

Section 5.3: Climate change

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5.3 Climate change

- 1 The Conference of the Parties of the UNFCCC has affirmed that climate change is one of the greatest challenges of our time.¹ Climate change is a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.² The world's climate system, including the atmosphere, oceans and cryosphere, is changing and will continue to change at rates unprecedented in recent human history. Findings on the scientific basis for climate change suggest that a number of human-induced alterations of the natural world are involved. These alterations affect the global energy balance (the balance between incoming energy from the sun and outgoing heat from the earth) and ultimately lead to climate change.
- 2 The Kyoto Protocol is an international agreement linked to the UNFCCC. Its main feature is that it sets binding targets for 37 industrialized countries and the European community to reduce GHG emissions, rather than simply encouraging them to attain these goals, as is the case with the Framework Convention. The targets amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.³ In 2012, the Doha Amendment (to the Kyoto Protocol) was adopted. This amendment further contributed to reducing GHG emissions by at least 18 percent below 1990 levels in the eight years from 2013 to 2020. It also expands the list of GHGs regulated by the Kyoto Protocol.⁴ These conventions and protocols involve reporting obligations, which in turn create additional data requirements and demand for environment statistics.
- 3 The Rio+20 United Nations Conference on Sustainable Development reaffirmed the pre-eminence of climate change, expressing alarm about the rise of GHGs globally. In its outcome document, it called for cooperative action to coordinate effective international response to this challenge to ensure reduction of the emission of GHGs. It noted that countries already experience adverse impacts of climate change such as persistent drought, extreme weather events, sea-level rise and threats to food security. In this regard, the Conference indicated adaptation to climate change to be an “urgent global priority”.⁵
- 4 The IPCC has developed a sequence of events that describes the complexity of climate change using a schematic framework (see Figure 5.7). The cross-cutting application of the FDES is based on this framework.

¹ United Nations Framework Convention on Climate Change (2011). “Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010. Available from <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf> (accessed 30 July 2015).

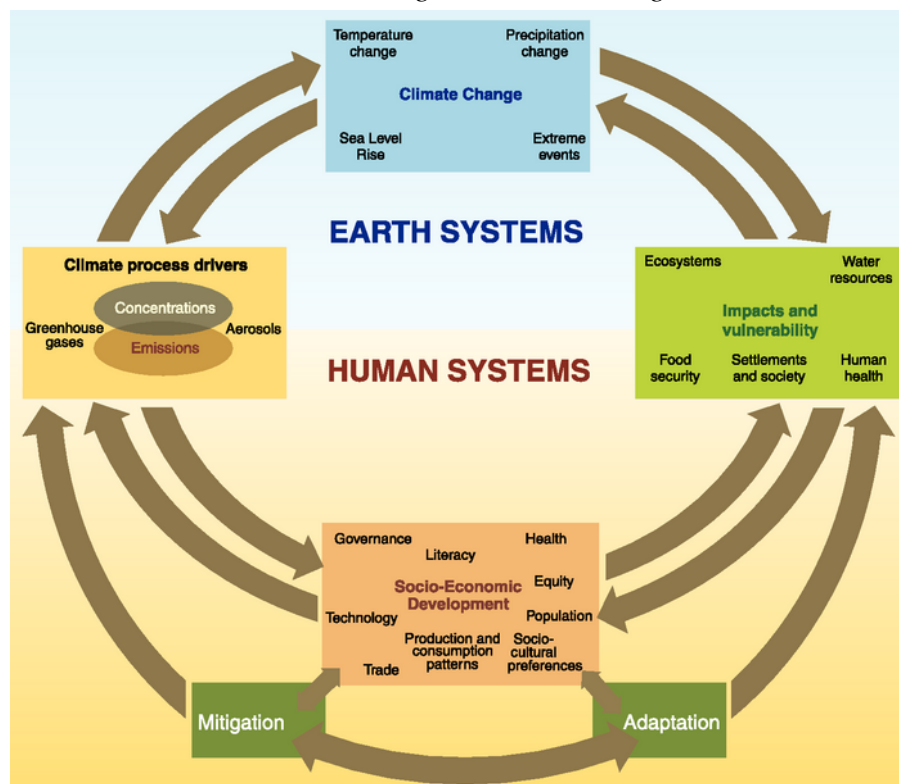
² United Nations Framework Convention on Climate Change (1992). Available from https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf (accessed 5 August 2015).

