slow onset processes and the major impacts of slow onset events;

(d) Chapter IV outlines a variety of approaches and tools to address slow onset events;

(e) Chapter V discusses implementation issues related to approaches to address loss and damage associated with slow onset events;

(f) Chapter VI discusses enabling environments for addressing slow onset events;

[6] FCCC/SBI/2011/7, paragraph 109.
[7] Decision 7/CP.17, paragraphs 6–11.

(g) Chapter VII discusses the development of a balanced and flexible strategy for reducing the risks of loss and damage associated with slow onset events.

# III. Conceptualizing approaches to address loss and damage associated with slow onset events

## A. Climate-related extreme events

16. The Intergovernmental Panel on Climate Change (IPCC) has concluded that current rates of climate change are leading to changes in the frequency, intensity, spatial extent, duration and timing of extreme weather- and climate-related events, collectively referred to as climate extremes (IPCC, 2012). The key findings from the IPCC report are summarized in box 1 below.

17. Changes in climate extremes reflect the influence of anthropogenic climate change in addition to natural climate variability. According to the IPCC, in the next two to three decades, the increase in climate extremes will probably be relatively small compared to the normal year-to-year variations in such extremes.

18. However, as climate change progresses over the course of the twenty-first century, its effects on climate extremes will become increasingly apparent (IPCC, 2012). Climate change may influence extreme events through long-term global warming as well as through climate regime shifts. The long-term trend of rising temperatures is accelerating, and changes of even 1 °C to 2 °C can have significant effects on extreme events (IPCC, 2012).

19. The work of Diffenbaugh and Scherer (2011) indicates that many regions are likely to permanently enter into a warmer climate regime during the twenty-first century, with the coolest warm season of the twenty-first century being hotter than the hottest warm season of the second half of the twentieth century. Tropical regions are particularly vulnerable to climate change, given that there is a 50 per cent likelihood that those regions will permanently move to a novel seasonal heat regime within the next two decades.

Box 1
**Key findings from the Intergovernmental Panel on Climate Change report on climate extremes**

(a) It is *virtually certain* that increases in the frequency and magnitude of warm daily temperature extremes and decreases in cold extremes will occur during the twenty-first century on a global scale;

(b) It is *very likely* that the length, frequency and/or intensity of warm spells or heat waves will increase over most land areas;

(c) A one-in-20 year annual hottest day is likely to become a one-in-two year annual extreme by the end of the twenty-first century in most regions;

(d) There is *high confidence* that changes in heat waves, glacial retreat, and/or permafrost degradation will affect high mountain phenomena such as slope instabilities, movements of mass and glacial lake outburst floods;

(e) It is *very likely* that mean sea level rise will contribute to upward trends in extreme coastal high water levels in the future;

(f) There is *medium confidence* that the duration and intensity of droughts will increase in some regions, including Southern Europe and the Mediterranean region, Central Europe, Central North America, Central America and Mexico, north-east Brazil and Southern Africa;

(g) There is *low confidence* in projections of changes in large-scale patterns of natural climate variability such as monsoons and El Niño/Southern Oscillation (ENSO) events. Confidence is low in projections of changes in monsoons (rainfall, circulation) because there is little consensus in climate models regarding the sign of future change in the monsoons. Model projections of changes in ENSO variability and the frequency of El Niño episodes are not consistent, and so there is low confidence in projections of changes in this phenomenon.

*Source*: IPCC. 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*.

20. Novel climate conditions and unprecedented climate change impacts may occur on a variety of temporal and spatial scales. A distinction is sometimes made between “rapid onset” and “slow onset” events. A rapid onset event may be a single, discrete event that occurs in a matter of days or even hours, whereas slow onset events evolve gradually from incremental changes occurring over many years or from an increased frequency or intensity of recurring events (Siegele, 2012).

21. There are some important relationships between rapid onset and slow onset events. Drought, for example, is an extreme weather event, but it is also closely linked to slow onset, incremental climatic change (IPCC, 2007).

22. Whether impacts result from a recurring rapid onset event or a slowly evolving process, impacts that accumulate over time may lead to a fundamental change in the state of the affected social-ecological system (United States Climate Change Science Program (CCSP), 2009).

23. An ecological threshold or tipping point is “the point at which there is an abrupt change in an ecosystem quality, property, or phenomenon, or where small changes in one or more external conditions produce large and persistent responses in an ecosystem. Ecological thresholds occur when external factors, positive feedbacks, or nonlinear instabilities in a system cause changes to propagate in a domino-like fashion that is

potentially irreversible. Once an ecological threshold is crossed, the ecosystem in question is not likely to return to its previous state" (CCSP, 2009, p.1).

24. There is some indication that interactions among rapid onset and slow onset events may result in thresholds being crossed. For example, a study in Florida found that once sea level reached a critical level, the transition from a landscape characterized by upland forests and freshwater wetlands to one dominated by mangroves occurred suddenly, following a single storm surge event (Ross et al., 2009).

25. The IPCC observed that "limits to resilience are faced when thresholds or tipping points associated with social and/or natural systems are exceeded, posing severe challenges for adaptation" (IPCC, 2012, p.20). Social tipping points occur, for example, when populations decide to migrate because climate-related damages become too severe and long-lasting.

## B. Impacts of slow onset events

26. The following sections of this chapter outline the main impacts of slow onset events as included in the Cancun Adaptation Framework.[8]

### 1. Sea level rise

27. Sea level rise results from the thermal expansion of the oceans and through the melting of glaciers and ice sheets resulting from rising atmospheric temperatures. The term "global sea level rise" refers to the worldwide average rise in mean sea level. Sea level rise at any given location may be greater or less than the global average depending on factors such as local land elevation. Thus, "relative sea level rise" is the rise in sea level measured with respect to a specified vertical reference point relative to the land, which may also be changing in elevation over time (e.g. due to subsidence). Most estimates of sea level rise in climate change publications refer to "global sea level rise", but "relative sea level rise" is the relevant metric for local analyses.

28. Global average sea levels rose at an average rate of about 1.7 mm (+/- 0.3 mm) per year from 1950 to 2009 and at a satellite-measured average rate of about 3.3 mm (+/- 0.4 mm) per year from 1993 to 2009 (Cazenave and Llovel, 2010; Nicholls and Cazenave, 2010). The recently identified accelerated decline of polar ice sheet mass (Velicogna, 2009) has raised the possibility of a future sea level rise of 1 m or more by 2100. Coastal storm surges are intensifying due to the combined effects of sea level rise and increased cyclonic activity resulting from warmer seas (IPCC, 2012).

29. Evidence of loss and damage resulting from sea level rise includes salinization of soils and reduced crop yields in cultivated areas; drinking water impairment from salinity intrusion into coastal aquifers; inundation and erosion of coastal ecosystems, including mangroves; loss of fish habitat and reduced fish production; damage to coastal infrastructure, including roads and port facilities; and loss of territory (IPCC, 2012).

30. The contribution of mean sea level rise to increased extreme coastal high water levels, coupled with the likely increase in tropical cyclone wind speed, is a serious problem for tropical small island states (IPCC, 2012). A study by the University of Oxford, in collaboration with the United Nations Development Programme (UNDP) office in Barbados, the Organisation of Eastern Caribbean States, the Caribbean Community

[8] FCCC/CP/2010/7/Add.1.

(CARICOM)[9] and CARIBSAVE, assessed the potential impacts of a 1–2 m sea level rise on coastal infrastructure and the tourism sector in the Caribbean. The study examined combined sea level rise and storm surge risks to quantify the extent of the erosion risk. The results of the study indicated that coastal erosion intensifies the impacts of sea level rise, greatly increasing economic losses. According to the assessment, a 1 m sea level rise would lead to average rebuilding costs for tourist resorts in the Caribbean of as much as 28 per cent of gross domestic product (GDP) by 2080. The researchers concluded that the impacts of sea level rise are "transformational" to the economies of SIDS and least developed countries (LDCs) in coastal areas (Simpson et al., 2010).

### 2. Increasing temperatures

31. The IPCC has estimated that if emissions continue to rise at current rates, by 2050 the concentration of greenhouse gases (GHGs) in the atmosphere will reach 550 parts per million and will continue to increase thereafter. Detailed projections for the twenty-first century indicate that global warming will continue and will accelerate, with the best estimates indicating a temperature increase of 3 °C by 2100 (within the range of 1.8 °C to 4 °C) (IPCC, 2007).

32. Increasing temperatures intensify the hydrologic cycle, causing dry regions to become drier and wet regions to become wetter. A recent analysis of observations over the past 50 years indicated that the intensification of the global water cycle is occurring at double the rate predicted by climate models (Durack et al., 2012).

33. In seasonally dry and tropical regions, crop productivity is projected to decrease as a result of local temperature increases of between 1 °C and 2 °C (IPCC, 2007). The IPCC has projected that a temperature increase of 2 °C, combined with decreases in soil water, would lead to a replacement of tropical forest by savannas in eastern Amazonia and in the tropical forests of central and southern Mexico, along with the replacement of semi-arid vegetation by arid vegetation in parts of north-east Brazil and most of central and northern Mexico (IPCC, 2007). Recent unprecedented dry years in the western Amazon (2005 and 2010) caused wide-scale tree mortality (Lewis et al., 2011). Tree dieback related to heat and drought has been observed in boreal forest over large areas of North America (Allen et al., 2010). Higher temperatures are changing the distribution of disease vectors, putting more people at risk from diseases such as malaria and dengue fever (Patz et al., 2005).

34. Increased sea surface temperatures (SSTs) resulting from rising air temperatures are producing coral "bleaching", a condition that occurs when warm waters cause coral polyps to expel the symbiotic algae that give them colour (Baker et al., 2010). Almost 30 per cent of warm-water corals in the Caribbean have disappeared since the beginning of the 1980s, largely as a result of increasingly frequent periods of high SSTs (World Bank, 2010). It is estimated that over 15,000 km of shoreline in the Caribbean could experience a 10 to 20 per cent reduction in wave and storm protection by 2050 as a result of reef degradation (World Bank, 2010). Many coastal economies depend on fisheries and on the tourism benefits of coral reefs, and a loss thereof would therefore have substantial economic impacts, as well as reducing marine biodiversity.

### 3. Ocean acidification

35. Ocean acidification refers to changes in ocean chemistry that have occurred as a result of carbon dioxide ($CO_2$) emissions. The ocean absorbs about one quarter of the $CO_2$ released into the atmosphere every year. The $CO_2$ absorbed by the ocean makes seawater

[9] Includes Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, Saint Lucia, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

more “acidic”, thereby interfering with the formation of the hard parts of corals and some shellfish; for example, the shells and plates of these organisms dissolve in the acidic water (Caldeira and Wickett, 2003).

36. The loss of shell-forming species, coral reefs and reef-dependent fisheries affects food security, trade and tourism. Tropical reefs support an estimated 25 per cent of marine fish species and provide food and livelihood security for some 500 million people worldwide (United Nations Environment Programme (UNEP), 2010). Coral reefs are also important for tourism, the major economic sector for many island and coastal States. The annual economic value of coral reefs to world tourism is estimated at around USD 9.6 billion (Conservation International, 2008).

37. Clams, scallops, mussels, oysters, abalone and conchs provide direct protein sources for various island and coastal communities and are valuable commercial fisheries. Many of these species show reduced growth and/or health under conditions of ocean acidification (UNEP, 2010).

### 4. Glacial retreat and related impacts

38. The melting of glaciers is directly related to increasing temperatures. Initially, melting produces erosion, mudslides and flooding, including very dangerous glacial lake outburst floods (GLOFs), but, as glaciers recede, water shortages will become a long-term problem for hundreds of millions of people, reducing runoff and river flows that support ecosystems and human livelihoods, and water availability for irrigation, hydropower and drinking water (United States Agency for International Development (USAID), 2010; United States National Research Council (NRC), 2012). Over the next 15 years, inter-tropical glaciers are very likely to disappear, reducing water availability and hydropower generation in Bolivia (Plurinational State of), Colombia, Ecuador and Peru (IPCC, 2007).

39. There is strong evidence of glacial retreat in the eastern Himalayas, where precipitation is dominated by monsoonal activity in summer. Any intensification of monsoonal activity and/or an increase in melting is likely to lead to flood disasters in this region (NRC, 2012).

### 5. Salinization

40. Increasing evaporation from rising temperatures contributes to the salinization of soil and water. Salts accumulate in the soils of arid environments. Saline soils contain large amounts of water-soluble salts that inhibit seed germination and plant growth, thereby reducing crop yields.

41. Saltwater intrusion into coastal aquifers occurs when groundwater withdrawal exceeds the recharge rate. The recharge rate declines as the precipitation decreases and higher temperatures increase evaporation. Salt-water intrusion also occurs as a result of sea level rise and when storm surges cause flooding of land by salt water.

### 6. Land and forest degradation

42. Land degradation results from a number of interacting climatic processes and human activities. Deforestation disrupts watershed processes, including the infiltration of precipitation into soils. During periods of limited rainfall, soils dry out and heavier rainfall results in greater and more rapid runoff, thereby increasing flooding and erosion. These processes reduce the productivity of the land, resulting in declining food production. Sediments and pollutants carried in heavy runoff are deposited to downstream waterbodies, impairing water quality and leading to overbank flooding. In coastal areas, the increased siltation of river deltas from upstream erosion, together with the destruction of mangroves,

reefs and other natural breakwaters, has increased exposure to storm surges and seawater intrusion into coastal aquifers (World Meteorological Organization (WMO), 2005a).

