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WORKING GROUP II CONTRIBUTION TO THE IPCC SIXTH ASSESSMENT REPORT (AR6)

Background information

(Submitted by the Co-Chairs of Working Group II on behalf of the Working Group II Bureau)

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WORKING GROUP II CONTRIBUTION TO THE IPCC SIXTH ASSESSMENT REPORT

Background Information

(Prepared by the Co-Chairs of Working Group II on behalf of the Working Group II Bureau)

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1. INTRODUCTION

This document is provided by the Co-Chairs of Working Group II on behalf of the Working Group II Bureau for the information of delegates at the Eleventh Session of Working Group II in order to describe the broad structure and rationale of the Working Group II contribution to the IPCC Sixth Assessment Report (WGII AR6) as outlined in WGII-11/Doc. 2. This document provides a report of the scoping process, including participant selection, as well as an overview of the scoping meeting specific to the WGII AR6.

2. CALL FOR NOMINATIONS

A call for nominations for participation in the scoping meeting was issued on 3 October 2016, to IPCC member Government Focal Points, Observer Organisations, and Bureau Members. Expertise was sought in the following areas:

Working Group II Areas of Expertise, Cross-cutting Areas of Expertise, and/or Regional Expertise

- Impacts on and vulnerability of natural and managed systems (land, freshwater and oceans) including genetics, physiology and regional ecosystem expertise.
- Palaeo and historical views of natural, managed and human systems across regions.
- Impacts, vulnerability and risks for sectors including fisheries, agriculture, tourism, transport, resource extraction, energy.
- Impacts, vulnerability and risks for human systems including health and wellbeing, indigenous and cultural, livelihoods, poverty.
- Impacts, vulnerability and risks for settlements, including rural, urban, cities, and those on small islands and in coastal areas, and related systems and processes including food, economic and energy security, migration.
- Adaptation needs, options, opportunities, constraints and influencing factors including contributions from psychology, sociology, and anthropology.

- Approaches for adaptation to climate change: ecosystem and community based adaptation, disaster risk reduction, and early warning systems.
- Socio-cultural, anthropological and psychological background of making and implementing decisions.

The call for nominations closed on 14 November 2016. Of the 1301 nominations received, 778 were assigned as WGII expertise after removing duplicates. Of the WGII expert nominations, 672 were submitted by Governments of 71 countries, of which 18 were also nominated by Observer Organisations and 6 also nominated by IPCC Bureau Members. Eighty-three experts were nominated solely by observer organisations and 23 solely by Bureau members.

3. PARTICIPANT SELECTION

Participants to the scoping meeting were selected following a process consistent with the IPCC policies and procedures. The selection process was undertaken by the IPCC Bureau, with participants for the scoping of the individual Working Group (WG) contributions selected by the relevant respective WG Bureau Members.

The objective of the selection process was to select around 60 experts for each WG contribution considering all criteria as stated in Appendix A of the Principles Governing IPCC Work:

"In selecting scoping meeting participants, consideration should be given to the following criteria: scientific, technical and socio-economic expertise, including the range of views; geographical representation; a mixture of experts with and without previous experience in IPCC; gender balance; experts with a background from relevant stakeholder and user groups, including governments."

Following the close of nominations, the full list was divided into three– one for each WG – according to the areas of expertise indicated by each nominee. Nominations may thus fall into more than one WG. For the 778 experts (after removing duplicates) indicating expertise in an area of WGII, the WGII Technical Support Unit compiled those nominations and prepared overview statistics of the nominations. Of the 778 nominations, based on the citizenship provided 55% of nominated experts were from developed countries and 45% were from developing countries or countries with economies in transition.

The selection process, including statistics at each stage of the process, is given in detail in Annex I. Of the 73 experts invited, 52 attended the AR6 Scoping Meeting, together with 7 WGII Bureau Members, giving a total of 59 participants to support the scoping of the WGII contribution. Of these, 49% were from developed countries and 51% were from developing countries and countries with economies in transition. The Participant List for the WGII contribution to the AR6 Scoping Meeting is provided as Annex II.

4. SCOPING MEETING

The scoping meeting for the AR6 was held in Addis Ababa, Ethiopia, from 1 to 5 May 2017. An overview of the Scoping Meeting, including a summary of the Chair's Vision Paper and Programme, is provided in IPCC-XLVI/Doc. 6. This section provides additional detail specific to the WGII scoping. A copy of the Programme for AR6 Scoping Meeting with the WGII contribution highlighted is provided as Annex III.

A pre-defined structure for the WGII AR6 outline was purposely not provided to the participants. Rather, to stimulate the scoping process, the WGII Bureau provided a contribution to the Chair's Vision Paper on overarching themes for the report (see IPCC-XLVI/Doc. 6). The programme for the WGII scoping was constructed to gather diverse views and allow for wide-ranging initial discussions, followed by breakout and plenary discussions focused on moving from themes to

chapters. Hence, the proposed outline for the WGII AR6 was developed in a dynamic and iterative process over the course of the scoping meeting. A visual representation of the meeting design is provided in Figure 5 below.