³ United Nations Framework Convention on Climate Change (2014). Kyoto Protocol. Available from: http://unfccc.int/kyoto_protocol/items/2830.php (accessed 30 July 2015).

⁴ United Nations Framework Convention on Climate Change (2014). Doha Amendment. Available from: http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php (accessed 31 July 2015).

⁵ United Nations (2012). Rio+20 outcome document, “The Future We Want”. Available from <http://www.uncsd2012.org/thefuturewewant.html> (accessed 16 July 2015).

Figure 5.7: Schematic framework representing anthropogenic drivers, impacts of and responses to climate change, and their linkages⁶



- 5 As seen, climate change occurs through a chain of events and can be observable at all levels, from local to global. Climate process drivers are GHG emissions associated with current production and consumption patterns, which depend heavily on fossil fuels for energy and transportation. These persistently high emissions lead to high atmospheric CO₂ concentrations, which in turn prevent heat from escaping the Earth resulting in increased temperature and humidity, thus changing climate patterns. The evidence of global warming and climate change is unequivocal,⁷ including global temperature rise, extreme events, sea level rise, shrinking ice sheets and glacial retreat.⁸ Climate change evidence refers to the processes that substantiate the occurrence of changing climate patterns at the global, regional and local levels. Climate change impacts include, among many others, more intense storms, changes in agricultural productivity, water scarcity and coral bleaching. Mitigation and adaptation processes are another important part of the sequence of climate change. Mitigation aims to decrease sources of GHGs, while climate change adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.⁹

⁶ Intergovernmental Panel on Climate Change. "Climate Change 2007: Synthesis Report". Available from http://www.ipcc.ch/publications_and_data/ar4/syr/en/mainssyr-introduction.html (accessed 31 July 2015).

⁷ Intergovernmental Panel on Climate Change. "Climate Change 2007: Synthesis Report". Available from http://www.ipcc.ch/publications_and_data/ar4/syr/en/spms1.html (accessed 31 July 2015).

⁸ Evidence of warming oceans, declining arctic sea ice (extent and thickness) and ocean acidification also exists. National Aeronautics and Space Administration. "Global Climate Change. Vital Signs of the Planet". Available from <http://climate.nasa.gov/evidence/> (accessed 31 July 2015).

⁹ United Nations Framework Convention on Climate Change (2013). "Glossary of Climate Change Acronyms". Available from http://unfccc.int/essential_background/glossary/items/3666.php#A (accessed 31 July 2015).

- 6 Climate change mitigation refers to efforts to reduce or prevent greenhouse gas emissions and may involve using new technologies, incorporating and increasing renewable energies, making older equipment more energy efficient and changing management practices or consumer behaviour. Efforts underway around the world range from building high-tech subway systems to installing bicycling paths and walkways. Protecting natural carbon sinks like forests and oceans, or creating new sinks through silviculture or green agriculture, are also elements of mitigation.¹⁰ The development and deployment of renewable energy technologies and more efficient use of renewable energy sources will play a significant role in mitigation of GHG emissions, thereby presenting important opportunities to mitigate climate change and contribute to sustainable development. Harnessing solar and wind energy, production of biofuels through new processes, enhanced geothermal systems and emerging ocean technologies are some areas of potential advancement in this regard. Current strategies to foster renewable energies, including direct regulation and the creation of economic instruments, must also be monitored.
- 7 Climate change impact and risks associated with climate change are real and are already evident in many systems and sectors essential for human livelihood, including water resources, food security, coastal zones and health. Weather patterns have become more extreme, with more intense and longer events such as droughts, floods and increased precipitation over many land areas, as well as more hot days and heat waves. Associated risks include more frequent and dangerous floods and storms, greater stress on water supplies, decline in agricultural productivity and food security and further spread of water-related diseases, particularly in tropical areas.
- 8 The UNFCCC has identified climate adaptation as a key building block for a coordinated response to climate change. The IPCC describes adaptation as an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.¹¹ Adaptation does not take place in response to climatic changes in isolation, but instead is a response to a series of events or to previously existing situations that are exacerbated through climate change. As a consequence, it can be difficult to determine which aspects of adaptation are driven solely or partially by climate change, as opposed to other factors not related to climate change. This makes it difficult and challenging to measure adaptation to climate change accurately. In addition, few comprehensive studies exist on what adaptation to climate change entails, as well as the costs and benefits of adaptation measures. Nonetheless, adaptation is an important and necessary response to climate change and statistics and methodologies to assess adaptation should be developed.