### 7. Loss of biodiversity

43. Slow onset climatic processes, such as increasing air and water temperatures and altered precipitation patterns, are affecting the structure, composition and functions of ecosystems, resulting in loss of biodiversity and reductions in the ecosystem services that help support human well-being. Ecosystem services are the benefits that humans derive from ecosystems, including: "provisioning services" such as food, water, timber and fibre; "regulating services" that affect climate, floods, disease, wastes and water quality; "cultural services" that provide recreational, aesthetic and spiritual benefits; and "supporting services" such as soil formation, photosynthesis and nutrient cycling (Millennium Ecosystem Assessment (MEA), 2005).

44. Ecosystem services generate substantial savings through "avoided costs". An example from Sri Lanka indicates that a coastal wetland may provide an economic value of USD 1,907 per hectare per year in reduced flood risks (Asian Development Bank (ADB), United Nations Economic and Social Commission for Asia and the Pacific and UNEP, 2012).

45. Temperature increases will potentially increase rates of extinction for many habitats and species. Based on a review of available studies up to 2006, the IPCC estimated that, on average, 20 to 30 per cent of the species assessed are likely to be at an increasingly high risk of extinction due to climate change impacts as global mean temperatures exceed 2 °C to 3 °C relative to pre-industrial levels (IPCC, 2007).

### 8. Desertification

46. The United Nations Convention to Combat Desertification (UNCCD) defines desertification as land degradation in arid, semi-arid and dry sub-humid areas (drylands). Processes that contribute to desertification include: alterations in temperature and precipitation patterns; soil erosion caused by wind and/or water; the deterioration of soil properties; and the long-term loss of natural vegetation (WMO, 2005b).

47. Climate change may exacerbate desertification through the alteration of spatial and temporal patterns in temperature, rainfall, solar radiation and winds. Increasing temperatures affect soil properties and processes, including organic matter decomposition, leaching, and soil water regimes. At lower latitudes, especially in seasonally dry and tropical regions, crop productivity is projected to decrease, even as a result of small local temperature increases (1 °C to 2 °C). In Africa, the area suitable for agricultural activity, the duration of the growing seasons and the yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease. In drier areas of Latin America, climate change is expected to lead to salinization and the desertification of agricultural lands (WMO, 2005b).

48. Desertification and the associated loss of vegetation contribute to loss of biodiversity and also to climate change through reduced carbon sequestration. The interrelationship among climate change, drought, land degradation and desertification is reflected in the objectives of both UNCCD and the UNFCCC, including explicit support for common actions in dryland ecosystems (UNCCD, 2011).

49. The cascading impacts of desertification also include loss of livelihoods and the displacement of populations from one degraded ecosystem zone to another. These kinds of impacts often have political ramifications and conflict implications.

# IV. Approaches and tools for addressing slow onset events

## A. Integrating disaster risk reduction, climate change adaptation and sustainable development

50. There is increasing interest in linking disaster risk reduction (DRR), climate change adaptation (CCA) and sustainable development efforts (Schipper and Pelling, 2006; Mercer, 2010; Olhoff and Schaer, 2011). The overlap of these concerns is reflected in a number of international agreements. For example, the Bali Action Plan calls for consideration of "disaster reduction strategies and means to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change".[10] The Hyogo Framework for Action[11] promotes "the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change" (United Nations International Strategy for Disaster Risk Reduction (UNISDR), 2005).

51. In this context, approaches for addressing slow onset events can be seen to fall along a continuum, ranging from development activities focused on vulnerability to activities that target specific impacts of climate change (see box 2 below). In practice, many actions span across more than one part of the continuum (McGray et al., 2007; Organisation for Economic Co-operation and Development, 2009; Olhoff and Schaer, 2011).

52. At one end of the continuum are activities focused on reducing vulnerability and building resilience to slow onset events and processes. These actions are primarily related to sustainable development, such as efforts to reduce poverty. The emphasis on reducing vulnerability and enhancing resilience is consistent with the objectives of the Cancun Adaptation Framework.

53. At the other end of the continuum are activities that address the risks of specific slow onset impacts of climate change. These activities focus on risks that are outside of climate variability.

54. The following sections of this chapter present examples of broad-based strategies for building resilience, followed by some examples of individual measures for reducing specific impacts of slow onset events. These actions are drawn from a variety of DRR, CCA and sustainable development disciplinaries. Although presented separately, it is important to emphasize that these activities are intended to form part of an integrated process for addressing multiple climate risks rather than actions to address a single event or period of time (IPCC, 2012).

[10] Decision 1/CP.13, paragraph 1(c).
[11] See <http://www.unisdr.org/eng/hfa/hfa.htm>.

Box 2
**Examples of categories of approaches to address slow onset events**

***Addressing the drivers of vulnerability***: these activities help to build the resilience of households and communities to both non climate related and climate-related stressors. Reducing poverty and other conditions that increase vulnerability to harm is beneficial whether or not the stressors that lead to harm are related to climate change. Examples include gender initiatives and livelihood diversification.

***Building capacity***: capacity-building includes developing and strengthening institutions in sectors directly affected by or sensitive *to* climate change. Examples include reforestation, natural resource management and weather monitoring.

***Managing climate risk***: activities in this category focus more specifically on hazards and impacts and follow the concept of climate *risk* management, which can be distinguished from typical development efforts through the use of climate information, although successful climate risk management activities may have strong development co-benefits. Examples include disaster planning activities, technological measures, such as the use of drought-resistant crops, and project 'climate proofing'.

***Confronting climate change***: activities in this category tend to *target* climate risks that are clearly outside of historic climate variability and that stem from anthropogenic climate change. Examples include: the relocation of communities in response to sea level rise; responses to glacial melt; and technological approaches, including developing infrastructure such as seawalls and dikes.

*Sources*: Modified from McGray H, Hammill A and Bradley R with Schipper EL and Parry J. 2007. *Weathering the Storm: Options for Framing Adaptation and Development*. World Resources Institute. Available at <http://www.wri.org/publication/weathering-the-storm>; Organisation for Economic Co-operation and Development. 2009. *Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance*; and Olhoff A and Schaer C. 2010. *Screening Tools and Guidelines to Support the Mainstreaming of Climate Change Adaptation into Development Assistance – A Stocktaking Report*. Available at <http://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy/www-ee-library/climate-change/stocktaking-of-tools-and-guidelines-to-mainstream-climate-change-adaptation/UNDP%20Stocktaking%20Report%20CC%20mainstreaming%20tools.pdf>.

## B. Ecosystem-based approaches for building resilience

55. Ecosystem-based measures help reduce vulnerability and build resilience across sectors. Integrated resource management and ecosystem-based adaptation (EbA) are particularly appropriate for slow onset events and processes because they involve long-term strategies for building resilience. As resilience develops, these approaches also help to protect against rapid onset events and other stressors which may occur independently of or in connection with slow onset events.

56. EbA involves the use of biodiversity and ecosystem functions to help countries adapt to the adverse effects of climate change (World Bank, 2010). Ecosystem-based actions are considered "triple-win" solutions because they provide cost-effective risk reduction, support biodiversity conservation and enable improvements in economic livelihoods and human well-being (IPCC, 2012).

57. EbA uses the sustainable management, conservation and restoration of ecosystems to improve adaptive capacity. EbA can: generate significant social, economic and cultural co-benefits; contribute to the conservation of biodiversity; and build upon the traditional knowledge and practices of indigenous peoples and local communities. In addition, healthy,

well-managed ecosystems have climate change mitigation potential, for example through carbon capture and storage in healthy forests, wetlands and coastal ecosystems. The reversal of land degradation and desertification and the protection of the coastal zone all contribute to EbA (World Bank, 2010).

58. Recognizing the importance of ecosystem services and integrating them into land-use management plans can result in substantial savings over the long term. For example, mangrove restoration in Viet Nam at a cost of USD 1.1 million has led to a saving of USD 7.3 million per year in dike maintenance costs and has provided employment for over 7,000 people (International Federation of Red Cross and Red Crescent Societies, 2001).

### 1. Sustainable land management

59. Sustainable land management (SLM) practices address land degradation. Specific measures help to improve and restore the structure of degraded soils, thereby promoting the infiltration of rainwater and increasing the soil's capacity to store water and nutrients (see para. 60 below). This in turn helps to promote the regrowth of vegetation, thus protecting landscapes from temperature extremes and helping to reverse desertification. SLM practices also contribute to climate change mitigation by sequestering carbon in soils and vegetation.

60. The main techniques for restoring soils and increasing vegetative growth include (Woodfine, 2009):

(a) Revitalizing biological tillage;

(b) Reducing compaction;

(c) Increasing rainfall infiltration;

(d) Protecting natural drainage through the soil profiles;

(e) Increasing water storage capability;

(f) Naturally improving soil nutrient status.

### 2. Community-based natural resource management

61. Community-based natural resource management (CBNRM) provides communities of stakeholders with legal rights, an institutional base and economic incentives to share responsibility for the sustained use and management of local natural resources. CBNRM generally draws from local and indigenous knowledge, which is often rooted in integrated ecosystem-based management practices such as SLM (see box 3 below).

Box 3
**Indigenous methods of sustainable land management**

The Chagga home gardens on the southern and eastern slopes of Kilimanjaro in the United Republic of Tanzania have been run using traditional sustainable land management practices for over a century. Those practices include: (a) using a mixture of annual and perennial cash and subsistence food crops; (b) planting and retaining a wide range of woody species for fruit, fodder, fuel, soil fertility and medicines; (c) rearing poultry and stall-fed livestock, utilizing feeds produced on-farm (e.g. crop residues and fodder plants) and providing manure for fertilizing crops; (d) implementing a diverse pattern of vertical and horizontal zoning of different tree and crop components to exploit the different micro-environments; (e) implementing sequential cropping patterns to maximize the continuity of production (reducing the risk of crop failure); and (f) keeping bees to provide honey and improve crop pollination.

*Source*: Woodfine. 2009.

## C. Measures and tools for responding to slow onset events

62. In addition to the broad-based strategies to build resilience discussed in paragraphs 55–61 above, a range of individual measures exist that address particular elements of slow onset processes. Some examples of sector-specific measures are provided in paragraphs 63–73 below.

### 1. Sea level rise

63. Field studies and the development of local digital elevation models are important for determining accretion and erosion rates relative to the local rate of sea level rise. This information can feed into models to evaluate actions to address risks under a range of climate scenarios. Field observations and modelling will help determine "hot spots" of vulnerability requiring enhanced protection measures.

64. Efforts to address sea level rise, such as the Conservancy Adaptation Project mentioned in box 4 below, and salinization frequently focus on work being carried out by and with the participation of local communities so as to address salinization by linking indigenous and traditional knowledge with scientific knowledge as well as by 'climate proofing' infrastructure (ADB, 2005).

Box 4
**The Conservancy Adaptation Project in Guyana**

The Conservancy Adaptation Project project in Guyana is reducing vulnerability to catastrophic flooding in low-lying coastal areas threatened by sea level rise. The project involves the implementation of a lowland drainage system aimed at increasing discharge capacity and improving the water level management of the water system. The project is also helping to strengthen the institutional framework for flood control within the national emergency management sector and is supporting the institutional consolidation of flood control measures to help create consensus around a medium- and long-term sea level rise intervention strategy.

*Source*: World Bank. Available at <http://www.worldbank.org/projects/P103539/conservancy-adaptation-project?lang=en>.

### 2. Rising temperatures

65. Some of the key methods to address the effects of rising temperatures include water conservation programmes, reserves to protect coral reefs and health programmes focused on temperature-sensitive disease vectors. As increasing temperatures affect multiple resources, many cross-sectoral strategies, including ecosystem-based approaches, can have beneficial results.

### 3. Ocean acidification

66. Ocean acidification is one of the most difficult slow onset events to address, because the atmospheric concentration of $CO_2$ has already resulted in harmful levels of acidification and the only measure that is certain to decrease acidification is to reduce GHG emissions (Caldeira and Wickett, 2003). Owing to the seriousness of the problem, a recent paper by Rau et al. (2012) proposed a number of methods that could potentially reduce ocean acidification (see table 1 below); however, they remain experimental and their effectiveness is unknown.

Table 1
**Examples of proposed innovative methods to address ocean acidification**[12]

| *Biological method* | *Chemical method* | *Hybrid and other methods* |
|---|---|---|
| Selective breeding | Chemical or geochemical modification of seawater (e.g. alkalinity addition, pH elevation) | Conversion of waste carbon dioxide to ocean alkalinity |
| Artificial selection | | Storage of land crop waste in ocean |
| Genetic engineering | | Ocean fertilization |
| Creation of refuges | | |
| Artificial preservation of genetic stock | | |

*Source*: modified from Rau GH, McLeod EL and Hoegh-Guldberg O. 2012. The need for new ocean conservation strategies in a high-carbon dioxide world. *Nature Climate Change*. 2.

### 4. Glacial retreat

67. Techniques to prevent GLOFs include the artificial draining of glacial lakes. This requires information which may not be readily available, including satellite surveys of lake areas and glacier velocities, inventories of lake properties and infrastructure at risk, and information on local hydrometeorology. Strengthened governance institutions and improved regional cooperation are important for addressing information gaps and other adaptation needs (USAID, 2010).

### 5. Salinization

68. Excess salinity can be removed from soils by leaching or by installing a drainage system for large areas. Methods to reduce the salinization of coastal aquifers may include the implementation of control techniques such as artificial recharge or subsurface barriers.

### 6. Land degradation and deforestation

69. Techniques to rehabilitate degraded lands include assisted natural regeneration (ANR), enrichment planting, agroforestry, and soil and water conservation. ANR is used to

[12] The feasibility of implementing these geoengineering techniques without causing other negative impacts has yet to be ascertained.

accelerate regeneration using techniques such as removing weeds around seedlings and protecting sites from fire. Enrichment planting involves the planting of desirable species in degraded areas, while plantations are often used to increase the total tree volume. Agroforestry is a set of land-use practices involving the deliberate combination of trees, agricultural crops and/or animals on the same land management unit in a particular spatial arrangement or temporal sequence (Blay et al., 2004; Woodfine, 2009).