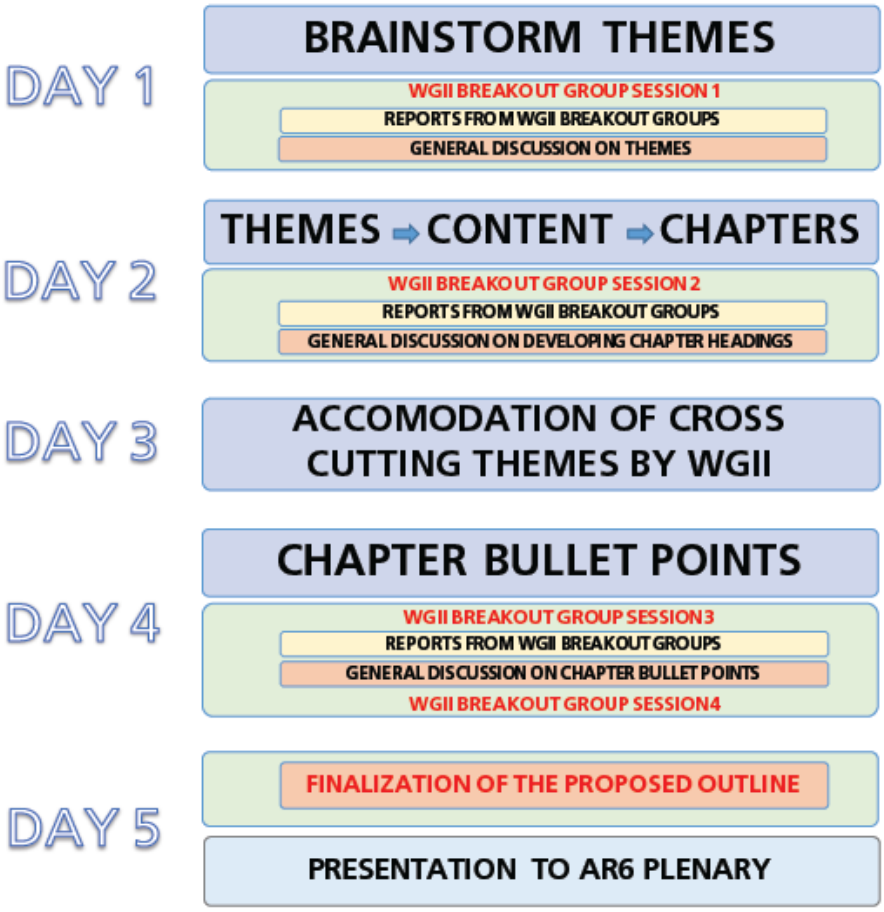

Figure 5: Meeting design and work-flow of the WGII Breakout Group sessions at the AR6 Scoping Meeting

4.1 Keynote Scene-Setting Presentations

Twelve keynote presentations were invited from the participants by the WGII Bureau to provide scene-setting introductions relevant to the broad themes for AR6. Keynote presentations (1-9, Table 1) relevant to the WGII AR6 were given at the start of Day 1 and Day 2. Two regional-specific scene-setting keynotes (R1 and R2, Table 1) were presented at the start of the regional cross-cutting breakout on Day 3. Each presenter was given the following general mandate:

- To provide a general overview of the given topic suited for an audience with diverse backgrounds and expertise to lay the groundwork for the discussions to follow
- To extend their coverage of the topic beyond their own core research area
- To give emphasis to new research and publications emerging since the IPCC Fifth Assessment Report to stimulate discussions

Table 1. Details of keynote presentations by theme and presenters

Keynote	Presenter	Citizenship	Topic
Natural and Managed Ecosystems and their Uses			
1	Guy Midgley	South Africa	Terrestrial Ecosystems
2	Anne Hollowed	United States of America	Marine Ecosystems
Human Systems, Health, Wellbeing, Settlements			
3	David Dodman	Jamaica	Human Systems and Climate Change: Established, Maturing and Emerging Themes
x	*Mary Nyasimi*	*Kenya*	*Invited, but unable to attend scoping meeting*
Adaptation Decision-making, Governance and Institutions, and Economics			
4	Bronwyn Haywood	New Zealand	Adaptation Decision-making: Needs, Options and Limits
5	Aromar Revi	India	Adaptation Decision-making
Multi-sector Impacts, Risks, Vulnerabilities, Opportunities and Challenges: Social and Economic Perspectives			
6	So-Min Cheong	Republic of Korea	Multi-sector Impacts, Risks, Vulnerabilities, Opportunities and Challenges
7	Neil Adger	United Kingdom	Multi-sector Impacts, Risks, Vulnerabilities, Opportunities and Challenges
Multi-sector Impacts, Risks, Vulnerabilities, Opportunities and Challenges: Historical Perspectives			
8	Wolfgang Kiessling	Germany	Palaeontological and Historical Records of Climate Change Impacts
9	Timothy Kohler	United States of America	What Archaeology can bring to the IPCC
Regional Aspects (Working Group Cross-Cutting)			
R1	Wolfgang Cramer	Germany	Regional aspects in IPCC
R2	Edwin Castellanos	Guatemala	Regional perspective from lower income developing countries

4.2 WGII Breakout Groups and Stocktaking Sessions

Open exchange of ideas and detailed discussions of possible options for the contents and structure of the report took place during four successive days of Breakout Group (BOG) sessions, each followed by a stocktaking WGII plenary session of reporting and discussion. WGII BOG sessions were designed to progressively distil possible topics and questions to be addressed in the WGII Assessment Report following discussion around a series of focused themes and leading to proposed chapter titles and bullets of indicative chapter content. The plenary sessions provided all WGII participants to take stock of the ideas emerging from across the different groups, discuss and clarify key issues, identify commonalities emerging from the discussions, and highlight key challenges, gaps and overlaps.