¹⁰ United Nations Environment Programme. Environment for Development - Climate Change Mitigation. Available from <http://www.unep.org/climatechange/mitigation/> (accessed 31 July 2015).

¹¹ Intergovernmental Panel on Climate Change, Fourth Assessment Report (2007). "Climate Change 2007: Impacts, Adaptation and Vulnerability", Cambridge University Press. Available from http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf (accessed 31 July 2015).

Statistics on Climate Change

- 9 A scientific approach to climate change must be supported by well structured, relevant, reliable and timely statistics. Simultaneously, the need for underlying data to inform the policy aspects of climate change remains a pressing requirement. Given their cross-cutting nature, climate change statistics are relevant to a large proportion of the domain of environment statistics.
- 10 The UNECE is working actively with its member countries and other international organisations to develop climate change-related statistics.¹² These efforts primarily address data that are already collected by statistical offices and can support climate change-related analysis or research. The work does not focus on scientific data (e.g., meteorological data) that measure changes in weather and climate. The CES set up a Task Force on Climate Change-Related Statistics in November 2011. Its work produced the CES' Recommendations on Climate Change-Related Statistics, which were endorsed by the CES plenary session in April 2014.¹³ According to UNECE, climate change-related statistics refer to environmental, social and economic data that measure the human causes of climate change, the impacts of climate change on human and natural systems, and the efforts by humans to avoid and adapt to these consequences.¹⁴
- 11 The information required to analyse climate change includes economic, social and environmental aspects. The FDES provides a set of environmental topics and individual environment statistics that are important when informing any country on climate change. These statistics should be complemented with both social and economic statistics to provide a comprehensive set of information.
- 12 With regard to determining and apportioning the appropriate environment statistics for measurement of climate change, it is important to consider a sequence of changes. Statistics pertaining to the different steps of the sequence depicted in Figure 5.7 are needed to monitor climate change and observe its impact on different countries and regions.
- 13 At present, the availability of relevant statistics in most countries varies across the stages in the sequence. Data on drivers of climate change, climate change evidence, impacts of climate change, such as natural extreme events and disasters, and mitigation activities are all fairly developed. However, other impacts of climate change, such as those on ecosystems, are more difficult to measure and because changes in the climate are not the only explanation of those impacts. Despite their importance, vulnerability and adaptation statistics are still at the early stage of development. Considerable statistical progress is expected and needed in these two areas in the upcoming years.

¹² United Nations Economic Commission for Europe (2014). Climate change-related statistics. Available from <http://www.unece.org/stats/climate.html> (accessed 31 July 2015).

¹³ United Nations Economic Commission for Europe (2014). "Recommendations on Climate Change-Related Statistics". Available from http://www.unece.org/fileadmin/DAM/stats/publications/2014/CES_CC_Recommendations.pdf (accessed 5 August 2015).

¹⁴ United Nations Economic Commission for Europe (2014). Climate change-related statistics. Available from <http://www.unece.org/stats/climate.html> (accessed 31 July 2015).

- 14 When compiling statistics on climate change at the national level in a particular country, it is important to assess relevance, as well as policy and legal aspects. The relevance of climate change varies by country, given different political dynamics and the country's characteristics in terms of carbon intensity and its vulnerability to climate change impact. Climate change policies also vary by country. For example, specific climate change strategies and mitigation and adaptation programmes may be in place or the country may be participating in a programme to mitigate carbon emissions. When preparing climate change statistics, it is important to first understand the national relevance, conceptual aspects, existing policies and reporting needs so that the appropriate statistics may be compiled to inform these policies. Similarly, on the international level, it is important to understand a country's participation¹⁵ in specific conventions and related MEAs when preparing climate change statistics.
- 15 The impacts of climate change most often manifest locally and vary greatly by location. As such, spatial considerations must be taken into account when assessing climate change and spatial aspects must be included in climate change statistics whenever possible. This enables policy makers and researchers to better determine the impacts from climate change and the appropriate mitigation strategies.

