Adaptation **C**ommittee

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Bonn, Germany, 24–27 March 2020

Synthesis report on how developing countries are addressing hazards, focusing on relevant lessons learned and good practices

Recommended action by the Adaptation Committee

This report presents adapation efforts taken by developing country Parties in response to climate hazards, focusing on relevant lessons learned and good practices. It draws primerly on reports submitted by Parties to the UNFCCC.

The Adaptation Committee (AC), at its 17th meeting, will be invited to consider information contained in this document and consider next steps.

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1. Introduction

1.1. Mandate

1. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA) requested the secretariat, under the guidance of the Adaptation Committee (AC) and the Least Developed Countries Expert Group (LEG), and in collaboration with relevant stakeholders, to prepare synthesis reports every two years starting in 2020. The synthesis reports, covering specific adaptation themes, are focused on relevant lessons learned and good practices in developing country Parties in the context of the recognition of their adaptation efforts.[1] The CMA also recalled that the global stocktake will review the overall progress made in achieving the global goal on adaptation and acknowledged that adaptation efforts contribute to this objective.[2]

2. The AC, at its sixteenth meeting, agreed on the theme of "How developing countries are addressing hazards, focusing on relevant lessons learned and good practices" for its first synthesis. It requested the secretariat to develop an initial draft for consideration by the seventeenth meeting of the Adaptation Committee.

1.2. Scope

3. This report identifies actions, within and taken by developing countries, in response to climate hazards that lead to enhancement of adaptive capacity, strengthening resilience, and a reduction in vulnerability. It is based on a review of National Adaptation Plans (NAPs), Nationally Determined Contributions (NDCs), National Communications, other relevant (workshop) reports including reports of the Technical Examination Process on Adaptation (TEP-A), the AC, the LEG, and reports prepared under the Nairobi Work Programme. In addition to the reports, literature is consulted, where appropriate, including to extract examples for improved understanding of the developing countries' adaptation reports. So far, 89 NDCs of developing countries and 18 NAPs, submitted to the UNFCCC, have been reviewed.

1.3. Structure

4. Following an introduction, the report includes the following sections:

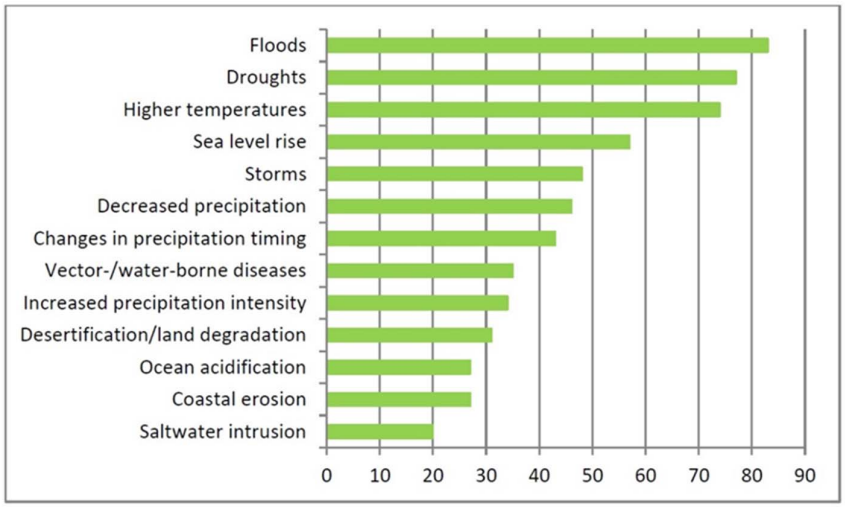
a) Section two captures information on developing countries' adaptation efforts in response to multiple climate hazards. The section is dedicated to multiple hazards in order not to overlook information where developing countries have referred to impacts such as climate extreme/slow-onset events that may cover several hazards.

b) Section three is structured by type of hazards and elaborates on key climate hazards faced by developing countries. The key climate hazards were addressed by Parties (see Figure 1, from UNFCCC synthesis report on INDCs).[3] Under each hazard, impacts and costs, good practices, as well as challenges from developing countries in response to the impacts of hazards are discussed. Where information was available, the efforts are further structured into sub-categories of (a) national strategies and plans, (b) legal and regulatory frameworks and policies, and (c) project implementation.

c) Section four, informed by previous chapters, provides an overview of lessons learned.

[1] See Decision 11/CMA.1 para 13.
[2] See Decision 11/CMA.1 para 14.
[3] UNFCCC synthesis report on INDCs, https://unfccc.int/sites/default/files/resource/docs/2016/cop22/eng/02.pdf .

Figure 1. Key climate hazards identified in the adaptation component of the intended nationally determined contributions (number of Parties referring to a hazard)

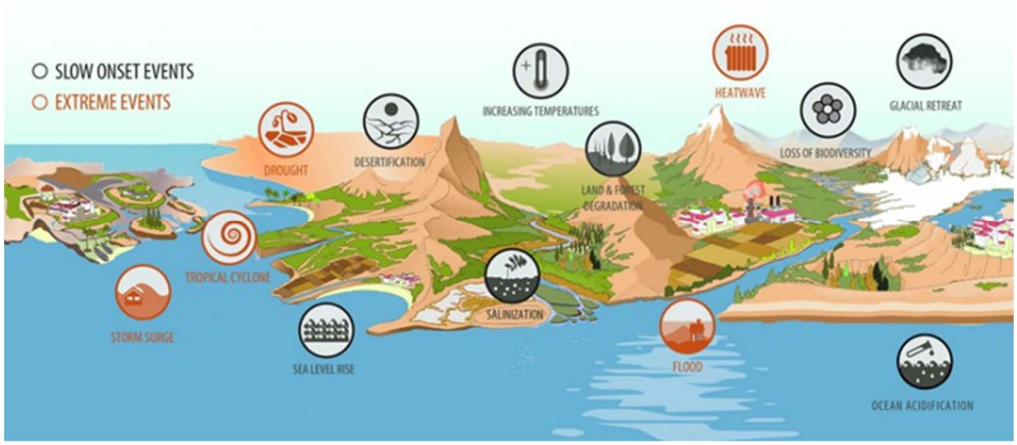


2. Countries' adaptation approaches in addressing multiple climate hazards

2.1. Impacts of hazards

5. All developing country Parties provided a description of key climate hazards faced by the countries. They also highlighted social and economic impacts of those hazards. A majority of Parties referred to multiple hazards, mentioning both extreme events and slow onset ones (see Figure 2). One Party, for example, reported on a range of hazards (including sea level rise, ocean acidification, storm, and floods) and estimated that the costs of climate change related risks would be 35 per cent of the country GDP. The estimate included only the potential impacts of climate change on coastal zone (USD 7-13 million per year) and water resources (USD 1-3 million per year).[4] Another one reported total losses of USD 6 billion due to extreme events in the period 2010–2011.