## 7. Loss of biodiversity

70. The first line of defence against loss of biodiversity is to reduce current non-climate stressors. Next in terms of importance is the need to create protected reserves and biodiversity corridors in fragmented landscapes in order to connect areas of suitable habitat.

71. Reserve design requires explicit consideration of climate change. For example, a species distribution model is a tool for projecting how the distribution of species of concern may change in response to changes in temperature and other climate variables. Another approach is to create "mobile reserves" that are based on changes in habitat conditions as opposed to a fixed location.

72. In addition to traditional approaches such as natural resource management and conservation planning, increasing efforts are being made to draw attention to the value of the ecosystem services provided by natural resources (MEA, 2005). Attaching monetary value to these services through approaches such as the Payment for Ecosystem Services programme not only helps to protect biodiversity but also creates alternative livelihoods (see box 5 below).

Box 5
**Payment for Ecosystem Services**

Innovative tools, such as the Payment for Ecosystem Services (PES) programme, promote biodiversity protection via the marketplace. Some PES arrangements generate income for farmers or landowners through direct payments, usually by a government agency, in exchange for managing their land to provide one or more ecosystem service. Regulatory ecosystem service markets are established through legislation that creates demand for a particular ecosystem service by setting a "cap" on the damage to, or investment in, an ecosystem service. There are also self-organized private arrangements in which individual beneficiaries of ecosystem services enter into contracts directly with the providers of those services.

*Source*: Forest Trends and the Katoomba Group. 2008. *Payments for Ecosystem Services, Getting Started: A Primer*. Available at <http://ecosystemmarketplace.com/documents/cms_documents/PAYMENTS%20FOR%20ECOSYSTEM%20SERVICES_GETTING%20STARTED_A%20Primer.pdf>.

## 8. Desertification

73. Forests and tree cover combat land degradation and desertification by stabilizing soils, reducing water loss and wind erosion and maintaining nutrient cycling in soils. Sustainable dryland management, including agroecological restoration described in box 6 below, is an approach for managing dryland ecosystems for food production and other human needs while also promoting long-term sustainability. It integrates a range of practices to diversify livelihood options, increase agricultural productivity and restore and protect the ecosystem. Practices such as rainwater harvesting and the use of shelterbelts help to conserve water and soils, reduce wind erosion and restore soil fertility. This approach also involves traditional and innovative techniques that enhance land, soil and

water conservation (Partnership for Environment and Disaster Risk Reduction (PEDRR), 2010).

Box 6
**Building resilience to drought through the agroecological restoration of drylands in Burkina Faso and Niger**

Agro ecological restoration processes began 30 years ago in the Sahel region of Africa to increase water availability, restore soil fertility and improve agricultural yields in degraded drylands. The initiatives were led by poor farmers from southern Niger and the central plateau of Burkina Faso whose livelihoods had been increasingly affected by drought and land degradation. The farmers experimented with low-cost adaptations of traditional agricultural and agroforestry techniques to solve local problems and exchanged best practices with others. Today, hundreds of thousands of farmers have replicated, adapted and benefited from these techniques and have transformed the once barren landscape at an unprecedented geographical and temporal scale. In Burkina Faso, more than 200,000 hectares of dryland have been rehabilitated and now produce an additional 80,000 tonnes of food per year. In Niger, more than 200 million on-farm trees have been regenerated, providing 500,000 additional tonnes of food per year, as well as many other goods and services. By supporting poverty reduction and increasing the coping and adaptive capacity of local populations, the initiatives have significantly reduced the risks associated with recurring droughts in the region.

*Source*: Reij C, Tappan G and Smale M. 2010. Resilience to drought through agro-ecological restoration of drylands, Burkina Faso and Niger. *In: Demonstrating the Role of Ecosystem-based Management for Disaster Risk Reduction*. Partnership for Environment and Disaster Risk Reduction. Available at <www.pedrr.net>.

Table 2
**Examples of methods and tools to address slow onset processes**

| *Slow onset process* | *Methods/tools* |
|---|---|
| Sea level rise | • Restore/maintain coastal wetlands and beaches<br>• Develop a lowland drainage system<br>• Create vegetative buffers and setback areas<br>• 'Climate proof' coastal infrastructure<br>• Provide fiscal incentives for changes to tourism infrastructure (e.g. retrofitting to comply with new building codes)<br>• Map flood zones and create zoning measures to limit development in flood zones<br>• Relocate homes/businesses currently in flood zones<br>• Develop opportunities for alternative livelihoods<br>• Provide local communities with customized information on flood risks<br>• Integrate traditional knowledge with scientific and technical information<br>• Develop monitoring and evaluation programmes |
| Temperature increase | • Develop water conservation programmes<br>• Determine relationships among temperature and disease vectors and develop programmes based on thresholds<br>• Develop protected areas for coral reefs<br>• Develop crop varieties and other agronomical practices that increase the resilience of agriculture |

| *Slow onset process* | *Methods/tools* |
|---|---|
| Ocean acidification | • Adapt fishing regulations<br>• Develop alternative fisheries<br>• Develop shellfish mariculture facilities<br>• Develop mobile marine protected areas<br>• Develop fishing cooperatives<br>• Provide marine extension services<br>• Retrain fishermen for alternative livelihoods<br>• Develop social protection programmes |
| Glacial retreat | • Conduct monitoring, including remote-sensing<br>• Develop an early warning system to protect downstream settlements from flooding during the melting phase<br>• Artificially drain lakes at risk of outburst<br>• Develop groundwater sources<br>• Implement regional water management programmes<br>• Diversify livelihoods<br>• Implement water conservation and irrigation techniques |
| Salinization | • Remove excess salts from soils by leaching or by installing a drainage system for large areas<br>• Reduce the salinization of coastal aquifers using techniques such as artificial recharge or subsurface barriers<br>• Conduct research and development to introduce saline-tolerant crops<br>• Diversify livelihoods |
| Land degradation and deforestation | • Conduct sustainable land management<br>• Implement erosion control programmes and soil conservation measures<br>• Promote agroforestry to improve forest ecosystems<br>• Coordinate with other land management programmes<br>• Promote alternatives to wood and charcoal for energy needs<br>• Avoid fragmentation and increase the connectivity of forests<br>• Provide buffer zones around forested areas<br>• Control land-use changes<br>• Protect mature forest stands<br>• Represent different forest types across environmental gradients<br>• Maximize the size of forest management units<br>• Actively manage insect pests in forests<br>• Practice low-intensity forestry<br>• Implement agroforestry |
| Loss of biodiversity | • Reduce non-climate stressors<br>• Create parks/reserves, protected areas and biodiversity corridors<br>• Use species distribution models to project how the distribution of species of concern may change in response to changes in temperature and other climate variables<br>• Conduct modelling of minimum viable population sizes |

| *Slow onset process* | *Methods/tools* |
|---|---|
| | • Develop/improve environmental regulations to restore and protect degraded habitats<br>• Integrate climate change considerations into environmental impact assessments for proposed projects |
| Desertification | • Protect soils by planting trees in dense perennial hedges to act as windbreaks<br>• Implement drip irrigation<br>• Develop an early warning system for drought<br>• Harvest rainwater<br>• Zone land areas at risk of desertification<br>• Develop strategies that allow pastoralists to move across borders temporarily as well as those that allow permanent resettlement |

*Sources:* McGray H, Hammill A and Bradley R with Schipper EL and Parry J. 2007. *Weathering the Storm: Options for Framing Adaptation and Development*. World Resources Institute. Available at <http://www.wri.org/publication/weathering-the-storm>; Organisation for Economic Co-operation and Development. 2009. *Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance.* OECD Publishing; Twigg and Benson. 2007. *Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organisations.* Geneva: International Federation of Red Cross and Red Crescent Societies/ProVention Consortium.

## D. Approaches to address residual risk

74. Although there are a number of developed approaches to address the impacts of slow onset events such as sea level rise, efforts are still under way to develop adequate institutional arrangements and capacities to address the residual risk of slow onset events. Residual risk could be referred to as the loss and damage that remains once all feasible measures (especially adaptation and mitigation) have been implemented.

75. In general, there are three strategies a government can adopt to address residual risk using financing mechanisms: retain the risk; transfer the risk; or share the risk (see box 7 below). These methods are discussed in detail in the report by Cummins and Mahul (2009) and in the UNFCCC technical paper *Mechanisms to Manage Financial Risks from Direct Impacts of Climate Change in Developing Countries* (UNFCCC, 2008b).

Box 7
**Definitions of risk financing terms**

**"Risk financing"** refers to the process of managing risk and the consequences of residual risk through products such as insurance contracts, catastrophe bonds, reinsurance or options;

**"Risk layering"** is the process of separating risk into tiers that allow for a more efficient financing and management of risks;

**"Risk pooling"** is the aggregation of individual risks to manage the consequences of independent risks;

**"Risk retention"** refers to the process whereby a party retains the financial responsibility or loss in the event of a shock;

**"Risk transfer"** is the process of shifting the burden of financial loss or responsibility for risk financing to another party, through insurance, reinsurance, legislation or other means.

*Source*: Cummins and Mahul. 2009. *Catastrophe Risk Financing in Developing Countries. Principles for Public Intervention*. Washington, DC: World Bank.

76. However, financial instruments for addressing the impacts of climate change, such as catastrophe bonds and weather derivatives, are not suitable for slow onset events because they do not involve a triggering event (UNFCCC, 2008b).

77. There are some studies using innovative approaches that may apply under certain conditions. For example, a study of drought risk in India adapted catastrophe modelling techniques to address the impact of drought. Although catastrophe modelling techniques are well-established for rapid onset events such as cyclones and floods, slow onset events and processes such as drought have different characteristics and are more difficult to quantify. One of the major challenges in assessing the economic impacts of drought is that, unlike rapid onset events, droughts do not show highly visible impacts, but rather produce large indirect losses compared to direct losses, with impacts spread out over large areas. The India study of drought risk developed new techniques to accommodate these kinds of impacts (World Bank, 2006).

78. The results of the World Bank study showed highly localized effects on farmers, along with effects on the national economy, suggesting the development of two possible innovative financing products aimed at inducing farmers to shift from farming practices that are known to be unviable in the long term because of increasing water scarcity. The financing products would offer farmers the opportunity to share the new risks associated with the transition to alternative farming practices with society, because the process would benefit both farmers and society. The researchers suggested that a type of "drought adaptation insurance" could be developed in order to provide coverage against risks resulting from a shift from non-viable farming practices. This insurance product would protect farmers against new sources of risk resulting from a change in their familiar farming practices towards those that are more drought-resilient and less water-intensive. Another option could be the implementation of a "drought adaptation credit" that could provide initial capital to help farmers shift to a long-term viable business. In the event of an unexpected loss caused by a failure in the adaptation investment, repayments could be postponed or (partially) waived (World Bank, 2006).

79. A livestock indemnity insurance programme currently in operation in Mongolia provides an innovative indexing and risk-layering approach involving a combination of insurance products, including self-insurance by herders, market-based insurance and social

insurance. It protects herders against excessive livestock mortality caused by harsh winters and summer drought. The insurance programme relies on a livestock mortality-rate index for all of the livestock in a local region (*soum*). The insurance pays out to individual herders whenever the mortality rate in the *soum* exceeds a specific threshold, and thus individual herders receive the insurance payout irrespective of their individual losses. The government has responsibility for the layer of risk left uncovered as a result of the market failure (social insurance), leaving markets to manage the lower levels of catastrophic risk (commercial insurance) and individuals to manage the threats related to high-basis risk (retention). An advantage of this approach is that, even if government policy changes and the social insurance subsidy is cut, the commercial level of insurance can continue (UNFCCC, 2011a).

80. The African Risk Capacity (ARC) project, a pan-African disaster risk pool managed by the African Union, addresses the increased risk of hunger and malnutrition using a combination of risk transfer and elements of risk retention and risk reduction. The initiative includes an early warning system and a risk pool that provides automatic payouts in case of drought. The payout is dependent on ex-ante contingency plans. Risk pooling provides substantial savings on administrative costs and on the capital required, but there is a need for international markets to reinsure the pool. The central ARC product is Africa RiskView. The software quantifies the risk, the number of people affected and the financial resources needed to respond.

81. First introduced in 1991, the Alliance of Small Island States (AOSIS) proposed an "international insurance pool" that would be funded by developed countries to compensate small island and low-lying developing countries for the otherwise uninsured loss and damage from slow onset sea level rise. A follow-up is under discussion.

82. In Latin America and the Caribbean, social protection measures to reduce hazard risks have been built into existing conditional transfer programmes. In these programmes, governments provide households with regular cash payments that are conditional on certain desired improvements, such as measures to reduce vulnerability (Global Assessment Report, 2011).

# V. Implementation issues

83. **Institutional arrangements and governance structures**. Political buy-in implementing actions to address slow onset events is essential, both to ensure resource availability and to ensure long-term commitment. The integration of slow onset processes and other climate extremes into national policy can take time, and the process can be hindered by changes in government or shifting policy priorities.

84. **Budgets and financial resources**. One of the most frequently mentioned barrier to adopting measures for slow onset events is insufficient financing. As costs to address slow onset events may initially be large and most benefits may not be apparent for many years, investment in measures targeting these events remains low. Further, the annual budget cycle often cannot accommodate needs related to events that evolve over many years.