Application of the FDES to climate change statistics

- 16 The following figures provide an example of the application of the FDES to climate change. Many topics and individual statistics that fall under different components of the FDES may be used to provide information on the different aspects of climate change. The following figures 5.8 and 5.9 organize the pertinent sub-components, topics and statistics of the Basic Set according to the sequence of climate change-related events as per the IPCC (Figure 5.7), with one modification – only those elements that fall under the realm of environment statistics are addressed under “Socio-Economic Development”.
- 17 The climate change sequence depicted in Figures 5.8 and 5.9 thus contains four boxes that present the stages of Climate Process Drivers, Climate Change Evidence, Climate Change Impacts and Vulnerability, and Mitigation and Adaptation.
- 18 Figure 5.8 presents the relevant information at the topic level, while Figure 5.9 provides more details and presents the individual environment statistics which can be used to assess climate change. Following the figures, an illustrative, non-exhaustive list of other commonly used indicators, statistics and statistical themes has also been provided for general reference purposes.

¹⁵ Participation means that the country or area has become party to the agreements under the treaty or convention, which is achieved through various means, depending on the country's circumstances, namely: accession, acceptance, approval, formal confirmation, ratification and succession. Countries or areas that have signed but not become party to the agreements under a given convention or treaty are not considered to be participating.