Figure 2. . Examples of extreme events and slow onset events



Source: Executive Committee of the Warsaw International Mechanism for Loss and Damage

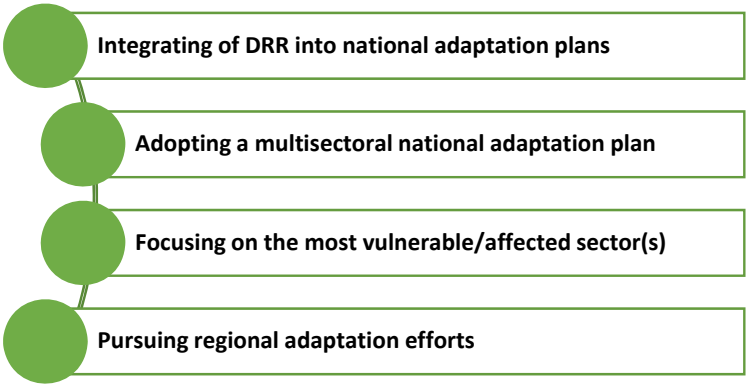
[4] Kiribati.

6. Developing countries have developed, or shard their intention to develop, adaptation measures in response to multiple hazards. In their adaptation planning, several Parties have given priority to protection of the population, ecosystem and natural resources, as well as key infrastructure, against the risks of extreme events. These include developing hazard maps and models for all potential hazards (including floods, sea level rise, storm surge, and tsunami), improvement of early warning system for climate events, construction of flood and cyclone shelters, construction of inland retention dams, climate resilient infrastructure and housing, and improvement of urban resilience through improvement of drainage system to address urban flooding. [5,6] Some mentioned priority adaptation needs such as using remote sensing and satellite-based technologies and approaches to improve monitoring and detection of hydrometeorological extreme events.[7] Planting of mangroves, construction of seawalls, and the relocation of communities to higher grounds were also part of ongoing adaptation initiatives.[8]

2.2. Good practices

7. Developing countries' good practices for multiple climate hazards can be categorised mainly into four types of adaptation response (Figure 3). These include (a) integrating disaster risk reduction (DRR) into national adaptation plans, (b) adopting a multisectoral national adaptation plan, e.g. through using multiple criteria analysis, (c) focusing on the most vulnerable/affected sector(s) and pursuing regional adaptation efforts. In undertaking these efforts, some countries have promoted an inclusive process, such as integration of gender consideration as well as inclusion of local communities and indigenous peoples into their practices. Also, some countries have addressed a combination of the approaches.

Figure 3. Good practices in response to multiple climate hazards



8. The **integration of disaster risk reduction into adaptation responses** can optimize efforts to reduce vulnerability and enhance resilience to the impacts of climate hazards. Several Parties adopted a disaster risk reduction approach to multiple climate hazards their countries face. They planned to reduce risks on all affected sectors through converging climate change adaptation and disaster risk reduction policies, and proposed adaptation actions, including development of national databases on climate data and early warning systems, improvement of local capacity and knowledge management, and enhancement of applications of technology.[9] For example, one Party planned to integrate its National Disaster Risk Management Policy within its adaptation plans, including through capacity building for resilience and technology transfer.

9. The country has cited the impact of extreme weather events as one of the main threats to human safety. While the country has improved in the past years its disaster risk management policies, it continues

[5] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bangladesh%20First/INDC_2015_of_Bangladesh.pdf
[6] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Dominican%20Republic%20First/INDC-DR%20August%202015%20(unofficial%20translation).pdf
[7] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bhutan%20First/Bhutan-INDC-20150930.pdf
[8] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Fiji%20First/FIJI_iNDC_Final_051115.pdf
[9] Jamaica, Indonesia, India.

to experience negative consequences caused by extreme weather events, with the public infrastructure being the most affected sector. The country has planned to improve infrastructure resilience by designing a national vulnerability monitoring program for infrastructure during extreme climate events, while recognizing the need to increase the capacity of the National Meteorological Institute to follow-up in real time, strengthen existing early warning systems, promote technology transfer to help adaptation, and to increase country wide research budget on climate change. [10]Another country developed a joint implementation plan on climate change and disaster risk management in 2014 which identifies priority adaptation measures to address current and ongoing climate risks. The implementation cost of the join plan over the period 2013–2023 were estimated to be approximately USD 75 million.[11]

10. Within the context of disaster risk management, some Parties developed legal and/or policy framework in response to climate hazards, these include:

a) Jamaica's Climate Change Policy Framework was prepared under a Government-of-Jamaica/EU/UNEP Climate Change Adaptation and Disaster Risk Reduction (CCADRR) Project. Climate-related hazards that have the highest impact on increasing vulnerability in the region include storms, floods and droughts.

b) The tsunami of Boxing Day 2004 in Indonesia, which caused considerable loss of life and destruction of property and infrastructure, led to the development of the Disaster Management Law of 2007. Also, the Indonesian Act on Meteorology, Climatology and Geophysics was developed in 2009.

c) In 2017, Lao's Ministry of Planning and Investment, with World Bank support, decreed the inclusion of climate and disaster risk considerations in the public investment review process. A climate change and disaster management law is currently being developed, together with a new five-year National Strategic Disaster Risk Management Plan.[12]

d) The Kenya Climate Risk Management Framework (2017) integrated climate change adaptation and disaster risk reduction in the context of sustainable development. The framework serves as a central part of policy and planning at national and county levels in Kenya.[13]

e) The Environment Protection Law No. 42/2014 issued in Kuwait in 2014 includes articles on topics related to climate change adaptation, such as articles 66 and 99 of the law deal with monitoring sea level rise and the marine environment. Article 118 of the law is dedicated to needs for natural disasters (e.g. sand and dust storms and flash floods) emergency and management plans.[14]