85. **Data and information exchange**. There is a need to monitor slow onset processes such as sea level rise and glacial melt in order to develop baselines and track rates of change. This requires long-term monitoring and efficient data storage, which currently are generally inadequate. Many developing countries are not equipped with even basic monitoring equipment such as flow meters and automated systems for collecting hydrological and meteorological data. Additionally, the most vulnerable countries lack the data and methods needed to determine the baseline risk associated with slow onset events other than sea level rise.

86. Much of the historical hydrometeorological data needed to determine climate trends remain in paper format. To make data accessible and provide opportunities for data exchange, the data must be digitized, which can be both time-consuming and costly.

87. Another barrier is the lack of compatibility among related data sources. Establishing regional standards for the collection of data related to slow onset events would facilitate the sharing of relevant data among countries. It is also necessary to ensure that data sources are "open access".

88. **Knowledge-sharing**. There is a need for greater integration of traditional knowledge and scientific observations. Traditional knowledge often includes effective coping strategies based on generations of coping with climate change. For example, many indigenous communities use environmental indicators such as the timing of plant flowering or the nesting height of birds to predict the occurrence of events such as floods and droughts. These systems could be adapted using information on climate change (PEDRR, 2010).

89. **Technical capacity**. In general, the technical information available to vulnerable countries for risk assessment is very limited, as is the training needed to operate the modern equipment used for information management (IPCC, 2012). In many countries, there is a need to modernize hydrometeorological services and develop remote-sensing capabilities. One of the key gaps in Africa, for example, is the lack of a system or capacity that allows national hydrometeorological agencies to store data in high-capacity hardware and carry out analysis from a common location (UNFCCC, 2012).

# VI. Enabling environments for addressing slow onset events

## A. Governance structures and institutional arrangements, including financing

90. An effective approach for coordinating policymaking with other stakeholders at the national level is through national platforms, with implementation undertaken at the local level by multi-stakeholder councils or committees and user groups. For example, in Mozambique, the National Institute for Disaster Management has been replicated at the regional, divisional and local levels.

91. Collaboration between relevant ministries is also important (e.g. ministries of the environment, water, agriculture and development planning). Governance structures and institutional arrangements that can facilitate adaptation to slow onset events range from national resource management agencies and hydrometeorological services to local resource user groups such as water user associations. The integration of governance and institutions across levels and sectors is also essential.

92. Locating responsibility for climate risk management in a central ministry or secretariat with a high level of political authority may help to facilitate adaptation. The existence of a specific ministry or agency designated as the climate change 'focal point' can be important for maintaining engagement and continuity over the longer timescale of slow onset processes. The effectiveness of institutional arrangements often depends on location within the national government, the degree of decentralization, multisectoral participation, political support and the share of the national budget granted to the institution (UNFCCC, 2008a).

93. The management of slow onset processes highlights the need for sustainable financing. At the national level, it is important to integrate budgeting for addressing slow onset processes into wider fiscal policy. Public–private partnerships with financial

institutions that help to promote preparedness and training programmes for community-based organizations could help to build capacity at the local level (UNFCCC, 2007).

## B. Policy and regulatory frameworks

94. A climate change policy provides an instrument for engaging different stakeholders in the planning, development and implementation of climate change interventions. Integration of the management of slow onset risks into national development planning, poverty reduction strategies and other relevant policy frameworks is important in order to avoid the duplication of efforts and to encourage coordinated actions across sectors.

95. Land-use regulations and zoning laws are important mechanisms for controlling activities that may reduce resilience, such as deforestation, the draining of wetlands and the settlement of floodplains, all of which act as additional drivers of vulnerability along with exposure, sensitivity and lack of adaptive capacity.

## C. Information and data exchange

96. Climate services provide information needed for decision-making in climate-sensitive sectors. Efforts to improve these resources are ongoing at the international, regional, national and local levels, as summarized below.

### 1. Efforts at the international level

97. The Global Framework for Climate Services (GFCS)[13] is an innovative approach for facilitating information exchange to address climate risk. GFCS is intended to help national hydrological and meteorological services develop protocols and standards for data exchange between themselves and other organizations and to improve information products and service delivery. The goal is to enable the more effective management of climate risks through the development and incorporation of science-based climate information and prediction into planning, policy and practice on global, regional and national scales.

98. At present, it is difficult to disassociate climate change effects from "normal" climate variability. The most clearly distinguishable impacts of climate change are slow onset events that will be exacerbated in the decades to come, resulting in serious and knock-on impacts, for example where communities must relocate in response to sea level rise, which in turn places pressure on other ecosystem zones and host communities. Activities that target such specific impacts require long-term planning using climate change projections. However, climate projections are less critical for addressing the underlying drivers of vulnerability. For communities that are highly vulnerable to slow onset events, the central task is to build their adaptive capacity (Hellmuth et al., 2007; Hellmuth et al., 2011).

### 2. Efforts at the regional level

99. The Pacific Risk Information System, created under the Pacific Catastrophic Risk Assessment and Financing Initiative, is a platform for sharing data and making them available online. Data from government data sets are being georeferenced and combined with information on infrastructure and other attributes. These efforts have included the development of country risk profiles (exposure summaries), thereby allowing decision makers in the region to understand the assets most at risk.

[13] See <http://www.wmo.int/pages/gfcs/index_en.php>.

100. There is increasing cooperation among African countries to strengthen information-sharing. Examples include water use for irrigation and hydropower programmes, which are facilitated by sharing information on river basins.

### 3. Efforts at the national and local levels

101. UNISDR is facilitating the elaboration of nationally developed disaster loss databases using common international standards and methodologies. DesInventar[14] is a conceptual and methodological tool for the construction of databases for accessing loss and damage data and for risk profiling. These databases could be designed to include impacts relevant to slow onset processes, which could include, for example, the number of displaced persons.

102. Information exchange could be facilitated by strengthening community-based user groups such as water user associations and forest user groups through the creation of links with related national policy frameworks.

## D. Transboundary arrangements and regional collaborations

103. Improved regional cooperation such as shared monitoring, scientific collaboration and transboundary agreements will help to increase opportunities for addressing slow onset events. Coordinated mechanisms at the national, regional and international levels that pool necessary expertise is one cost-effective way to enhance technical capacity. Examples of successful regional programmes include the Mangroves for the Future programme, a partnership initiative coordinated by the International Union for Conservation of Nature (IUCN) in eight Asian countries.

104. A number of transboundary arrangements for DRR provide opportunities to include the consideration of slow onset events, such as sea level rise, that occur across regions, including the CARICOM Comprehensive Disaster Management Strategy, the UNFCCC Comprehensive Hazard and Risk Management tool in the South Pacific and the UNISDR Comprehensive Disaster Risk Management Framework in South-East Asia. Papua New Guinea and the Solomon Islands are working together to improve data collection on sea level rise within the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security.

105. Other existing collaborations include the Congo Basin Forest Partnership, the Forum of Ministers of Environment of Latin America and the Caribbean, the Economic Commission for Latin America and the Caribbean, the Organization of Eastern Caribbean States, the Caribbean Community Climate Change Centre, the Pacific Islands Forum, the Secretariat of the Pacific Community, and the Pacific Regional Environment Programme.

### 1. Integrated water resource management

106. Integrated water resource management (IWRM) is a comprehensive, participatory planning and implementation process for managing and developing water resources in a way that balances social, environmental and economic needs. It provides a framework for negotiating among water users and ensures a balance between economic efficiency (allocating scarce water resources to different sectors), social equity (access and benefiting from water use) and environmental sustainability (protecting aquatic ecosystems and the water resource base). It is particularly useful in managing transboundary river basins and watersheds.

[14] See <www.desinventar.net>.

### 2. Integrated coastal zone management

107. Integrated coastal zone management (ICZM) is a multidisciplinary and iterative process for managing all aspects of coastal areas. It includes information collection, planning, decision-making, management and monitoring based on the participation of all stakeholders in a given coastal area. Similarly to IWRM, ICZM seeks to encourage dialogue among different users and ensure a balance among environmental, economic and social objectives within relevant policy areas, sectors and levels of administration. ICZM can involve habitat restoration (e.g. dunes), biodiversity protection (e.g. coral reefs), disaster risk management (e.g. storm surges) and the adaptation of agricultural practices (e.g. increased flood risk or salinization). ICZM also addresses afforestation, infrastructure protection and the sustainability of energy resources.

108. A project supported by the Global Environment Facility and managed by the United Nations Educational, Scientific and Cultural Organization is supporting integrated coastal management in Western Africa (Cape Verde, Gambia, Guinea-Bissau, Mauritania and Senegal), addressing climate change concerns such as coastal erosion and declining fish stocks within the framework of integrated management of the coast.[15]

Box 8
**Cap-Net: support for integrated water resource management**

The United Nations Development Programme has developed an online, international capacity-building tool, Cap-Net, to support integrated water resource management. Cap-Net is a partnership of autonomous international, regional and national institutions and networks committed to capacity-building in the water sector and sustainable water management. The network is built on three principles: local ownership; partnership among capacity-builders; and response to demand for capacity-building. Cap-Net now includes 21 capacity-building networks worldwide, along with three thematic networks linking hundreds of capacity-building networks across the developing world.

*Source*: http://www.cap-net.org/>.

# VII. Developing a balanced and flexible strategy

## A. Portfolio of tools

109. The development of a combined portfolio of tools will help to support a balanced and flexible approach to reducing the risks associated with slow onset events, and will also help to address multiple risks and the compounding nature of many slow onset events. Foundational tools include "low regrets" measures that are likely to be beneficial regardless of the way in which slow onset processes evolve under future climate change. This would include specific measures such as ensuring that zoning laws are enforced, as well as overarching framework strategies such as SLM and EbA. Actions to reduce and transfer risk will help to balance the overall portfolio.

[15] See <http://www.accc-africa.org/>.

## B. Tailoring approaches and tools

110. There are a number of reasons for tailoring approaches and tools to specific contexts. Many risks are site-specific and may require different actions depending on how the underlying risk factors vary within a given area, including the social, economic and environmental conditions. Even at the community level, there may be important differences in vulnerability and risk (see box 9 below).

Box 9
**Tailoring interventions for different vulnerability profiles**

The World Bank's pilot Andhra Pradesh Drought Adaptation Initiative focuses on approaches that recognize basic differences among communities located in dryland farming systems in the region. The impacts of drought vary significantly at small geographic scales in the region due to the natural variability in weather patterns, differences in soil types and water availability, access to markets and social circumstances. Therefore, the project compiled vulnerability profiles and tailored interventions to each community. First, the project targeted areas that were representative of different challenges (e.g. little irrigated land, common property, depleted soil tops). Secondly, the project held participatory consultations with communities to identify other drivers of vulnerability and devise ways of addressing factors that limit long-term adaptation to climate change. Next, the project developed a variety of matrices that could be used to classify the drivers of vulnerability, the way that climate change would impact these vulnerabilities, and potential responses. Finally, the project used the matrices to determine the blend of interventions that should be implemented in different communities. As a result, the project has been able to tailor adaptation strategies to communities' unique risk profiles. Based on the results of the pilot, there are plans to scale up the approach to a larger area.

*Source*: World Bank. 2006. *Overcoming Drought: Adaptation Strategies for Andhra Pradesh, India*. Washington, DC: International Bank for Reconstruction and Development/World Bank. Available at <http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/09/11/000160016_20060911122737/Rendered/PDF/372600IN0Overc101OFFICIAL0USE0ONLY1.pdf>.

## C. Approaches for evaluating options

### 1. Economic methods

111. Evaluating the costs and benefits of alternatives is a core process for evaluating management options and making trade-offs (Economics of Climate Adaptation, 2009; Hammill and Tanner, 2011). A recent UNFCCC publication under the Nairobi work programme on impacts, vulnerability and adaptation to climate change discusses economic methods in detail (UNFCCC, 2011c). Methods include cost-benefit analysis and cost–effectiveness analysis. Whereas a cost-benefit analysis weighs the trade-offs between costs and benefits, a cost–effectiveness analysis only requires monetizing the costs of options. The analysis involves comparing options that achieve the same or similar level of benefits at different costs; the least-cost option is the priority.

112. A cost-benefit analysis may also consider non-monetary benefits; in other words, the benefits relating to goods and services that are not traded in markets and for which there is no commonly agreed-upon method of monetary valuation. Important social and environmental aspects of loss and damage, such as loss of cultural heritage, institutional capacity and ecosystem services are so-called "intangible" benefits. One way in which

economists include the value of such benefits in a cost–benefit analysis is to conduct a survey that asks respondents how much they would be "willing to pay" for a clearly specified change, such as the additional protection needed to preserve a favourite wildlife viewing site. This type of analysis values risks from the perspective of what economists refer to as "social welfare", and therefore captures the wider costs and benefits to society as a whole, rather than considering only the financial aspects. That is, it captures the environmental, social and economic consequences, sometimes referred to as the "triple-bottom line" (Freeman, 2003; Department for Environment, Food and Rural Affairs, 2007).

### 2. Non-economic methods

113. In addition to economic factors, other considerations may include: the level of existing knowledge and technical capacity to implement different measures; the availability of related infrastructure and other foundational resources; the relative vulnerability of different communities; and the local biophysical and socioeconomic context, including cultural traditions.