Figure 5.8: Topics in the FDES that relate to climate change

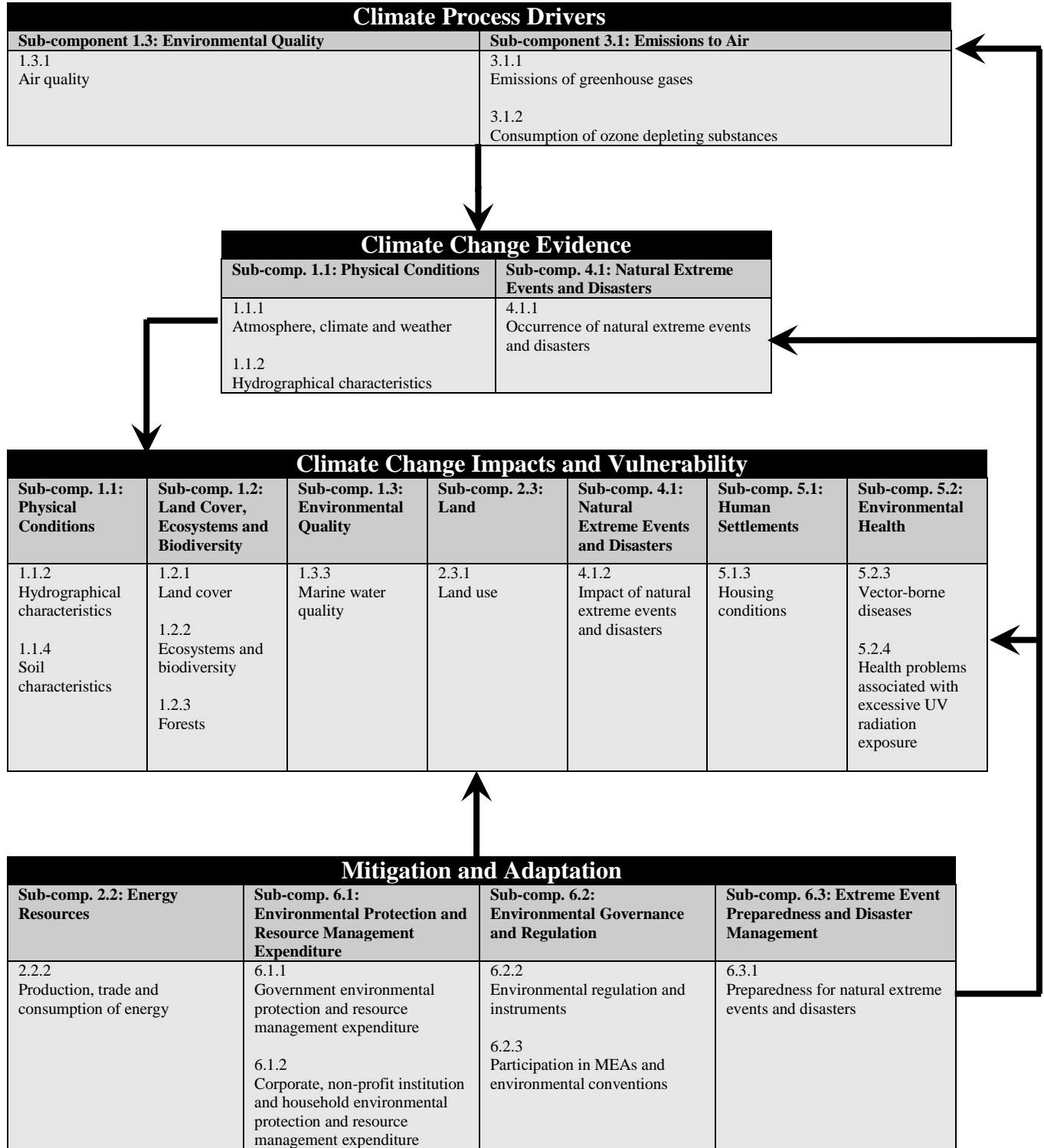


Figure 5.9: Climate change statistics in the Core Set and Basic Set of Environment Statistics
(Bold Text – Core Set/Tier 1; Regular Text – Tier 2; Italicized Text – Tier 3)

Climate Process Drivers	
Sub-component 1.3: Environmental Quality	
Topic 1.3.1: Air quality	1.3.1.b: Global atmospheric concentrations of greenhouse gases 1.3.1.b.1 Global atmospheric concentration level of carbon dioxide (CO ₂) 1.3.1.b.2 Global atmospheric concentration level of methane (CH ₄)
Sub-component 3.1: Emissions to Air	
Topic 3.1.1: Emissions of greenhouse gases	3.1.1.a: Total emissions of direct greenhouse gases (GHGs), by gas: 3.1.1.a.1: Carbon dioxide (CO₂) 3.1.1.a.2: Methane (CH₄) 3.1.1.a.3: Nitrous oxide (N₂O) 3.1.1.a.4: Perfluorocarbons (PFCs) 3.1.1.a.5: Hydrofluorocarbons (HFCs) 3.1.1.a.6: Sulphur hexafluoride (SF ₆) 3.1.1.b: Total emissions of indirect greenhouse gases (GHGs), by gas: 3.1.1.b.1: Sulphur dioxide (SO₂) 3.1.1.b.2: Nitrogen oxides (NO_x) 3.1.1.b.3: Non-methane volatile organic compounds (NM-VOCs) 3.1.1.b.4: Other
Topic 3.1.2: Consumption of ozone depleting substances	3.1.2.a: Consumption of ozone depleting substances (ODSs), by substance: 3.1.2.a.1: Chlorofluorocarbons (CFCs) 3.1.2.a.2: Hydrochlorofluorocarbons (HCFCs) 3.1.2.a.3: Halons 3.1.2.a.4: Methyl chloroform 3.1.2.a.5: Carbon tetrachloride 3.1.2.a.6: Methyl bromide 3.1.2.a.7: Other

Climate Change Evidence	
Sub-component 1.1: Physical Conditions	
Topic 1.1.1: Atmosphere, climate and weather	1.1.1.a: Temperature 1.1.1.a.1: Monthly average 1.1.1.a.2: Minimum monthly average 1.1.1.a.3: Maximum monthly average 1.1.1.b: Precipitation (also in 2.6.1.a) 1.1.1.b.1: Annual average 1.1.1.b.2: Long-term annual average 1.1.1.b.3: Monthly average 1.1.1.b.4: Minimum monthly value 1.1.1.b.5: Maximum monthly value
Topic 1.1.2: Hydrographical characteristics	1.1.2.e: Seas <i>1.1.2.e.4: Sea level</i>
Sub-component 4.1: Natural Extreme Events and Disasters	
Topic 4.1.1: Occurrence of natural extreme events and disasters	4.1.1.a: Occurrence of natural extreme events and disasters 4.1.1.a.1: Type of natural extreme event and disaster (geophysical, meteorological, hydrological, climatological, biological) 4.1.1.a.2: Location 4.1.1.a.3: Magnitude (where applicable) 4.1.1.a.4: Date of occurrence 4.1.1.a.5: Duration