11. Several Parties have undertaken or planned to undertake **multisectoral national adaptation** response to climate risks (see box 1 for an example). One Party elaborated on the process of creating a multisectoral national adaptation plan, starting within its national climate change cabinet by first conducting an identification of priorities by all sectors, municipal representatives, and relevant actors of civil society, academia and the private sector. Then the process continued by reviewing the country's current policies and programmes for public and private investment on adaptation with the participation of all relevant actors. After the review, which was said to be iterative and expected to continue in the future, a set of initial needs regarding adaptation were identified. Among the initial needs were the development of structural and non-structural works to prevent floods, widening of the monitoring networks, and strengthening of early warning systems and health climate services. [15]

12. Another country undertook a national climate change risk assessment to identify priority risks for each sector. It used a multiple criteria analysis, comprising several steps: (1) identification of event/outcome risks based on previously undertaken vulnerability assessments, (2) ranking of the risks based on severity

[10] Costa Rica.
[11] Kiribati.
[12] Lao.
[13] http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/10/8737.pdf.
[14] Kuwait's NDC
[15] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Argentina%20First/Traducción%20NDC_Argentina.pdf.

of social/economic/environmental impacts using indicators, (3) probability/frequency analysis on prioritized event/outcome risks that scored the highest in the previous step, (4) verification of the outcomes through stakeholders consultation during a national consultative workshop, and (5) development of a list of national priority risks based on top ranked risks for each sector. [16]

Box 1. Alegria's multisectoral adaptation to extreme events through the integration of DRR

Algeria, after the 2001 floods and the 2003 earthquake, has developed a multisectoral approach to protect urban settlements and infrastructure from future losses from hazards. For example, the Ministry of Public Work has developed a database to identify major infrastructure at risk from earthquake, fire and flooding as well as a pilot project to explore flood risk to the infrastructure sector. Algeria's Ministry of Land-Use Planning and Environment collaborated with UNDP Algeria to integrate DRR into urban planning using GIS mapping which led to implementation of risk-sensitive plans across nine provinces.

The Ministry of Education has applied awareness raising measures on DRR, including sensitizing students and teachers to major hazards and integrating natural hazards and preparedness programmes into the school curriculum, as well as leading a series of national campaigns in schools and communities.

Source: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Algeria%20First/Algeria%20-%20INDC%20(English%20unofficial%20translation)%20September%2003,2015.pdf

13. Some developing countries have undertaken vulnerability assessments to identify the **most vulnerable/affected sectors**. The most referred to vulnerable sectors by Parties include water, health and agriculture. For example, one country took into account climatic projections and the potential impacts of climate hazards, ranging from coastal floods and intrusions of salt-water into groundwater to a decrease in corn yields, and developed key adaptive targets, by 2030, in the water sector. The targets include reducing the vulnerability of natural and human systems to floods and degradation of water quality, promoting water management, enhancing knowledge regarding the climatic system and forecasting of weather conditions. Another Party focused on a wide-ranging intervention measures in the health sector to reduce the burden of climate sensitive health disease. Climate sensitive diseases considered in its plan include heat wave-related health impacts, water-, vector-, and food-borne diseases, respiratory and air-borne diseases, and occupational health risks induced by climate change.[17] Others included, in their submissions, preparation of contingency plans for public health under the impacts of climate change and improving the capacity of public medical services to adapt to climate change. [18]

14. Climate change adaptation and building resilience were considered a national security issue and a priority for some countries which have been severely affected by extreme climate events, [19] with some climate extremes resulting in unprecedented impacts at a regional scale. Some countries collaborated, with a view to **reducing regional vulnerability**, to implement their priority actions from their adaptation plans. See Box 2 for an example.

Box 2. Colombia's regional multisectoral approach to climate change adaptation

Impacts of the "La Niña" phenomenon, which took place in 2010–2011 in Colombia, was estimated USD 6 billion. It was reported that over 3.2 million people were affected, 3.5 million hectares flooded, and 845 primary and secondary roads closed, affecting the social and economic life of the country significantly. Taking into account the impacts caused by La Niña phenomena in 2010–2011, the country formulated its NAP in 2011, and has taken actions to implement it through regional (the Caribbean and Andean regions) and sectoral (transport, housing, energy, agriculture and health sectors) adaptation efforts.

[16] Dominica.
[17] Jordan.
[18] China NDC.
[19] Costa Rica.

To date, Colombian entities have formulated 11 regional adaptation plans, which have prioritized adaptation actions as well as plans for the agricultural sector and the primary road network. The country intended to align its adaptation efforts with other global targets that contribute to increasing resilience, such as those of the Convention on Biological Diversity (CBD), the 2030 Development Agenda, and the UN Convention to Combat Desertification (UNCCD), as well as the Sendai Framework for Disaster Risk Reduction 2015–2030. [20]

15. Some Parties underscored the importance of **inclusive approaches to adaptation** and sustainable development, through including the integration of gender considerations into their adaptation measures.[21,22] One Party in the context of sustainable development-oriented adaptation addressed integration of gender considerations in climate change policies and strategies in all relevant sectors, such as in its national strategies for poverty eradication and social development, and planned to develop and compile information and methodologies to facilitate the integration of gender considerations in this regard.

16. Some Parties recognized the importance of development and implementation of adaptation plans that are location and context-specific, emphasising on the enhanced and active participation of local communities and indigenous people. They also highlighted the integration of climate resilient indigenous practices, such as their practices of soil and water conservation, into adaptation. With regard to addressing climate hazards, a few Parties included in their adaptation actions the inclusion of local/indigenous knowledge (e.g. indigenous weather forecasting) into early warning systems and national climate risk surveillance programme, through launching partnership programme with academia and undertaking research in order to collect, compile, and analyze traditional local knowledge on climate.[23]

3. Adaptation efforts by type of hazard

This section provides examples of good practices from developing countries in response to key climate hazards reported by countries. The five main hazards identified by Parties are floods, droughts, high temperatures, sea level rise, and storms (see Figure 1). High temperatures is excluded for the purpose of this report, mainly because it has been discussed, in Parties submission, as a climate variable that leads /contributes to increase in intensity or frequency of other climate hazards. Hence, this section is structured into four hazards (floods, droughts, sea level rise, and storms) and attempts to present good practices in response to these hazards.