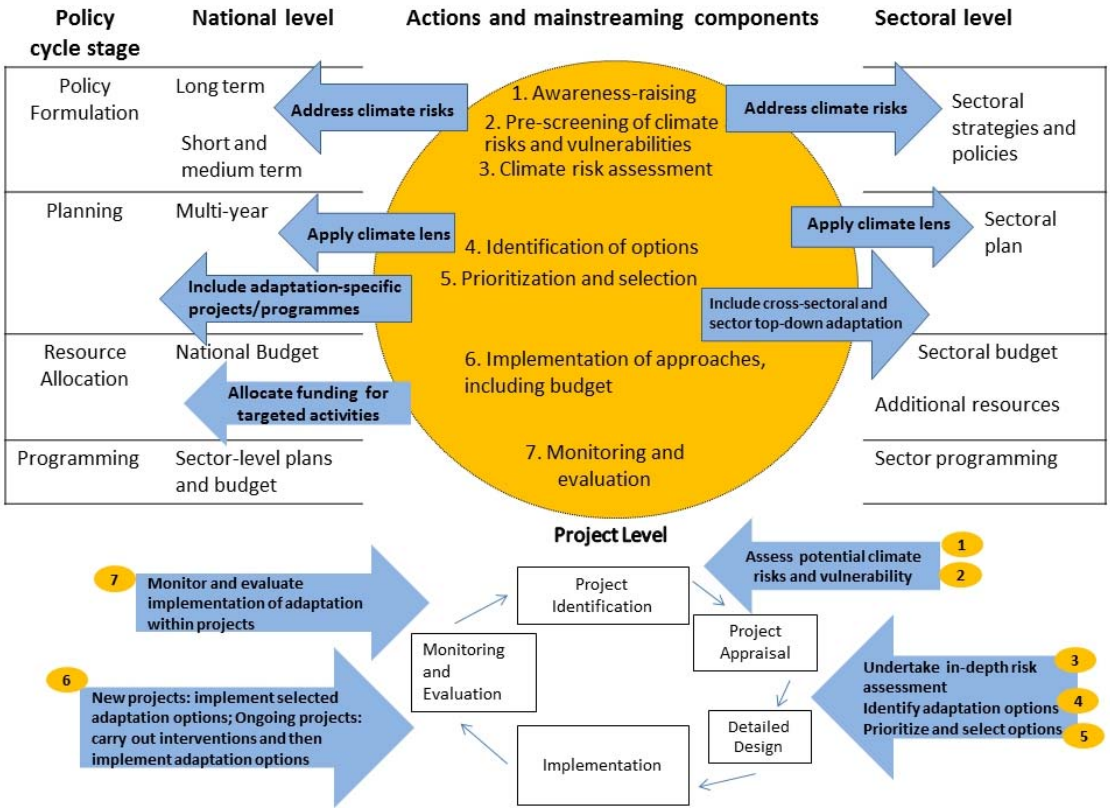
114. Multicriteria analysis (MCA) is the most commonly used non-economic method for determining preferences among alternative options. The options are assessed against a range of weighted criteria using qualitative or semi-quantitative scoring, and then ranked based on the scores and weights. MCA is sometimes combined with an economic or financial analysis (UNFCCC, 2011c).

## D. Mainstreaming

115. An approach for integrating actions to address slow onset events into broader planning is a process known as "mainstreaming" (Olhoff and Schaer, 2010). Mainstreaming involves integrating climate concerns into relevant policies, plans, programmes and projects at the national, subnational and local levels (USAID, 2009). In the context of slow onset events, mainstreaming helps to ensure integration across approaches and sectors and an ongoing commitment of resources.

116. Figure 1 below provides an overview of the mainstreaming approach, illustrating national- and sectoral-level adaptation actions according to the respective stage in the policy cycle and possible entry points for project activities.

Figure 1
**Overview of the mainstreaming approach**




*Source:* Modified from Olhoff and Schaer. 2010. *Screening Tools and Guidelines to Support the Mainstreaming of Climate Change Adaptation into Development Assistance – A Stocktaking Report*. Available at <http://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy/www-ee-library/climate-change/stocktaking-of-tools-and-guidelines-to-mainstream-climate-change-adaptation/UNDP%20Stocktaking%20Report%20CC%20mainstreaming%20tools.pdf>.

117. At the national level, entry points are related to long-term and multi-year planning. The focus is on incorporating slow onset events into relevant national planning activities, such as national poverty reduction strategies, land-use planning and the development of building codes and standards. In least developed countries the process to formulate and implement national adaptation plans[16] may be an important entry point for the consideration of slow onset events in national planning decisions.

118. Establishing actions to address slow onset events at the sectoral level is also important. In most countries, sectoral institutions already play a central role in decision-making. Meanwhile, cross-sectoral approaches and coordination and communication are also important (i.e. not working in "silos").

119. At the project level, environmental impact assessments provide a way of incorporating the consideration of slow onset events.

[16] Decision 1/CP.16, paragraph 15.

## E. Adaptive management

120. According to the IPCC, "responding to climate change involves an iterative risk management process" (IPCC, 2007). The process of adaptive management provides a systematic approach to iterative risk management. It is an approach to decision-making under uncertainty that was first developed to support natural resource management and is now widely used in a number of contexts. The goal is to monitor the outcome of management actions over time and make changes to those actions as needed. The process facilitates learning-by-doing and promotes a flexible decision-making process.

121. Ongoing monitoring and adaptive management is especially critical for understanding how slow onset processes respond to climate change over a range of spatial and temporal scales. Attention to the way in which exposure and vulnerability may change as slowly evolving risks proceed is particularly important in the context of resilience-building.

122. The possibility of "maladaptation" and other unintended consequences may become apparent through ongoing monitoring. Although selected strategies may reduce risk in the short term, they may increase exposure and vulnerability over the longer term. For example, dike systems can reduce flood exposure by offering immediate protection, but may also encourage settlement patterns that reduce resilience and increase risk in the long term (IPCC, 2012).

123. Adaptive management also makes it possible to respond to triggers or thresholds that may signal the need for new management actions. This is particularly important for slow onset climate extremes. Climate change will alter the dynamics of particular processes in response to changing climate variables and may eventually push a system outside of its coping capacity. The identification of thresholds or "action triggers" would provide a way of identifying points when coping capacity is declining and may even help to identify a "point of no return" beyond which the system change may be irreversibly altered.

# Annex I

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# Annex II

## Case studies: examples and lessons learned from the expert meetings held in the context of thematic area 2 of the work programme

1. This annex draws upon case studies and discussions from the four expert meetings held in the context of thematic area 2 of the work programme on loss and damage, as well as the findings from the literature review which served as a background input to these meetings. The section begins with a summary of the case studies, challenges and key messages from the three regional expert meetings for Africa, Asia and Eastern Europe, and Latin America and the expert meeting for small island developing States (SIDS), then proceeds with an overview of the evidence, gaps and key messages identified from the literature review vis-à-vis addressing the adverse effects of slow onset events.

## A. Expert meetings

### 1. Africa

2. In addition to significant impacts from extreme weather events, countries in Africa are facing a range of climate-related slow onset processes. Though rising temperatures and associated drought together with land degradation and desertification receive the most attention, a range of other impacts are already inflicting loss and damage in Africa, including sea level rise, loss of biodiversity, ocean acidification and even glacial retreat. The Africa region is beset by a general lack of resources and capacity, although this condition is skewed by subregional, national and other types of differences – for example, the francophone countries appear to be more disadvantaged than the anglophone countries. At the regional expert meeting held for Africa in Addis Ababa, Ethiopia, from 13 to 15 June 2012, participants acknowledged at an early stage in the meeting that slow onset processes are already inflicting damage on the African continent.

3. Although droughts are considered to be extreme events, they are closely linked with slow onset climate events in Africa. Discussions during the Africa regional expert meeting raised the need for transformational approaches to address loss and damage, as opposed to managing disasters and crises as they arise.

4. The Centre de Suivi Ecologique is addressing coastal erosion in Senegal through the protection of beaches and the development, strengthening and implementation of regulations to protect coastal areas, and is offering training on and promoting awareness of issues related to coastal erosion. Climate change is also being mainstreamed into national development priorities in Senegal (Sall et al., 2012).

5. International Union for Conservation of Nature (IUCN) is strengthening governance in the African drylands, which are highly vulnerable to desertification, by securing the rights to natural resources, enforcing the rules, regulations and policies of natural resource management and enhancing the application of sustainable land management approaches with the objective of enhancing livelihood security and environmental health (Davies, 2012). The point was raised that the traditional management of risks often goes unnoticed or unacknowledged and can be eroded with external interventions. It was suggested that the traditional management of natural resources could be an entry point for addressing loss and damage arising from impacts related to slow onset processes. Further examples can be found in annex III to this paper.

6. Discussions highlighted a number of challenges in relation to addressing loss and damage from slow onset processes, including the need for the timely delivery of high-quality information, strong institutional arrangements with appropriate legislation and policies, and effective cash transfers. It was also widely acknowledged that it is necessary to combine an understanding of current and future needs with innovative approaches based on the lessons learned from current experiences. A list of other challenges relevant to slow onset processes raised during the discussions can be found in annex III to this paper.

7. Coordinated mechanisms at the national, regional and international levels that pool necessary expertise, incentivize risk reduction and loss prevention, and ensure that risk transfer approaches complement and accelerate adaptation were viewed important, together with platforms for knowledge-sharing.

### 2. Latin America

8. Latin American countries are facing a range of slow onset processes, from sea level rise in coastal regions to glacial retreat in mountainous areas and its cascading effects downstream. Although Latin America is facing a range of slow onset processes, sudden onset extreme events continue to receive the most attention. The Latin America regional expert meeting, held in Mexico City, Mexico, from 23 to 25 July 2012.

9. Some examples of approaches to address slow onset processes discussed, include, Climate Risk Management (CRM), an approach to identify climate risks and evaluate impacts on socio economic development. In Peru, CRM is being used to reduce the risk of lower agricultural yields due to temperature increase and glacial retreat, which has affected the availability of water. The project has: enhanced agricultural practices through the use of irrigation, reservoirs and reforestation; encouraged crop diversification; and provided access to finance (Isaar and Keller, 2012).

10. The examples that were given emphasized the importance of: capacity-building at the subnational and national levels to capture data; mainstreaming climate change into development planning; developing institutional architecture; and harmonizing approaches; building on existing initiatives, strengthening compensation for losses through safety nets, and creating and strengthening linkages with adaptation plans.

11. The limitations of using infrastructural measures to address slow onset climatic stressors at the appropriate temporal and spatial scales, and the necessity of institutional approaches, were highlighted. It was acknowledged that institutional fragmentation will need to be addressed in order to successfully address associated loss and damage.

12. It was widely acknowledged that slow onset processes should receive the same attention as extreme events, as they could affect the frequency and intensity of extreme events and will have unforeseeable long-term impacts. A better understanding of slow onset processes is needed in the form of assessment.

### 3. Asia and Eastern Europe

13. Asian and Eastern European countries represent a diversity of ecosystems, dense human settlements, exposure to the widest range of climatic stressors of all types and abundant examples of approaches to manage slow onset processes.

14. The Asia and Eastern Europe regional expert meeting on approaches to address loss and damage was held in Bangkok, Thailand, from 26 to 28 August 2012.

15. The case studies summarized in paragraphs 16–17 below are a combination of the approaches submitted prior to the meeting and those presented during the meeting that specifically address slow onset processes. Further examples of approaches that can be used to address slow onset processes can be found in annex III to this paper.

16. IUCN has established the Mangroves for the Future programme in India, Pakistan, Sri Lanka, Thailand and Viet Nam in order to strengthen the resilience of ecosystem-dependent communities. Lessons learned include the need for effective governance structures and arrangements, and the importance of choosing local partners with experience and expertise.

17. The International Centre for Integrated Mountain Development recently performed a risk assessment of glacial lake outburst flooding in the Tsho Rolpa region of Nepal, which informed mitigation measures for beneficiaries downstream. Lessons during this work included: the need for a proactive government; the vitality of community involvement; and cooperation with the scientific community.

18. As in previous expert meetings on loss and damage the importance of capacity-building, mainstreaming and integrating indigenous knowledge and scientific information into approaches and policies enhancing regional collaboration, and communication strategies for addressing slow onset processes, were emphasized.

19. The need to acknowledge the health impacts of these processes and the fact that they will exacerbate the vulnerability of those already poor and marginalized communities was highlighted.

20. The sub-paragraphs below provide a summary of the four breakout discussions which took place during the meeting, which focused on glacial melt, desertification, loss of biodiversity, and sea level rise and salinization, respectively:

(a) The discussion on glacial melt emphasized the cross-sectoral nature of these impacts and the fact that they will intensify over time and result in hazards such as flash floods, GLOFs and landslides;

(b) The discussion on desertification stressed the need to recognize interactions between slow onset and rapid onset events and the existence of tipping elements. Proposed approaches included land zoning, integrated water management, insurance mechanisms and regional cooperation;

(c) The discussion on the loss of biodiversity stressed the permanence of the loss of biodiversity and its impact on future generations. Potential approaches proposed include targeting governance, utilizing indigenous and community knowledge, and financial instruments such as social and environmental bonds;

(d) The discussion on sea level rise and salinization centred on approaches rather than needs. Participants highlighted work currently being carried out with local communities to address salinization by linking indigenous and traditional knowledge to science in Bangladesh, as well as ‘climate proofing’ infrastructure throughout the region.

### 4. Small island developing States

21. SIDS have a number of characteristics that make them highly vulnerable to the impacts of climate change, particularly slow onset events and processes such as sea level rise and ocean acidification. The adverse effects of climate change – especially sea level rise – are a major barrier to sustainable development in SIDS. It was widely acknowledged that slow onset processes are already occurring and are exacerbating extreme events and non climate related drivers of vulnerability. The SIDS expert meeting, took place from 9 to 11 October 2012, in Bridgetown, Barbados.

22. The discussions during the SIDS expert meeting concentrated on slow onset processes, given the high vulnerability of SIDS to sea level rise and other slow onset processes. Similarly to the Asia and Eastern Europe regional expert meeting, participants were asked to submit information sheets to suggest concrete approaches to address loss and

damage. Some examples of those approaches are summarized in paragraphs 23–24 below. Further examples can be found in annex III to this paper.