Climate Change Impacts and Vulnerability

Sub-component 1.1: Physical Conditions

Topic 1.1.2: Hydrographical characteristics	1.1.2.a: Lakes 1.1.2.a.1: Surface area 1.1.2.a.2: <i>Maximum depth</i> 1.1.2.b: Rivers and streams 1.1.2.b.1: Length 1.1.2.c: Artificial reservoirs 1.1.2.c.1: <i>Surface area</i> 1.1.2.c.2: <i>Maximum depth</i> 1.1.2.e: Seas 1.1.2.e.5: <i>Area of sea ice</i> 1.1.2.g: Glaciers
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Topic 1.1.4: Soil characteristics	1.1.4.b: Soil degradation 1.1.4.b.2: Area affected by desertification
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Sub-component 1.2: Land Cover, Ecosystems and Biodiversity

Topic 1.2.1: Land cover	1.2.1.a: Area under land cover categories
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Topic 1.2.2: Ecosystems and biodiversity	1.2.2.a: General ecosystem characteristics, extent and pattern 1.2.2.a.1: Area of ecosystems 1.2.2.b: Ecosystems' chemical and physical characteristics 1.2.2.b.2: <i>Carbon</i> 1.2.2.c: Biodiversity 1.2.2.c.1: Known flora and fauna species 1.2.2.c.2: Endemic flora and fauna species 1.2.2.c.3: Invasive alien flora and fauna species 1.2.2.c.4: Species population 1.2.2.c.5: <i>Habitat fragmentation</i>
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Topic 1.2.3: Forests	1.2.3.a: Forest area 1.2.3.a.1: Total 1.2.3.a.2: Natural 1.2.3.a.3: Planted 1.2.3.a.4: Protected forest area (also in 1.2.2.d) 1.2.3.a.5: Forest area affected by fire 1.2.3.b: Forest biomass 1.2.3.b.1: Total 1.2.3.b.2: <i>Carbon storage in living forest biomass</i>
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Sub-component 1.3: Environmental Quality

Topic 1.3.3: Marine water quality	1.3.3.b: Organic matter 1.3.3.b.1: Biochemical oxygen demand (BOD) 1.3.3.b.2: Chemical oxygen demand (COD) 1.3.3.f: Physical and chemical characteristics [of marine water bodies] 1.3.3.f.1: <i>pH/Acidity/Alkalinity</i> 1.3.3.f.2: Temperature 1.3.3.f.3: <i>Total suspended solids (TSS)</i> 1.3.3.f.4: <i>Salinity</i> 1.3.3.f.5: Dissolved oxygen (DO) 1.3.3.f.6: <i>Density</i> 1.3.3.g: Coral bleaching 1.3.3.g.1: Area affected by coral bleaching
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Sub-component 2.3: Land

Topic 2.3.1: Land use	2.3.1.a: Area under land use categories
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Topic 2.3.2: Use of forest land	2.3.2.a: Use of forest land 2.3.2.a.1: Area deforested 2.3.2.a.2: Area reforested 2.3.2.a.3: Area afforested 2.3.2.a.4: <i>Natural growth</i>
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Sub-component 4.1: Natural Extreme Events and Disasters	
Topic 4.1.2: Impact of natural extreme events and disasters	4.1.2.a: People affected by natural extreme events and disasters 4.1.2.a.1: Number of people killed 4.1.2.a.2: Number of people injured 4.1.2.a.3: Number of people homeless 4.1.2.a.4: Number of people affected 4.1.2.b: Economic losses due to natural extreme events and disasters 4.1.2.c: Physical losses/damages due to natural extreme events and disasters 4.1.2.d: Effects of natural extreme events and disasters on integrity of ecosystems <i>4.1.2.d.1: Area affected by natural disasters</i> <i>4.1.2.d.2: Loss of vegetation cover</i> <i>4.1.2.d.3: Area of watershed affected</i> <i>4.1.2.d.4: Other</i>
Sub-component 5.1: Human Settlements	
Topic 5.1.3: Housing conditions	5.1.3.c: Population living in hazard-prone areas 5.1.3.d: Hazard-prone areas
Sub-component 5.2: Environmental Health	
Topic 5.2.3: Vector-borne diseases	5.2.3.a: Vector-borne diseases 5.2.3.a.1: Incidence 5.2.3.a.2: Prevalence 5.2.3.a.3: Mortality 5.2.3.a.4: <i>Loss of work days</i> 5.2.3.a.5: <i>Estimates of economic cost in monetary terms</i>
Topic 5.2.4: Health problems associated with excessive UV radiation exposure	5.2.4.a: Problems associated with excessive UV radiation exposure 5.2.4.a.1: <i>Incidence</i> 5.2.4.a.2: <i>Prevalence</i> 5.2.4.a.3: <i>Loss of work days</i> 5.2.4.a.4: <i>Estimates of economic cost in monetary terms</i>