3.1. Floods

17. Around 80 percent of the developing countries which submitted their NDCs addressed floods in their reports. Floods were highlighted, in most submissions, as one of the climate-related hazards that have increased and will increase countries vulnerability to climate change.[24] Flooding has been reported, by majority, to impact more than one sector, and that the impacts of flooding are not limited to short-term contact with floodwaters. Some addressed the impacts of floods on key economic sectors, while others elaborated on their significant impact on water resources, the health sector and agricultural production. Disruption of services, increases in water and vector borne diseases, and long-term effects to ecosystems, such as destruction of wildlife habitats, were associated with flooding. [25]

[20] Colombia.
[21] Jordan.
[22] Kenya.
[23] NAPs of Fiji, Kenya, Sri Lanka.
[24] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Dominica%20First/Commonwealth%20of%20Dominica-%20Intended%20Nationally%20Determined%20Contributions%20(INDC).pdf.
[25] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Burkina%20Faso%20First/INDC%20Burkina_ENG.%20version_finale.pdf.

18. A few countries reported specifically on the damages and costs incurred related to flood events. One Party, while mentioning the total flood prone area in the country being about 45.64 million ha, reported that the country's annual average flood damage during the period 1996–2005 was USD 753.2 million.[26]

19. Parties have planned or started implementing adaptation actions to enhance resilience, including by developing early warning systems, ramping up disaster preparedness programmes for natural disaster risk reduction, improvement of human settlements, integrated watershed management and climate resilient infrastructure development.[27] Examples of good practices in responding to floods include, but are not limited to, national plans and strategies, legal and regulatory frameworks and policies, as well as concrete project implementation.

3.1.1. National plans

20. Majority of developing countries have included in their plans adaptation measures to reduce their vulnerabilities and to enhance their adaptive capacities to the impacts of flooding. Some expressed requiring financial support to implement their adaptation plan. For example, one country, while planning to mainstream climate change considerations in all sectors of national development and requiring significant support to implement its plan, specifically identified the agriculture sector to be under threat from flooding. If the country receives its needed support, it will undertake actions in implementation of the climate resilience strategy and action plan. The actions include introduction of new agricultural techniques, development and implementation of early warning systems, enhanced weather forecasting by including microclimate studies and localized forecasting, development and introduction of crop varieties which are flood resistant, developing environmental and climate change awareness programmes at all levels, as well as developing innovative financial risk management and insurance measures. [28] In addition, planting of traditional tree and root crops is being undertaken to minimize soil erosion by some countries. [29]

21. Another developing country reported on the impacts of floods on its health sector, such as increases in vector borne diseases and the spread of water-borne illnesses. Given that climate change projections suggest increased risk of flooding in the country, the country's adaptation response is to protect by 2030 all waterways with a view to reducing the risks of floods and their health impacts in particular. Additionally, some of the country's mitigation responses (e.g. protection of all remaining wetlands and watershed areas as GHG sinks, by 2030) have adaptation co-benefits by enhancing water retention and reducing the risks of flooding and storm surge. [30] See box 3 for an example of lessons learned from flooding in Cambodia.

Box 3. Lessons learned from flood disasters: a case of Cambodia

Cambodia's heavy rainfall in October 2013 resulted in flash floods, impacting over half a million people and more than half of Cambodia's provinces.

The total cost of flood impacts was USD 356 million, of which USD 153 million accounted for the destruction of physical assets (damage), and 203 million US$ was the estimated losses in production and economic flows.

The country hence developed a number of priority adaptation actions under the Implementation of Climate Change Action Plan for Water Resources and Meteorology (2014-2018). These include strengthening early warning systems and climate information dissemination and developing and rehabilitating the flood protection dykes. Also, the country addresses waterborne and food-borne diseases associated with climate variables under its Implementation of Climate Change Action Plan for Public Health (2014–2018).

[26] India's NDC.
[27] Indonesia's NDC.
[28] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Guyana%20First/Guyana%27s%20revised%20NDC%20-%20Final.pdf
[29] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Fiji%20First/FIJI_iNDC_Final_051115.pdf.
[30] Antigua and Barbuda.

Source: Cambodia's NDC.

22. A few Parties included, in their reports and communications, investment cost for flood prevention and management. [31]For example, one country estimated that flood prevention and management of flood waters for its main regional capitals would cost (in constant 2015 USD) 686,000,000 in 2020, 882,000,000 in 2025, and 1,078,000,000 in 2030. The country also estimated investment cost for strengthening of the early warning system for management of extreme climate events to be, in US dollars, 2,286,000 in 2020; 2,667,000 in 2025; and 2,667,000 in 2030. [32]

3.1.2. Legal and regulatory frameworks and policies

23. In addition to national adaptation plans, some countries have developed laws and/or policy and legislation frameworks for disaster prevention and risk management, including for climatic risks such as floods. In Algeria, the 2004 Law on the Prevention of Major Risks and the Management of Catastrophes established the legal framework for disaster prevention and risk management. The Law provides guidelines for establishing a general plan of flood prevention which shall contain a national flood risk map, a reference height in the areas at risk under which it is forbidden to be built and thresholds, modalities and procedures of alerts.[33]

24. The National Civil Defence and Protection Policy of Brazil, instituted by Law 12.608, of 10 of April 2012, combines efforts of adaptation and national risk management and disaster warnings, with a focus on increasing adaptive capacity and reducing vulnerability.[34] The law was passed after a series of devastating flooding events during 2008 to 2011. It focused strongly on response towards flooding and landslide events. The law stipulates the maintenance of a national register of areas susceptible to the occurrence of high impact landslides, sudden floods or related geological or hydrological processes. It directs the municipalities to design a master plan comprising of susceptible areas and adopt measures to reduce the risk, among which, the execution of a contingency plan and safety works and, when necessary, the removal of buildings and the resettlement of occupants in a safe place. [35]

25. One of key climate change related policies of Nigeria is the National Policy on Erosion and Flood Control. The policy serves several functions including responding to national emergencies as they relate to soil erosion and flood control as well as monitoring and evaluation of the implementation of approved Soil Erosion and Flood Control projects nationwide.[36]

3.1.3. Project implementation

26. Several Parties cited establishment of monitoring and early warning systems of climate events, including for floods. One Party referred to its National Centre for Monitoring and Early Warning of Natural Disasters that has mapped areas of risk of extreme rainfall events in 800+ municipalities for monitoring purposes and has in place an action plan to respond to such events.[37,38] Another developing country reported that it has currently developed contingency flood management plans in many states based on early warning systems and other weather forecasting systems.[39] See boxes 4 and 5 for examples of countries' flood management.