23. The Strategic National Policy Unit in Kiribati has implemented vocational training programmes and a labour mobility scheme to assist citizens who wish to migrate. Lessons from the project include the inability of local infrastructure to support the training programmes without external support and the need for the courses to be aligned with international standards. There are many people who will need to migrate from Kiribati in the coming years and, thus, there is a significant need to scale up this programme. During the meeting, a representative from Kiribati explained the process by which the Government of Kiribati has recently acquired 5,000 hectares of land in Fiji to accommodate the possible relocation of up to 100,000 people.

24. USAID's Coastal Community Adaptation Program is helping to build resilience to extreme events in the short term and slow onset processes in the long term in vulnerable communities in 12 countries in the Pacific by: rehabilitating and constructing climate-resilient infrastructure in coastal zones; building capacity for disaster risk prevention and preparedness; and mainstreaming climate-resilient policies and practices into local planning and building standards.

25. The approaches presented in the course of the SIDS meeting, tailored to addressing slow onset processes, highlighted the importance of regional collaboration, capacity-building and mainstreaming. The discussion on migration, as an approach to address loss and damage related to slow onset processes, stressed the need to facilitate migration "with dignity" using training programmes and labour schemes as well as acknowledging issues related to sovereignty and the loss of culture, which some SIDS will inevitably face.

26. Issues associated with addressing the loss of livelihoods and cultural values, preserving the culture of relocated communities, and those related to political and economic sovereignty, were also raised.

27. A summary of the breakout discussions held during the meeting can be found in annex III to this paper.

28. The discussion on sea level rise highlighted concerns around salinization, coastal erosion and inundation. Best practices outlined included capacity-building programmes, regional cooperation and conducting an ongoing dialogue with decision makers. Planned migration by creating trust funds and making new territory available for those displaced is under consideration in some areas. Gaps and limitations include capacity and skills to quantify losses, data-sharing and the ability to transition from policy to implementation.

29. In the discussion on temperature increase, land and forest degradation and desertification, impacts on food security arising from reduced agricultural productivity were identified as priorities. Best practices proposed for addressing loss and damage arising from these slow onset processes included strategies for conserving mangrove forests, water use strategies, soil management techniques and research to find new crops and seeds. Gaps and limitations included political will, uncertainty and international approaches to address slow onset processes. During the discussion, the priorities for immediate action included sustainable finance, the engagement of regional centres, more relevant and accessible information, and capacity-building.

30. The discussion on ocean acidification stressed the link between GHG emissions and emphasized the impacts on livelihoods, GDP, food security, loss of biodiversity and displacement. Approaches proposed for addressing loss and damage from ocean acidification included increasing mitigation targets and enhancing adaptation strategies. Priorities identified included facilitating the transformation of economies by promoting diversification with the aim of compensating for sectors that are affected by ocean

acidification such as tourism and fisheries. One such area for investment proposed by participants was investment in green technologies and renewable energy.

## B. Summary

31. The four expert meetings represented a progression of understanding on the impacts of slow onset climatic events and processes and how to address them. At the Africa and Latin America regional expert meetings, the presentations and discussions emphasized DRR and current ways of addressing loss and damage, particularly risk management of weather-related extremes. Several key themes emerged during the discussions on slow onset processes, some of which are region-specific but most of which can be universally applied.

32. The discussions during the expert meetings revealed that the results of loss and damage arising from slow onset events are already being felt. The existence of tipping points – or thresholds that accelerate the progression of slow onset processes – was also emphasized.

33. Slow onset processes represent a challenge to climate-resilient development and poverty reduction. Thus, addressing loss and damage associated with slow onset events and processes can ultimately reduce vulnerability and increase resilience. In all of the meetings, the importance of targeting approaches to the poorest and most vulnerable was emphasized.

34. In order to implement approaches to address loss and damage arising from slow onset events, issues related to capacity-building, technology acquisition, data quality and cooperation across sectors will need to be addressed. The discussions also reflected the need for political will and the importance of long-term planning beyond election cycles. The importance of regional cooperation was highlighted in all of the meetings. The existence of transboundary issues and shared resources as well as the potential for sharing technical expertise and data was emphasized repeatedly.

35. Local or indigenous knowledge must be integrated with sound scientific information in order to inform policies and strategies that adequately address loss and damage arising from slow onset events. Research is also needed to inform the implementation of approaches to address slow onset climate change, particularly from the perspective of affected communities. It is widely acknowledged that a holistic approach consisting of a combination of strategies will be needed in order to address loss and damage to slow onset climate change. However, deeper understanding is needed to determine how to address loss and damage associated with the adverse effects of slow onset climate change in a range of contexts and to identify a suite of complementary approaches for implementation.

# Annex III

## Case studies on approaches to address loss and damage arising from slow onset events and processes

Annex III summarizes the examples of approaches to address loss and damage arising from slow onset events and processes presented or discussed at the four expert meetings as well as those presented in the literature review. Each of the four sections contains tables of case studies highlighting key issues for comparison. These tables allow the reader to trace patterns in the gaps, opportunities and current experiences of managing slow onset climatic stressors across the four regions.

## A. Expert meetings

### 1. Africa

Table 1.1
**Approaches to address loss and damage arising from slow onset climatic processes presented at the Africa regional expert meeting**[1]

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* | *Main challenges* |
|---|---|---|---|---|
| Early warning systems | Temperature increase | A presentation by the University of Nairobi highlighted the elements of an early warning system, which include: knowledge of risks; technical monitoring and prediction of those risks; the dissemination of easily understood warnings to those who are at risk; and the ability of those at risk to respond. Early warning systems should be targeted towards decision makers at the local level. National meteorological services need to alter the way in which they provide services – particularly at the local level – in order to ensure that the information reaches and is easily understood by those at risk. It is also important to involve the local community and build on the action already being taken within the community (Ouma, 2012) | | Barriers to the effective use of climate information include: credibility; lack of ability to interpret information; accessibility; and the translation of forecasts to impacts |
| Ecosystem protection (combined with | Sea level rise | The Centre de Suivi Ecologique is facilitating adaptation to coastal erosion in Senegal by | | |

[1] These examples were taken from presentations given at the Africa regional expert meeting. Available at <http://unfccc.int/6872>.

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* | *Main challenges* |
|---|---|---|---|---|
| institutional approaches) | | protecting beaches, developing and implementing regulations for the protection of coastal areas and mainstreaming climate change into national development priorities. Training and awareness-raising is also a significant component of the project (Sall et al., 2012) | | |
| Insurance | Temperature increase | The Horn of Africa Risk Transfer for Adaptation (HARITA) initiative is currently being implemented in Ethiopia as part of an adaptation strategy. A community-level initiative, HARITA strives to strengthen the food and income situation of Ethiopian smallholders through a combination of natural resource management (risk reduction), insurance (risk transfer), and microcredit (enabling risk retention). The project builds on existing networks and activities and complements other risk management activities such as community savings programmes (Osgood, 2012) | | |
| Institutional approaches | Desertification and temperature increase | A presentation by the Observatoire du sahara et du sahel (OSS) emphasized the importance of the implementation of national adaptation programmes of action and of implementing recommendations outlined in the national communications to the UNFCCC with support from relevant national policies, laws and institutions for adaptation activities, and the sourcing of technical support, both regionally and internationally using the Intergovernmental Authority on Development (IGAD) as a vehicle for coordination and cooperation (Tadesse, 2012) | Transboundary cooperation is important, especially information-sharing on the development of early warning systems<br>Strategies on the use of transboundary resources are needed to ensure that vulnerability assessments at the national level are analysed at the subregional level | IGAD could extend technical assistance to national bodies and facilitate the coordination of international action, especially multilateral environmental agreements |
| Strengthening governance | Temperature increase and desertification | The International Union for Conservation of Nature has implemented a programme for | The traditional management of risks and processes | The traditional management of natural resources could be |

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* | *Main challenges* |
|---|---|---|---|---|
| | | strengthening governance with the objective of enhancing livelihood security and environmental health in African drylands. The mechanisms for achieving these objectives include: securing the rights to natural resources; enforcing the rules, regulations and policies of natural resource management; and enhancing the application of sustainable land management approaches (Davies, 2012) | already exists but is often unnoticed or unaccounted for and is thus eroded when other measures are introduced. The presentation also highlighted the long-term decline in the traditional management of natural assets as a result of development processes | an entry point for the development of approaches to address slow onset processes |

Table 1.2
**Challenges, needs, gaps, lessons learned and key messages identified during the discussions on addressing loss and damage arising from slow onset processes at the Africa regional expert meeting**

| *Challenges* | *Needs* | *Gaps* | *Lessons learned* | *Key messages* |
|---|---|---|---|---|
| - Quality, availability and access to data<br>- Limited resources and capacity<br>- Climate impacts may erode traditional capacity<br>- Sea level rise may damage infrastructure and lead to loss of biodiversity which will impact tourism and the agriculture and water sectors (among others) | - Focusing more on communities at risk<br>- Taking a broader view of the drivers of risk<br>- Factoring climate change into national development plans<br>- Implementing integrated planning based on local priorities<br>- Using historical and current hydrometeorological data<br>- Recognizing and using local and indigenous knowledge<br>- Developing resources at the institutional and community levels<br>- Ensuring political buy-in<br>- Improving technical capacity<br>- Improving governance structures<br>- Ensuring longer project implementation periods<br>- Enhancing cooperation on human mobility<br>- Strengthening regional and subregional cooperation | - Existing risk management approaches start from a risk management perspective<br>- Existing tools are not equipped to deal with non-economic loss and damage<br>- Quality, availability and access to data | -The importance of strong governance at the local level<br>- The importance of communicating climate and weather information in a way that is easily understood by end users<br>- The importance of bottom-up approaches, the participation of all agencies and community participation<br>- Approaches should be interdependent and complementary | - More needs to be understood about slow onset processes<br>- Loss and damage arising from slow onset processes is already occurring, thereby making the identification and implementation of approaches to address loss and damage arising from slow onset processes a priority<br>- A complement of approaches will be required to address long-term foreseeable risks |

## 2. Latin America

Table 2.1
**Approaches to address loss and damage arising from slow onset climatic processes presented at the Latin America regional expert meeting**[2]

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* | *Main challenges* |
|---|---|---|---|---|
| Adaptation | Temperature increase and loss of biodiversity | A presentation on the economics of climate change in Central America profiled sustainable adaptation, which includes an array of activities that promote development and facilitate adaptation, including: water management; protection and recovery of ecosystems; technology and innovation; poverty reduction, fiscal policy and disaster risk reduction initiatives (Lennox, 2012) | Sustainable adaptation requires attention to inadequate adaptation, benefits and intersectoral costs. As greenhouse gas (GHG) emissions increase, the costs of adaptation will also increase. Moreover, it is also important to acknowledge that it is impossible to adapt to all impacts; there will inevitably be some degree of loss and damage | Sustainable development may have co-benefits in the form of decreases in GHG emissions, which will have benefits on health and energy security, reduce deforestation and decrease the costs of adaptation. Unilateral measures and/or a global agreement will force a transition towards a low-carbon economy |
| Institutional | Temperature increase (among other impacts) | The Governments of Peru and Switzerland have collaborated to develop a programme to integrate science and technology into adaptation strategies in Brazil | | |
| Institutional | Temperature increase, glacial retreat | A joint presentation by the Institute for Sustainable Development and the United Nations Development Programme profiled Climate Risk Management (CRM), an approach to identify climate risks and evaluate impacts on socio-economic development. The assessment engages a range of stakeholders including hydrometeorological agencies and vulnerable communities to develop CRM strategies that address more than just physical losses. In Peru, CRM is being used to reduce the risk of lower agricultural yields due to temperature increase and glacial retreat, which has affected the availability of water. The project has: enhanced agricultural practices through the use of irrigation, reservoirs and reforestation; encouraged | Lessons learned include the need to harmonize approaches, understand slow onset processes, develop institutional architecture and institutional linkages at all levels, mainstream into development planning, prioritize resource allocation and build capacity at the subnational and national levels to capture and interpret | |

[2] These examples were taken from presentations given at the Latin America regional expert meeting. Available at <http://unfccc.int/6952>.

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* | *Main challenges* |
|---|---|---|---|---|
| | | crop diversification; provided access to finance, insurance and markets; and facilitated livelihood diversification (Isaar and Keller, 2012) | data | |

Table 2.2
**Challenges, needs, gaps, lessons learned and key messages identified during the discussions on addressing loss and damage arising from slow onset processes at the Latin America regional expert meeting**

| *Challenges* | *Needs* | *Gaps* | *Lessons learned* | *Key messages* |
|---|---|---|---|---|
| - Electoral consistency | - Mainstreaming climate change adaptation and disaster risk reduction into development policy and practice<br>- Creating linkages with adaptation plans<br>- Evaluating the effectiveness of existing laws<br>- Communicating climate trends to the public<br>- Enhancing understanding of how climate change will deter development outcomes and impact forests and biodiversity<br>- Acknowledging the relationship between slow onset processes and extreme events<br>- Building on existing initiatives<br>- Strengthening compensation for losses through safety nets<br>- Ensuring institutional leadership at state level<br>- Consulting a range of actors when designing strategies<br>- Considering non-economic losses<br>- Ensuring policy and budgetary consistency<br>- Building on lessons learned from regional experiences | - Quality, availability and access to data | - All databases should be in the public domain and data-sharing, trust and cooperation should be facilitated between institutions<br>- Within regions there are shared resources and scope for building capacity, sharing technical expertise and facilitating collaboration | - More information is needed about slow onset processes<br>- New approaches and a more accurate assessment of slow onset processes in the region are needed<br>- Non-economic losses should be considered when developing approaches to address loss and damage arising from slow onset processes |

### 3. Asia and Eastern Europe

Table 3.1

**Approaches to address loss and damage arising from slow onset climatic processes presented at the Asia and Eastern Europe regional expert meeting**[3]

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* |
|---|---|---|---|
| Infrastructure | Glacial melt | The International Centre for Integrated Mountain Development recently conducted an assessment of the risk of glacial lake outburst flooding in the Tsho Rolpa region of Nepal. The geophysical study of a lake in the region and its downstream environment informed mitigation measures, which included the construction of an open channel to reduce the lake level and decrease the risk of flooding. The targeted beneficiaries of the project were those living downstream of the lake | Lessons learned in the course of implementation included the need for community involvement and the importance of: accounting for the challenges of working in the Himalayan environment in the planning process; a proactive government; cooperation with the scientific community; and both media and donor support |
| Structural | Sea level rise (and extreme events such as cyclones) | Mangroves for the Future (MFF) is an International Union for Conservation of Nature programme, which works in several Asian countries – including India, Pakistan, Sri Lanka, Thailand and Viet Nam – to strengthen the resilience of ecosystem-dependent communities. MFF is implemented through agreements with the country office or grants to medium-sized projects | Lessons learned include: the need for effective governance structures and arrangements which help MFF feed into national processes; the importance of choosing local partners with experience and expertise; linking the project to existing institutions to mobilize local capacity and support; capitalizing on local knowledge and capacity and ensuring community involvement; understanding the local conditions and selecting projects with the potential for growth |

[3] These examples were taken from presentations given at the Asia and Eastern Europe regional expert meeting. Available at <http://unfccc.int/adaptation/cancun_adaptation_framework/loss_and_damage/items/6993.php>.