Mitigation and Adaptation	
Sub-component 2.2: Energy Resources	
Topic 2.2.2: Production, trade and consumption of energy	2.2.2.a: Production of energy 2.2.2.a.3: Production from renewable sources
Sub-component 6.1: Environmental Protection and Resource Management Expenditure	
Topic 6.1.1: Government environmental protection and resource management expenditure	6.1.1.a: Government environmental protection and resource management expenditure [on climate change mitigation activities] 6.1.1.a.1: Annual government environmental protection expenditure 6.1.1.a.2: Annual government resource management expenditure
Topic 6.1.2: Corporate, non-profit institution and household environmental protection and resource management expenditure	6.1.2.a: Private sector environmental protection and resource management expenditure [on climate change mitigation activities] 6.1.2.a.1: Annual corporate environmental protection expenditure 6.1.2.a.2: <i>Annual corporate resource management expenditure</i> 6.1.2.a.3: <i>Annual non-profit institution environmental protection expenditure</i> 6.1.2.a.4: <i>Annual non-profit institution resource management expenditure</i> 6.1.2.a.5: <i>Annual household environmental protection expenditure</i> 6.1.2.a.6: <i>Annual household resource management expenditure</i>
Sub-component 6.2: Environmental Governance and Regulation	
Topic 6.2.2: Environmental	6.2.2.a: Direct regulation 6.2.2.a.1: List of regulated pollutants and description (e.g., by year of adoption and maximum

regulation and instruments	allowable levels) [related to climate change] 6.2.2.a.2: Description (e.g., name, year established) of licensing system to ensure compliance with environmental standards for businesses or other new facilities [related to climate change] 6.2.2.a.3: Number of applications for licences received and approved per year [related to climate change] 6.2.2.a.4: List of quotas for biological resource extraction 6.2.2.a.5: Budget and number of staff dedicated to enforcement of environmental regulations [related to climate change] 6.2.2.b: Economic instruments [related to climate change] 6.2.2.b.1: <i>List and description (e.g., year of establishment) of green/environmental taxes</i> 6.2.2.b.2: <i>List and description (e.g., year of establishment) of environmentally relevant subsidies</i> 6.2.2.b.3: <i>List of eco-labelling and environmental certification programmes</i> 6.2.2.b.4: Emission permits traded
Topic 6.2.3: Participation in MEAs and other global environmental conventions	6.2.3.a: Participation in MEAs and other global environmental conventions 6.2.3.a.1: List and description (e.g., country's year of participation^(a)) of MEAs and other global environment conventions [related to climate change]
	(a) Participation means that the country or area has become party to the agreements under the treaty or convention, which is achieved through various means, depending on the country's circumstances, namely: accession, acceptance, approval, formal confirmation, ratification and succession. Countries or areas that have signed but not become party to the agreements under a given convention or treaty are not considered to be participating.
Sub-component 6.3: Extreme Event Preparedness and Disaster Management	
Topic 6.3.1: Preparedness for natural extreme events and disasters	6.3.1.a: National natural extreme event and disaster preparedness and management systems 6.3.1.a.1: Existence of national disaster plans/programmes 6.3.1.a.2: Description (e.g., number of staff) of national disaster plans/programmes