[31] Malaysia.
[32] Burkina Faso.
[33] http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/05/ALGERIA.pdf
[34] https://www4.unfccc.int/sites/NAPC/Documents/Parties/Brazil%20NAP%20English.pdf
[35] https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12608.htm
[36] Nigeria's NDC; https://www.osgf.gov.ng/offices/ecological-fund/soil-erosion-and-flood-control
[37] https://www4.unfccc.int/sites/NAPC/Documents/Parties/Brazil%20NAP%20English.pdf
[38] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Brazil%20First/BRAZIL%20iNDC%20english%20FINAL.pdf
[39] India's NDC.

Box 4. Flood management in Bangladesh

Bangladesh has experienced several disasters, in particular flooding. In response to the impacts of climate hazards, the country has implemented projects including construction of flood embankments, coastal polders and cyclone shelters with active participation of communities.

The Government of Bangladesh has also invested over USD 10 billion during the last three decades in order to reduce country's vulnerability and enhance its resilience to the impacts of climate change and natural disasters. Bangladesh has recently established two innovative funds to promote cross sectoral adaptation actions and policies, which are the Bangladesh Climate Change Trust Fund (BCCTF) from the Government's own budget and the Bangladesh Climate Change Resilient Fund (BCCRF) with the support of development partners.

Source:
https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bangladesh%20First/INDC_2015_of_Bangladesh.pdf

Box 5. 2019 Mozambique flooding

Mozambique experienced heavy flooding in 2019 which was more extreme than the 2000 flooding. The Mozambique National Disaster Management Institute reported that more than 200,000 people were affected and 135 lives were lost, with 150,000 + people being displaced in the province of Gaza. In terms of damage, more than 2,000 homes were destroyed, and damage to infrastructure was estimated USD29 million. In addition, key power lines were damaged which led to a reduction in the power exports to South Africa, from 1,500 to 650 Megawatts.

Half of Mozambique's population is at risk of water-related hazards and the country's GDP growth is impacted negatively due to flooding (approximately USD105 million annually). The country with the assistance of international organizations and funds has taken strong measures to improve its disaster risk management and climate change adaptation. These include the implementation of early warning systems, using remote sensing technique survey for critically affected areas, and rehabilitation of existing ones; enacting the 2014 disaster risk management law; and development of a resettlement strategy for relocating affected families who were not able to return to their homes.

Source: https://www.gfdrr.org/en/updates-field-responding-floods-mozambique ;https://reliefweb.int/report/mozambique/protection-cluster-strategy-idai-response-march-september-2019-early-recovery-enpt

27. There are also some regional projects in response to flood impacts. For example, a community-based flood early warning system is an integrated system of tools and plans to respond to flood emergencies developed by the International Centre for Integrated Mountain Development, and is managed by communities in Afghanistan, India, Nepal, and Pakistan.[40]

3.2. Drought

28. More than two third of the developing countries which submitted their NDCs addressed droughts in their submissions.[41] The majority of which reported on the risk and/or impacts of droughts, such as an increase in the frequency and magnitude of droughts and/or the damage caused by droughts.[42] Some included the affected sectors in their reports, ranging from the agriculture sector being the most affected

[40] https://susecoeng.com/majorprojects/cbfews/; ICIMOD website; see also http://servir.icimod.org/science-applications/enhancing-flood-early-warning-systems.
[41] 62 of 89 countries.
[42] Chile.

one to social and economic sectors, including health, food, water, infrastructure, and services.[43,44] A few mentioned adaptation response to droughts in the form of priorities, plans and proposed actions, and strategies. One country mentioned that it has experienced higher temperatures and lost approximately 50 per cent of the glacier surface during the past 50 years, which has consequently exposed different regions of the country to prolonged dry periods, and that, by 2030, 27 per cent of the country could be affected by persistent drought.[45] Another Party expressed major concerns about the vulnerability of its water sector to droughts that recur every 5 to 10 years, as well as the significant impacts that these droughts exhibit on the agriculture sector, e.g. a drought in 2010 which resulted in losses to the crop sector totalling USD 1 million.[46]

3.2.1. National strategies and plans

29. In developing their climate change adaptation priorities, including for addressing droughts, some countries were guided by their already existing national development programmes and plans to ensure that adaptation measures are mainstreamed into national as well as sectoral planning and strategies, and that the current environmental projects strategically entail adaptation.

30. Some highlighted within their national adaptation plans priority areas such as scaling up climate smart agriculture which includes development of crop varieties with increased productivity under drought stress. Others elaborated on techniques such as low to zero tillage and multi-cropping to increase mulching which reduces evapotranspiration and soil erosion.[47, 48] One country has started to introduce new agricultural techniques such as hydroponics and fertigation,[49] and planned to expand, subject to availability of financial support, the introduction of drought tolerant crop varieties. [50] A few included, in their plans, adaptation measures such as development of innovative financial risk management and insurance measures,[51] with one country anticipating to make an affordable insurance scheme available for farmers by 2030.[52]

31. Several Parties have initiated strategies to adapt to drought episodes, and prioritized development or improvement of early warning systems and weather forecasting (e.g. by including microclimate studies and localized forecasting), climate information dissemination, as well as community-based adaptation actions.[53,54]

32. With regard to community-based adaptation, one country, after experiencing more frequent and severe droughts (e.g. in 2012, drought was experienced by half of country's provinces and negatively affected thousands hectares of rice growing areas), has prioritised improving the adaptive capacity of communities, especially through increasing the use of mobile pumping stations and permanent stations in responding to mini-droughts. It proposed measures, including disseminating more efficient small-scale irrigation techniques and promoting soil conservation schemes for farmers and rural producers, improving strategies associated with the distribution of agro-climatic zones and the structure of crops, and improving data collection and modelling capacity associated with water and soil management.[55]

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[43] Djibouti.
[44] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Guinea%20Bissau%20First/GUINEA-BISSAU_INDC_Version%20to%20the%20UNFCCC%20(eng).pdf
[45] Bolivia.
[46] Antigua and Barbuda.
[47] Botswana.
[48] Chad.
[49] Fertigation is an agricultural practice that uses irrigation water as a transport mechanism for the application of fertilisers to soil and crops (FAO).
[50] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Guyana%20First/Guyana%27s%20revised%20NDC%20-%20Final.pdf
[51] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Guyana%20First/Guyana%27s%20revised%20NDC%20-%20Final.pdf
[52] Antigua and Barbuda.
[53] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bangladesh%20First/INDC_2015_of_Bangladesh.pdf
[54] Central African Republic.
[55] Cabo Verde.