Table 3.2
**Summary of the breakout discussion on glacial melt at the Asia and Eastern Europe regional expert meeting**

| *Challenges and needs* | *Priorities* | *Potential responses* |
|---|---|---|
| - The impacts on a range of sectors, including agriculture, water, energy and tourism<br>- Cross-sectoral challenges and needs which will intensify over time<br>- Glacial melt could lead to extreme events and hazards such as flash floods, glacial lake outburst floods and landslides<br>- Different experiences and approaches are needed for rural versus urban areas<br>- Care should be taken to avoid maladaptation<br>- No insurance penetration in some areas | - Assuring financial resources<br>- Increasing the availability of data<br>- Enhancing knowledge and data management<br>- Translating information into policies<br>- Strengthening decision-making<br>- Developing communication tools to inform communities<br>- Building capacity at all levels<br>- Providing livelihood options and alternatives where available and safety nets where not available<br>- Developing methods and technologies for addressing impacts arising from slow onset processes, including traditional and indigenous knowledge and technologies<br>- Ensuring international sharing of good practices and lessons learned<br>- Developing early warning systems | - Providing options and alternatives at the local level<br>- Planning and integration<br>- Developing intersectoral approaches<br>- Creating a contingency fund at the national level<br>- Enhancing transboundary cooperation at the regional level<br>- Learning from successful traditional adaptation approaches<br>- Developing approaches to address migration<br>- Designing tools based on the needs of the community while providing incentives for adaptation<br>- Recognizing that rehabilitation and compensation will be necessary in some cases |

Table 3.3
**Summary of the breakout discussion on desertification at the Asia and Eastern Europe regional expert meeting**

| *Challenges and needs* | *Priorities* | *Potential responses* |
|---|---|---|
| - The need to share good practices<br>- Interactions between slow onset and rapid onset events<br>- The existence of tipping elements<br>- Recognizing that the continuum of approaches to address loss and damage overlaps with adaptation | - Water, food and energy insecurity<br>- Risk of loss and damage to pastoralist societies<br>- Transboundary solutions<br>- Institutions, regulations and legal frameworks at all levels<br>- Recognizing the gap between knowledge and action | - Acknowledging the importance of assessment as an essential first step<br>- Implementing land zoning and localized approaches<br>- Ensuring integrated water management<br>- Developing insurance approaches |

Table 3.4
**Summary of the breakout discussion on loss of biodiversity at the Asia and Eastern Europe regional expert meeting**

| *Challenges and needs* | *Priorities* | *Potential responses* |
|---|---|---|
| - The permanence of biodiversity and the loss to future generations<br>- In order to avoid tipping points, it is essential to plan in the long term, not just according to the election cycle<br>- The negotiation of long-term planning versus short-term needs | - Land-use change<br>- The cost of the loss of livelihoods to development<br>- Health<br>- Ecosystem services<br>- Coastal degradation<br>- The fragmentation of ecosystems<br>- Impacts on sectors and key industries | - Implementing multisectoral approaches across institutions and ministries<br>- Analysing and refining governance<br>- Utilizing indigenous and community knowledge to develop frameworks<br>- Involving the private sector<br>- Using financial instruments such as social and environmental bonds and sustainable finance tools<br>- Converting the intangible value of biodiversity into visible value<br>- Enhancing education and awareness<br>- Implementing evidence-based policies and activities<br>- Enhancing economic and gender empowerment<br>- Increasing opportunities for communities<br>- Reducing existing vulnerabilities<br>- Developing an iterative management processes with strong lesson learning, monitoring and evaluation, and stakeholder engagement |

Table 3.5
**Summary of the breakout discussion on sea level rise at the Asia and Eastern Europe regional expert meeting**

| *Challenges and needs* | *Priorities* | *Potential responses* |
|---|---|---|
| - Sea level rise is not a standalone problem; it frequently leads to salinization and other problems, such as the loss of biodiversity of mangrove ecosystems<br>- Government support<br>- Scaling up | - Ensuring strong commitments on regional cooperation<br>- Understanding how loss and damage is different from adaptation<br>- Factoring the impacts of sea level rise and salinization into development planning | - Linking traditional knowledge to scientific findings<br>- Mainstreaming climate change into local and national planning<br>- Taking future climate impacts into account when designing infrastructural approaches<br>- Working closely with the disaster risk reduction community<br>- Conducting research to develop saline-tolerant crops<br>- Conducting research to explore the limits of adaptation as well as potential permanent losses<br>- Implementing index-based insurance<br>- Developing approaches to address non-economic losses<br>- Developing approaches to address resettlement both within and beyond state borders<br>- Conducting pilot projects<br>- Ensuring that approaches address the most vulnerable members of society<br>- Providing compensation from national and/or international funds |

Table 3.6

**Challenges, needs, gaps, lessons learned and key messages identified during the discussions on addressing loss and damage arising from slow onset processes at the Asia and Eastern Europe regional expert meeting**

| *Challenges* | *Needs* | *Gaps* | *Lessons learned* | *Key messages* |
|---|---|---|---|---|
| - Long-term planning versus short-term needs must be negotiated<br>- Climate change is a relatively new policy area in many countries and adaptation is not yet a priority<br>- Institutional limitations vis-à-vis data availability, quality, accessibility and affordability<br>- Limited capacity and expertise<br>- The absence of relevant legislation and regulations<br>- Limited financial resources to maintain databases and develop and sustain human and institutional capacity is also an issue<br>- Slow onset processes have the potential to overwhelm the coping capacity of some nations | - Ensuring replication and regional cooperation<br>- Increasing the availability of data for systematic observations<br>- Enhancing education and awareness-raising<br>- Implementing and developing monitoring and modelling to strengthen decision-making<br>- Strengthening capacity-building<br>- Developing methods and technologies that incorporate traditional and indigenous knowledge<br>- Sharing good practices<br>- Developing localized approaches<br>- Ensuring integrated water management<br>- Developing multisectoral approaches across institutions<br>- Involving the private sector<br>- Developing financial instruments such as social and environmental bonds and sustainable finance tools<br>- Converting the intangible value of biodiversity into visible value<br>- Implementing evidence-based policies and activities | - There is currently a gap between knowledge and action<br>- Institutions to champion regional cooperative efforts, such as regional development banks, and support to develop and enhance climate services are needed<br>- Some regional blocs – such as the South Asian Association for Regional Cooperation – are not effective, which creates a space and a need for regional and international organizations; this might be a role for "track II diplomacy" | - The importance of knowledge and data management<br>- The importance of acknowledging different experiences and needs in urban versus rural areas<br>- The importance of assessment as an essential first step<br>- In order to avoid tipping points, it is essential to plan in the long term, not just four or five years ahead according to the election cycle<br>- The importance of understanding the knowledge life cycle (awareness; generating knowledge; decision-making; mainstreaming into 'business as usual')<br>- The need to build on existing work, tailor information to the audience and incorporate science<br>- Support has come mostly from multilateral development banks but there is a need to diversify the resource channels<br>- Social or cultural networks can compensate for the lack | - Recognizing the diversity of slow onset processes impacting the region and interacting with extreme events<br>- Approaches should be based on the needs of the community and should provide incentives for adaptation<br>- In some cases, migration may be the only option available<br>- Rehabilitation and compensation will also be necessary in some cases<br>- It is important to recognize the interactions between rapid onset events and slow onset processes, the existence of tipping elements, the continuum of approaches and links to adaptation<br>- Regional priorities include: water, food and energy insecurity; the risk of loss and damage to pastoralist societies; transboundary solutions; and the importance of institutions and regulations at all levels<br>- The main regional issues include: the need for |

| *Challenges* | *Needs* | *Gaps* | *Lessons learned* | *Key messages* |
|---|---|---|---|---|
| | - Enhancing economic and gender empowerment<br>- Increasing opportunities for communities<br>- Reducing existing vulnerabilities<br>- Increasing political will to drive integrated approaches<br>- Ensuring multi-stakeholder participation<br>- Enhancing synergies and linkages between disaster risk reduction, adaptation, development, and loss and damage<br>- Ensuring a clear understanding of institutional roles and capacities and how they could be changed to meet the new challenge of loss and damage<br>- Implementing land zoning | | of effectiveness of political blocs<br>- The importance of an iterative management process with strong lesson learning<br>- The importance of cross-ministerial coordination at all levels<br>- The potential role of non-governmental organizations in translating information for end users | regional collaboration; the need to share experiences and to address transboundary resources such as water; data-sharing; and the need to create hydrometeorological databases |

*Note*: At the Asia and Eastern Europe regional expert meeting, breakout groups were formed to focus discussions on the best practices, gaps and needs in the following regions: South-East Asia, South Asia, and Central Asia and Eastern Europe. The discussions are summarized in the tables below.

### 3.1 South-East Asia

Table 3.7
**Summary of the breakout discussion on needs, priorities and potential responses to address loss and damage arising from slow onset processes in South-East Asia**

| *Needs* | *Priorities* | *Potential responses* |
|---|---|---|
| - More regional platforms<br>- More experience on cross-sectoral approaches<br>- Challenges with regard to coordination, data-sharing and the duplication of efforts<br>- The need to scale up pilot projects, and data access and sharing across the region | - Enhancing regional cooperation<br>- Insurance regulations and coordination<br>- Capacity-building for decision-making<br>- Political commitment<br>- Accessible and digestible data<br>- Tailoring approaches to the needs of individual countries | - Using regional platforms<br>- Building on existing regional and international platforms and tools<br>- Using models such as the Mekong River Commission for capacity-building and other purposes<br>- Coordinating responses and cost-sharing<br>- Democratizing data and knowledge<br>- Creating spaces for non-governmental organizations to collaborate |

### 3.2 South Asia

Table 3.8
**Summary of the discussion on needs, priorities and potential responses to address loss and damage arising from slow onset processes in South Asia**

| *Needs* | *Priorities* | *Potential responses* |
|---|---|---|
| - Effective regional cooperation<br>- Social and cultural networks to compensate for the lack of effectiveness of political blocs<br>- Political will | - Watershed management<br>- Transboundary water issues<br>- Forecasting, biodiversity<br>- Desertification<br>- Food security<br>- Disease control | - Promoting livelihood resilience<br>- Enhancing infrastructure<br>- Providing basic services and social protection<br>- Encouraging both public and private investment<br>- Reforming existing institutions and creating new ones<br>- Sharing practices and resources – including data and human resources – and using available resources appropriately |

### 3.3 Central Asia and Eastern Europe

Table 3.9
**Summary of the discussion on needs, priorities and potential responses to address loss and damage arising from slow onset processes in Central Asia and Eastern Europe**

| *Needs and challenges* | *Priorities* | *Potential responses* |
|---|---|---|
| - Adaptation is not yet a priority in many countries<br>- Limitations vis-à-vis data availability, quality, accessibility and affordability as well as limited capacity and expertise<br>- The absence of relevant legislation and regulations<br>- Limited financial resources to maintain databases and develop and sustain human and institutional capacity | - Regional collaboration to share experiences and address transboundary resources, such as water, data-sharing and the creation of hydrometeorological databases<br>- Capacity development and technological support | - Supporting countries to develop their own national priorities<br>- Implementing adaptation plans and strategies to help raise the profile of the need to address climate change impacts<br>- Identifying institutions that could champion regional cooperative efforts, such as regional development banks, and provide support to develop and enhance climate services |

## 4. Small island developing States

Table 4.1
**Approaches to address loss and damage arising from slow onset climatic processes presented at the small island developing States expert meeting**[4]

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* | *Main challenges* |
|---|---|---|---|---|
| Early warning system | Sea level rise | A water monitoring system – the Hydrological Cycle Observation System – has been established in the Pacific to enhance the knowledge, resources and technical capacity of 14 water agencies in the region to collect hydrological data and monitor water resources | | |
| Institutional | Sea level rise | The Strategic National Policy Unit in Kiribati has implemented a vocational training programme and a labour mobility scheme to assist citizens who wish to migrate. Technical and vocational training programmes are provided as well as seasonal employment | Lessons from the project include the inability of local infrastructure to support the training programmes without external support and the need for the courses to be aligned | There are many people who will need to migrate in the coming years. Thus, there is a significant need to scale up this programme, and especially |

[4] These examples were taken from presentations given at the small island developing States expert meeting. Available at <http://unfccc.int/adaptation/cancun_adaptation_framework/loss_and_damage/items/7058.php>.

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* | *Main challenges* |
|---|---|---|---|---|
| | | programmes in Australia and New Zealand and English-language programmes. The training schemes target beneficiaries from 16 to 24 years old while the seasonal employment programmes target rural inhabitants with little formal education | with international standards. Relocation requires integration, which is made easier with English-language skills | to target youth. Significant resources, both technical and financial, are required to sustain the programmes. Given the level of interest in the programmes, scaling up is critical, but additional partners must first be identified |
| Infrastructure | Sea level rise (among other impacts) | The Coastal Community Adaptation Project of the United States Agency for International Development is helping to build resilience to extreme events in the short term and slow onset processes in the long term in vulnerable communities in 12 countries in the Pacific. The programme helps to build resilience by rehabilitating and constructing climate-resilient infrastructure in coastal zones, building capacity for disaster risk prevention and preparedness, and mainstreaming climate-resilient policies and practices into local planning and building standards. The project is benefitting up to 90 vulnerable communities throughout the Pacific islands | | |
| Infrastructure | Sea level rise (among other impacts) | The United Nations Development Programme (UNDP) is working in Barbados and other countries belonging to the Organization for Eastern Caribbean States to reduce loss and damage arising from extreme events and to examine loss and damage arising from slow onset processes. To understand slow onset processes, UNDP is undertaking research on the significance of slow onset processes and loss and damage in small island developing States (SIDS), engaging with the local and international scientific community, and holding informal and formal dialogues with stakeholders to understand issues related to | Lessons learned include: the need for multisectoral, multi-hazard approaches for effective disaster risk reduction (DRR) planning and development; knowledge and awareness-raising across government ministries to help them integrate climate change adaptation (CCA) and DRR into policies and plans; and the effective use of data. There is a need to strengthen capacity in SIDS to implement DRR and | Resource requirements include building technical capacity to collect and update data and create an enabling environment for DRR and CCA integration and mechanisms for South–South cooperation |

| *Type of intervention* | *Type of slow onset event* | *Example and reference* | *Main lessons learned* | *Main challenges* |
|---|---|---|---|---|
| | | slow onset processes. The targeted beneficiaries are a range of stakeholders from policy and decision makers to national and subnational organizations and communities | CCA strategies as well as a need for mechanisms for South–South cooperation, including with regard to the transfer of technology, knowledge, approaches and tools | |

Table 4.2
**Summary of the breakout discussion on sea level rise, salinization, coastal erosion and inundation at the small island developing States expert meeting**

| *Challenges and needs* | *Priorities* | *Potential responses* |
|---|---|---|
| - Lack of capacity and skills to quantify losses<br>- Enabling environment<br>- Insurance<br>- Data-sharing<br>- Public awareness | - Enabling the transition from policy to implementation<br>- Implementing holistic approaches<br>- Developing projections and mapping<br>- Conducting assessments to determine the impacts on sectors and geographic areas<br>- Monitoring climate change and its impacts<br>- Collecting data and creating databases<br>- Using data from existing databases<br>- Building programmes<br>- Enhancing regional cooperation<br>- Involving a wide range of stakeholders and organizations<br>- Conducting an ongoing dialogue with decision makers | - Risk reduction and adaptation approaches include: infrastructure (e.g. seawalls, coastal defence measures, etc.); ecosystem services (e.g. afforestation and rainfall capture); insurance as a tool for risk reduction; traditional approaches (e.g. temporary relocation and diversifying livelihood strategies); and early warning systems<br>- Risk retention approaches include insurance-based incentives that encourage disaster risk reduction initiatives<br>- Planned migration by providing a trust fund and new territory for those displaced by slow onset processes |

Table 4.3
**Summary of the breakout discussion on temperature increase at the small island developing States expert meeting**

| *Experience and good practices* | *Gaps and limitations* | *Priorities* | *Potential responses* |
|---|---|---|---|
| - Mangrove forests serve multiple purposes<br>- Agroforestry/intercropping<br>- Rainwater harvesting/water use strategies<br>- Soil management techniques<br>- Greenhouses<br>- Protective houses | - Political will<br>- Challenges to behavioural change<br>- Communication and environmental education<br>- Capacity-building/retention<br>- Uncertainty and lack of knowledge<br>- Monitoring and evaluation<br>- Budget deficits<br>- International approaches<br>- Technology<br>- Lack of clear authority and duplication of efforts<br>- Data quality | - Providing more accurate and more accessible information<br>- Developing innovative outreach approaches<br>- Enabling practices/skills | - Financing<br>- International approaches<br>- Integrated approaches<br>- Regional centres of excellence<br>- Insurance<br>- Education and awareness<br>- Research to find new crops and seeds |

*Note*: At the small island developing States (SIDS) expert meeting, breakout groups were formed to focus discussions on the best practices, gaps and needs in SIDS in the Caribbean, Pacific and Africa regions. The discussions are summarized in the tables below.

### 4.1 Caribbean small island developing States

Table 4.4
**Summary of the discussion on existing practices, gaps and needs in the Caribbean small island developing States**

| *Existing practices* | *Gaps* | *Needs* |
|---|---|---|
| - The Caribbean Catastrophe Risk Insurance Facility<br>- The development of economic frameworks<br>- The Reducing Risk to Human and Natural Assets Resulting from Climate Change project<br>- The Pilot Program for Climate Resilience<br>- The World Health Organization regional pilot for climate variability and change and impacts on health<br>- UNFCCC second national communications<br>- The Database Management System for a Regional Integrated Observing Network for Environmental Change in the Wider Caribbean<br>- Hydrometeorological forecasting systems, the Early Recovery System, loss and damage assessments and forecasting<br>- DesInventar | - There is insufficient regional coordination<br>- Decision makers need better information that is tailored to their needs<br>- The need for quantitative information<br>- There is insufficient emphasis on mainstreaming climate change and disaster risk reduction at the national and regional levels<br>- A number of tools exist but are not used effectively<br>- Funding and resource constraints hamper development | - Developing a common understanding<br>- Creating more common space<br>- Looking closely at institutional arrangements<br>- Developing capacity<br>- Harmonizing approaches<br>- Prioritizing actions<br>- Enhancing communication<br>- Mobilizing resources |

### 4.2 Pacific small island developing States

Table 4.5
**Summary of the discussion on existing practices, priorities and responses in the Pacific small island developing States**

| *Existing practices* | *Priorities* | *Responses* |
|---|---|---|
| - Regional coordination at the national level<br>- Understanding loss and damage from tropical cyclone risk (the Pacific Catastrophic Risk Assessment and Financing Initiative)<br>- Regional organizations responsible for national implementation<br>- Ongoing work on adaptation will assist in understanding the limits of adaptation<br>- Translating regional work at the national and local | - Increasing small island developing States (SIDS)–SIDS cooperation<br>- Implementing a SIDS financing facility for loss and damage at the international level<br>- Ensuring international funding for regional technical support mechanisms<br>- Increasing investments in SIDS DOCK and energy efficiency | - Developing business opportunities within the SIDS group to acquire Light Detection and Ranging (LIDAR) data<br>- Using available government radar satellite data, which could help to fill gaps in data<br>- Enhancing international intervention that pools financial and technology needs<br>- Synergizing skills<br>- Utilizing technical expertise within the United |

| *Existing practices* | *Priorities* | *Responses* |
|---|---|---|
| levels as an extension of assisting national processes<br>- Current measures being used are frequently ad hoc<br>- Acquiring proper data resolution can be cost-prohibitive<br>- The affordability of regional approaches at the local level is often prohibitive | - Engaging in the United Nations Secretary-General Energy4All Initiative<br>- Developing a SIDS recruitment platform to assist with capacity constraints | Nations to fill capacity requirements<br>- Conducting continuous adaptation capacity-building programmes<br>- Strengthening national institutions<br>- Establishing a legal framework<br>- Establishing a trust fund that can be capitalized to afford insurance cover |

### 4.3 African small island developing States

Table 4.6
**Summary of the discussions on current practices, lessons learned, challenges, potential responses and strategies, and priorities in the African small island developing States**

| *Current practices and lessons learned* | *Challenges* | *Potential responses and strategies* | *Priorities* |
|---|---|---|---|
| - The Indian Ocean Commission (a climate adaptation initiative in five countries)<br>- Proposal for a regional climate service centre<br>- Dialogue with other small island developing States (SIDS)<br>- The Climate Vulnerable Forum<br>- In Eastern Africa coastal regions, there is a disconnect between community-level policies and overarching regional- and international-level policies<br>- La Reunion (regional centre for cyclone warning in the Indian Ocean)<br>- The Southern African Development Community (integration with some SIDS and a drought monitoring system in Harare, Zimbabwe)<br>- Partnerships in Environmental Management for the Seas of East Asia | - Geography and population distribution<br>- Capacity gaps at the national level<br>- Language challenges (differences between eastern and western islands)<br>- Lack of regional counterparts for international systems<br>- SIDS sometimes receive less attention because they are widely spread among different United Nations regions | - Ensuring strong political commitment and leadership<br>- Increasing the visibility of the needs of African SIDS<br>- Ensuring that efforts are not duplicated when needs can be filled through alternative arrangements<br>- Ensuring sustainable finance<br>- Developing a regional action plan<br>- Strengthening coherence among regional groups<br>- Developing capacity at multiple levels | - Ensuring that development banks provide a platform for regional institutions to develop comprehensive approaches<br>- Recognizing the value of regional institutions in bringing regional and international frameworks into national decision-making<br>- Increasing stakeholder involvement (e.g. the Global Island Partnership)<br>- Sharing lessons learned (e.g. graduation from least developed country status)<br>- Using the United Nations Department of Economic and Social Affairs data-gathering system<br>- Using monitoring and evaluation systems |

| | |
|---|---|
| - Coordinating Body on the Seas of East Africa | - Enhancing coral reef monitoring and marine protected area outreach activity<br>- Developing disaster risk reduction and insurance schemes<br>- Establishing long-term, integrated approaches |

Table 4.7
**Challenges, needs, lessons learned and key messages identified during the discussions on addressing loss and damage arising from slow onset processes at the small island developing States expert meeting**

| *Challenges* | *Needs* | *Lessons learned* | *Key messages* |
|---|---|---|---|
| - Political will<br>- Uncertainty and lack of knowledge<br>- Monitoring and evaluation<br>- Budget deficits<br>- Lack of international approaches to address slow onset processes<br>- Lack of clear authority<br>- Duplication of efforts<br>- The challenges for resource mobilization include lack of adequate data, especially baseline economic data<br>- Insufficient institutional arrangements<br>- Annual budget cycles prevent the development of long-term programmatic approaches to adaptation<br>- Tribal and other land tenure | - Regional centres that offer more accurate and more accessible information<br>- Enhancing education and awareness/innovative outreach approaches<br>- Enabling practices/skills<br>- Building capacity<br>- Ensuring that all sectors look beyond standard management responses<br>- Accounting for tipping points in adaptation planning<br>- More integrated approaches are required to address damage arising from slow onset events<br>- National structures require greater support if responses are to be commensurate with the scale of the problem<br>- The needs associated with risk management include: the need for enhanced technical and financial support for risk reduction efforts for climate-related extreme weather events; the facilitation of information; and the provision of training on how to reduce risks from the progressive negative impacts of climate change using an integrated approach<br>- There is also a need to: identify institutions to champion | - Best practices outlined include: capacity-building programmes; regional cooperation; the potential for using data from existing databases; the involvement of a wide range of stakeholders and organizations; and conducting an ongoing dialogue with decision makers<br>- Potential risk reduction and adaptation approaches include: enhancing infrastructure (e.g. seawalls, coastal defence measures, etc.); developing ecosystem services (e.g. afforestation and rainfall capture); using insurance as a tool for risk reduction; using traditional approaches (e.g. temporary | - Possible mechanisms for addressing slow onset processes include: effective preparation (e.g. enhancing understanding and awareness, and long-term planning, monitoring and forecasting, etc.); and transferring and sharing risk (e.g. investigating financial and index-based approaches, micro-, macro- and regional insurance, sustainable finance across sectors, etc.)<br>- There is a need to better understand impacts and facilitate data collection and database creation<br>- Holistic approaches were identified as a priority |

| *Challenges* | *Needs* | *Lessons learned* | *Key messages* |
|---|---|---|---|
| systems are a hurdle for resource allocation and adaptation<br>- Donor funds are not long-term<br>- Difficulty of accessing fast-start financing<br>- Lack of coordination, finance, governance in remote areas and technical capacity<br>- Lack of risk management expertise<br>- Fragmented decision-making processes<br>- Competing interests<br>- Uncertainty due to the lack of data or information | loss and damage; increase public education and awareness; increase synergies and coordination both vertically and horizontally; enhance compliance and enforcement/policing; revise existing mechanisms/plans/policies to incorporate the impacts of slow onset processes; replicate best practices; and increase communication between the disaster risk reduction (DRR) and climate change adaptation communities<br>- Ensuring skilled management of the participation process at all levels<br>- Ensuring predictable sources of funding<br>- Addressing the implementation gaps, especially with respect to institutions<br>- Developing programmes that support self-reliance<br>- Increasing United Nations country presence, especially in the Pacific islands<br>- Enhancing communication and environmental education | relocation and diversifying livelihood strategies); and implementing early warning systems<br>- Potential risk retention approaches include insurance-based incentives that encourage DRR initiatives by reducing premiums if they are implemented<br>- Planned migration by providing a trust fund and new territory for those displaced by slow onset processes could be facilitated | |

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