33. Additionally, a few countries included in their adaptation plans the efficient management and protection of natural resources[56] and enhancement of ecosystem resilience against drought.[57]

3.2.2. Project implementation

34. Some of the projects that countries implemented in response to climate hazards which considered droughts include (a) the introduction of modern sustainable agriculture techniques, (b) strengthening water supplies through EbA, and (c) the use of desalination plants. Examples of each of the abovementioned projects are provided in the following paragraphs.

35. **Introduction of modern sustainable agriculture techniques in Eritrea**: the impacts of climate change are mainly manifested in recurring droughts in Eritrea. It has affected people's livelihoods in large areas of the country, with the majority of affected households being those that are female-headed. Eritrea's agriculture sector is highly vulnerable, and yet over 70 per cent of population depends on agriculture for its livelihoods. Water scarcity, soil nutrient deficiency, and overreliance on traditional farming practices, have resulted in low levels of agricultural production and increases in prices of imported food staples (which more than doubled in price over the past several years). As a result of recurrent droughts, food insecurity is a challenge for the population for most parts of the year. To adapt to climate change, Eritrea has been undertaking efforts to enhance modern sustainable agriculture practices[58] such as date palm multiplication through tissue culture. A project entitled "Micro-propagation of Date Palm Cultivars using Tissue Culture Techniques" funded by FAO (USD 436,000) was initiated in 2015 (and completed in 2017) to strengthen the tissue culture laboratory at the National Agricultural Research Institute (NARI), which is an agency within the Ministry of Agriculture of Eritrea, and to build the capacities and enhance the skills of date palm farmers and other actors involved in value chain.

36. **Implementation of priority NAPA actions to strengthen resilience in Djibouti's most vulnerable coastal zones:** this programme was in response to severe water shortages and degraded watersheds as well as prolonged periods of drought affecting the country. The project was implemented by the UN Environment Programme together with the Ministry of Urbanism, Habitat and Environment, and funded by the Least Developed Countries Fund (USD 2.1million) as well as USD 2.4 million of co-finance. The country is classified as 'severely water poor', and climate extreme events were accountable for 50 per cent of human mortalities during the period of 1990 to 2014. The area of intervention includes Khor Angar in the North (pop. 3,500) and Damerjog (pop. 600) in the South. Among the activities of the project was the upgrading of wells, boreholes and pumps to address the impacts of drought. To control water flow and enhancing the water supply, micro-dams were built which improved the community's livelihood by allowing them to grow vegetables for their own-consumption and/or for selling to the market.[59]

37. **The use of desalination plants in Antigua and Barbuda:** after experiencing several low-rainfall years consecutively, and drought becoming a recurrent feature of Antigua and Barbuda's climate, the country has been using desalination as the primary adaptation solution for enhancing freshwater resources (Figure 4). Adaptation in the water sector is Antigua and Barbuda's national priority, and the country has relied on desalination considerably, with it accounting for 60 per cent of national water supply, and during times of drought accounting for up to 90 per cent of fresh water supply. One of its adaptation goals is to increase desalination capacity in response to freshwater scarcity, by 50 per cent above 2015 levels, from approximately 5.4 million to over 8 million US gallons per day by 2025.[60] A 2015 report by FAO stated that the country's agricultural and municipal water demands were being met by four desalination plants, two surface water treatment plants, numerous small ponds and five well fields.[61]

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[56] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Grenada%20First/Grenada%20INDC.pdf

[57] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Algeria%20First/Algeria%20-%20INDC%20(English%20unofficial%20translation)%20September%2003,2015.pdf

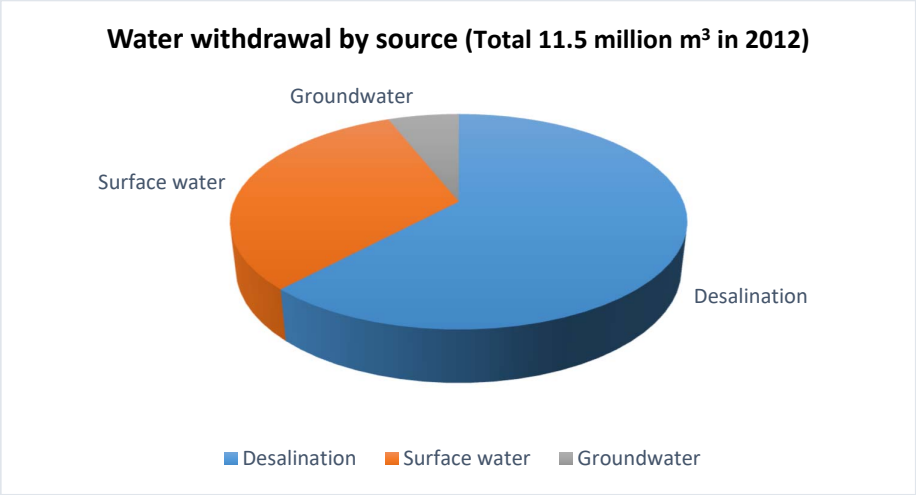
[58] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Eritrea%20First/NRC%20Eritrea.pdf

[59] Djibouti's NDC ; and http://wedocs.unep.org/bitstream/handle/20.500.11822/28425/DjiboutiEba.pdf?sequence=1&isAllowed=y

[60] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Antigua%20and%20Barbuda%20First/Antigua%20and%20Barbuda%20First.pdf

[61] http://www.fao.org/3/ca0429en/CA0429EN.pdf

Figure 4. The sources of water in Antigua and Barbuda



Source: FAO. 2015. AQUASTAT Country Profile – Antigua and Barbuda. (http://www.fao.org/3/ca0429en/CA0429EN.pdf)

3.3. Sea level rise

38. More than a third of developing countries' NDCs cited sea level rise in different ways. Some reported on observed and projected sea level rise in their countries, as well as the impacts; while, others highlighted the development of maps and models for sea level rise. A majority of Parties affected by sea level rise reported on the impacts mainly within two sectors: the shoreline sector and the infrastructure sector. A diversity of adaptation responses to coastal impacts of sea level rise have been planned or implemented, according to Parties' reports.

3.3.1. Adaptation measures

39. Some Parties proposed **hard measures** such as construction of dykes, coastal embankments, and sea walls for protection of coastal zones against seal level rise and beach erosion.[62] One Party, while emphasizing the importance of safety of its coastal zone for the country development and having considered construction of dykes, mentioned that implementation of such measures is pending funding, and that its initial cost estimate would amount to a total of more than €20 billion.[63] Another Party reported on its key adaptive targets in the shoreline sector, including cleaning up the banks of lakes and lagoons located in the vicinity of the shoreline.[64]

40. Parties reported a variety of **soft measures** to respond to sea level rise. These include designing a national vulnerability monitoring program for infrastructure,[65] developing or improving early warning systems, developing hazard maps and models for sea level rise, creating and refining policies and budgetary systems that can mobilize resources toward climate change and disaster risk management activities,[66] reviewing municipality regulations to facilitate the enforcement of buffer zones for coastal areas and mangrove areas, mainstreaming cost-benefit analysis into the decision making process for enhancing climate resilience and disasters preparedness, revising capital budget appraisal guidelines to incorporate comprehensive hazard, vulnerability and adaptation assessments, and capacity-building for communities

[62] Cabo Verde's NDC.
[63] Djibouti.
[64] Benin's NDC.
[65] Costa Rica.
[66] Fiji.

whose vulnerability assessments have indicated that relocation is the planned long-term adaptation strategy.[67]

3.3.2. Regulations

41. With regard to updating regulation to support adaptation to sea-leval rise, few measures were found in Parties' submission. One country referred to a technical manual, developed at its Ministry of Works Dredging and Land Reclamation, that included recommended land reclamation level of 0.4 meter, take into account the clearance for expected sea level rise of 0.4 meter due to global warming.[68]

Another country referring to its Environment Protection Law stated that to adapt to the expected rise in sea level and its impact on the coasts of the country articles (66) and (99) of the Law are dedicated for the marine environment and the need to create a national network for monitoring and regulating the marine environment and conducting studies to monitor sea level rise.[69]

3.3.3. Project implementation

42. Some Parties mentioned ecosystem-based adaptation (EbA) for improving protection of costal zones against sea level rise (see Box 6). For example, mangrove rehabilitation and plantations were among Parties' adaptation measures to respond to seal level rise. Mangroves promote sediment trapping and retention through a variety of mechanisms, so are highly resilient to fluctuations in sea level. One Party cited a mangrove transplantation project for planting mangrove seedlings in order to rehabilitate degraded coastal areas, which began in 2013. Another Party, while recognizing mitigation co-benefits of mangrove plantations, reported on approximately 195,000 hectares of mangrove plantations under its adaptation goals.[70]

43. In addition to sea level rise impacts on the shoreline and the infrastructure sectors, some Parties highlighted the impact on the water sector, mainly due to intrusion of sea level rise in groundwater aquifers. In the Caribbean, sea level rise has been observed at between 1.5 and 3 mm per year, which is increasingly putting inland freshwater resources at risk of saline intrusion.[71] In response to the impact of sea level rise on water resources, Parties emphasised the importance of developing a climate-resilient and integrated water resources strategy in order to sustainably manage its water resources. One Party reported on the establishment of its National Water Resources Council in 2009 to address these challenges.[72] Some Parties, in response to rising sea level salinization of fresh ground water, have transitioned to use water purification measures, including the application of reverse osmosis, which is a process that removes unwanted ions, molecules, and particles from drinking water by forcing water under pressure through a membrane. One Party highlighted that its dependence on processed water has increased in order to be able to meet the needs of its tourism- and services-dependent economy.[73]

Box 6. Adaptation measures to reduce vulnerability to sea level rise in Tanzania

The Government of Tanzania implemented two projects, addressed its NAPA priorities, relating to water resources and coastal regions. The two projects entitled "Developing Core Capacity to Address Adaptation to Climate Change in Productive Coastal Zones" and "Implementation of Concrete Adaptation Measures to Reduce Vulnerability of Livelihoods and Economy of Coastal Communities of Tanzania" were supported by the Least Developed Countries Fund (2012-17) and the Adaptation Fund (2012-19) respectively. The two projects were implemented in Dar-es-Salaam and the coastal districts of Pangani, Rufiji, Bagamoyo and Zanzibar facing challenges from sea level rise.

The projects adopted approaches of building and upgrading seawalls, relocating aquifers to protect from rising seas, and restoring mangrove forests that protect communities from floods. The projects were centered on the concept of EbA. Some specific measures are as follows:

[67] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Fiji%20First/FIJI_iNDC_Final_051115.pdf
[68] Bahrain.
[69] Kuwait
[70] Bangladesh.
[71] Antigua and Barbuda.
[72] Bahrain.
[73] Bahamas.

- Construction of sea-defence structures such as seawalls, groynes and dykes covering a total area of 2,400 m,
- Restoration of about 1000 ha of mangroves in Rufiji district, and
- Rehabilitation of up to 3000 m2 of coral reefs.

Source: https://www.adaptation-fund.org/project/implementation-of-concrete-adaptation-measures-to-reduce-vulnerability-of-livelihood-and-economy-of-coastal-communities-in-tanzania/

3.4. Storms and hurricane

44. Storms and hurricanes constitute a prominent threat to approximately a third of developing country Parties, particularly coastal and small island countries. Several Parties belonging to these categories have uniformly projected threats from increased intensity and frequency of storms and hurricanes in their submissions. Some Parties have indicated an increase in variability and unpredictability of storm and hurricane events,[74] while others have witnessed particular patterns of these extreme events such as storm surges,[75] windstorms[76], dust storms[77] and tropical cyclones.[78]

45. Parties from the Small Island Developing States (SIDS) reported specific risks and impacts with known effects of climate change on drivers of hazards, including increased intensity of hurricanes[79] and the Sargassum seaweed phenomenon, amplified by the rise of tropical storm activity.[80] One Party reported losses equivalent to 8.0 per cent of its GDP due to hurricanes,[81] while another Party from the SIDS reported losses and damages equivalent to 1.2 per cent of its GDP and 5.3 per cent of its national budget in 2007 due to tropical storms (Olga and Noel).[82]

46. Several Parties from the least developed countries (LDCs) reported a severe impact of these climate hazards in increasing their socio-economic vulnerabilities, with One country referring to its rank in the Climate Change Vulnerability Index (CCVI-2011).[83]

47. In outlining specific actions oriented towards adaptation to storms and hurricanes, Parties identified vulnerable sectors to prioritize in their plans and policies. These include agriculture and fisheries, forestry, water, infrastructure, and urban planning. Health is also among the key affected sectors due to storms and hurricanes with some Parties highlighting direct and indirect impacts on public health due to increasing incidence of storms and hurricanes, ranging from loss of life and spread of vector- and water-borne diseases.[84] One Party also reported severe impacts on the tourism sector with losses to the tune of USD 6 million 2004.[85] A few Parties have also identified education as a vulnerable sector.[86]

3.4.1. Strategies, plans and priority actions

48. In the context of storms and hurricanes, the integration of climate change policies and strategies with the existing legal and policy framework was highlighted by several Parties. Some countries have specified a sector-specific streamlining of climate actions and strategies. For instance, one Party undertook the integration of its climate change policy into developing a new port design and mainstreaming climate action

[74] Dominica's NDC.
[75] Antigua and Barbuda's NDC, Bangladesh's NDC, Dominica's NDC.
[76] Bolivia's NDC.
[77] Kuwait's NDC.
[78] India's NDC.
[79] St. Lucia, NAP.
[80] Grenada.
[81] Jamaica's NDC.
[82] Dominican Republic's NDC.
[83] Bangladesh's NDC.
[84] Grenada's NAP, Kiribati's NAP.
[85] St. Lucia's NAP.
[86] St. Lucia and Jamaica.

strategies into tourism planning.[87] Additionally, Parties outlined disaster and resource management measures such as improving policy, legal, regulatory and institutional framework for the water sector to improve storm water drainage and setting up coastal zone management units.[88]

49. Priority actions and strategies developed by Parties in their submissions address multiple fronts of the risks posed by storms and hurricanes. Targeting disaster preparedness, some Parties proposed measures such as cyclone shelters, storm surge protection,[89] early warning systems,[90] hazard support plans,[91] and construction codes for hurricane-resistant infrastructure[92] (see box 7).They also highlighted a range of risk assessment and modeling strategies, such as improving technical capacity for spatial data management and risk modeling for storm surges[93] and for modeling of coastal inundation impacts.[94]

50. Some Parties focused on risk reduction and transfer measures, proposing micro-insurance initiatives.[95] One Party indicated emergency relief measures in its adaptation strategies against storms and hurricanes.[96]

Box 7. Adaptation to hurricanes in Antigua and Barbuda following Hurricane Irna in 2017

Hurricane Irma caused a great deal of devastation in Barbuda in 2017. The region sustained huge losses to property had to undertake forced evacuation of all 2000 inhabitants of the Caribbean Island to neighbouring Antigua. With the financial assistance to the tune of USD10 million from the Adaptation Fund, the country has been implementing its climate change adaptation project since 2017. The project is designed to help Antigua's most vulnerable communities situated in the coastal McKinnon's watershed to build resilience against flooding, hurricanes and higher temperatures by adopting an integrated approach.

Measures include restoring natural drainage canals and climate-proofing vulnerable homes and storm shelters to reduce flooding and disaster risks.

- Restoring natural drainage canals: by cleaning, widening and deepening drainage canals, retention ponds and culverts to natural sizes this measure aims to build capacity to handle extreme rainfall and storms.
- Climate-proofing vulnerable homes: by providing access to an innovative, low-interest revolving loan programme, this measure provides vulnerable households to climate-proof their homes.
- Storm shelters to reduce flooding and disaster risks: by supporting community groups in depressed areas with grants, this measure sought to develop climate-resilient buildings to serve as storm shelters.

The project also enhanced collaboration with other funds such as the Global Environmental Facility's Special Climate Change Fund (SCCF) by undertaking a hydrological study with their support and providing potential to scale it up.

Source: www.adaptation-fund.org.

51. Parties also alluded to measures that address the overarching issue of resilience. The measures include the refurbishment of infrastructure and enhancement of ecosystem capacities to absorb climate stresses from storms surges and hurricanes. One Party has proposed an urban renewal mission for 500 cities with a focus on ensuring basic infrastructure services such as water supply, sewerage, storm water drains, transport and development of green spaces and parks by adopting climate resilient and energy efficient

[87] Kiribati NAP.
[88] Grenada.
[89] Lao PDR's NDC.
[90] Bangladesh's NDC.
[91] Kiribati's NAP.
[92] Grenada's NAP.
[93] Grenada's NAP.
[94] Kiribati's NAP.
[95] Kiribati.
[96] Jamaica's NDC.

policies and regulations.[97] Community management of resources also emerged as a key adaptation strategy in submissions of some Parties.[98]

4. Overall lessons learned

52. A majority of developing countries reported more on the impacts of extreme climate events than on those of slow onset events, with floods and droughts being the most mentioned. Climate risks and hazards have increased in intensity and frequency, intensifying the impacts of hazards and the cost associated with them.

53. Developing countries approaches in response to climate hazards vary, depending partly on how they have been affected by the hazards and their capacity to adapt. Among the good practices reported by Parties are: integrating disaster risk reduction into national adaptation plans, undertaking a multisectoral national approach, building on already existing national development programmes, and promoting socially-inclusive processes. In addition, Parties recognised the importance of considering adaptation not only as local or national action but also one that goes beyond national boundaries, and hence included in their adaptation efforts actions at regional level.

54. Although there has been significant progress in adaptation on-the-ground, the efforts could not avert the climate impacts and costs incurred by them. Climate-related risks and hazards for natural and human systems will be higher than at present, and it is therefore crucial to scale up adaptation. In particular, there is tremendous potential to scale up climate-smart agriculture, integrated water resources management, development of early warning systems and health climate services, urban green infrastructure as well as enhancement of resilient of ecosystem services.

55. Several developing county Parties have planned and proposed measures for responding to climate impacts. However, the implementation of their plans is conditional on availability of resources. Climate impacts are growing and so is the vulnerability of countries to climate hazards. Climate hazards have been particularly impacting the poor, despite national and international efforts. To reduce vulnerability to current impacts, and to enhance adaptive capacity and resilience to future impacts, more support is required for adaptation action by developing countries, and more effort is needed to improve links between climate change adaptation and poverty reduction.

56. Developing countries regional adaptation efforts have great potential to accelerate climate change adaptation and to help countries and regions to adapt more effectively and efficiently. There lie opportunities in adopting a transboundary view of climate hazards, which will help create positive interdependencies between countries, and enhance mutual learning and technology transfer through regional cooperation.

5. Next steps

57. At its seventeenth meeting, the AC may wish to:

a) Discuss ways to finalize the draft, including any follow-up actions that could be undertaken; and

b) Decide whether the finalized report should be published in a user-friendly format.

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[97] India's NDC, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf.

[98] Kiribati, https://www4.unfccc.int/sites/NAPC/Documents/Parties/Kiribati-Joint-Implementation-Plan-for-Climate-Change-and-Disaster-Risk-Management-2019-2028.pdf.