Day 1: Breakout Group Session 1

Breakout group session 1 (BOG1) was designed to provide an open forum where participants express their ideas and priorities for the WGII AR6. The charge of BOG1 was to identify the broad themes and issues that should be covered in WGII AR6 while considering potential overlaps and complementarities with the Special Reports and the emergence of new knowledge since AR5. In

addition, potential cross-cutting topics across WGs that emerged during BOG1 were recorded for further discussion.

BOG1 consisted of six groups, each comprising of around 12 participants, that were run in parallel session. Each BOG1 group was assigned the same task and chaired jointly by a WGII Bureau Member and one of the participants. Participants were preassigned to groups to ensure a mix of expertise, geographic region, IPCC experience and gender in each group.

The WGII Bureau met on the evening of Day 1 to review the outcomes of BOG1 and to develop Breakout Group proposals for Day 2.

Day 2: Breakout Group Session 2

Based on the outcomes of the brainstorming session, the subsequent plenary discussion, and the WGII Bureau discussion, four groups each focused on a different topic were proposed for the second breakout group session (BOG2):

BOG2a: Natural and Managed Ecosystems: values and benefits
BOG2b: Human Systems: wellbeing and security
BOG2c: Socio-ecological Systems (coupled natural-human systems)
BOG2d: Sustainable Development Pathways: integrating adaptation and mitigation

Each group was tasked with identifying potential content and collecting initial thoughts on grouping content into chapters. Participants chose which group to attend, thereby each group consisted of relevant expertise. An interim stocktaking session allowed fruitful discussion across the BOG2 groups on refinement of the emerging narrative and content of the report. At the stocktake, participants decided to merge BOG2b and BOG2c into a 'Human Systems' topic and then split into sub-groups focusing on (i) cities, (ii) food, fibre and other service, (iii) human health, (iv) water, and (v) poverty and livelihoods, thus moving towards defining chapters.

The Scientific Steering Committee for the AR6 Scoping Meeting met on the evening of Day 2 to review the emerging cross-cutting themes and to develop cross-cutting BOG proposals for Day 3.

Day 3: Cross-Cutting Themes

Day 3 was dedicated primarily to themes cross-cutting across two or more WGs (see IPCC-XLVI/Doc.6). WGII participants distributed among cross-cutting BOGs based on their expertise. Breakout Groups were regional aspects; risk and uncertainty; adaptation-mitigation interactions; cities and climate change; geoengineering; the Global Stocktake; scenarios; and processes for integration during the AR6 cycle. A discussion of the cross-cutting BOGs from a WGII perspective is given in Section 6.

The regional chapters will sit in the WGII Assessment Report. Introductory presentations to the regional cross-cutting BOG were given by two WGII participants (R1-2; Table 2) and by a WGI participant. Cross-cutting BOGs were charged with defining how the themes would be addressed and managed across multiple WG.

Working Group II met in plenary the late afternoon to discuss how the cross-cutting themes could be accommodated in the WGII Assessment Report.

In the evening the of Day 3 the WGII Bureau met to consider the themes, topics and emerging chapter structure and from these, develop a proposed set of chapters for the next day's programme for WGII.

Day 4 Breakout Group Sessions 3 and 4

In response to the emerging chapter structure, BOGs were continued around the themes, each with a number of chapters developing within them:

- Natural Systems (terrestrial and freshwater; ocean and coastal)
- Human Systems (water; food; cities; health; poverty)
- Sustainable Development (three synthesis chapters)

All BOGs were tasked with developing the final draft indicative bullets of content and considering the additional detail that would be provided in the informational annotation document (see Section 5). A stocktaking session in the middle of the day allowed discussion across BOGs and subsequent refinement of content.

Two additional sub-BOGs were formed, the first to develop indicative content that would provide a discussion of the common elements across the report and presented in the first chapter of the report. The second sub-BOG identified the common elements to be addressed across the regional chapters of the WGII Assessment Report.

In the evening of Day 4, the WGII Bureau met with the facilitators for each of the chapter BOGs to refine the draft chapter title and bullets in the draft outline submitted by the BOGs.

Day 5

The WGII participants met in plenary to consider the outcome of the WGII Bureau and facilitators meeting. The chapter titles and indicative bullets for the 18 chapters were considered. The chapters were discussed and consensus was reached on the wording for each chapter title and indicative bullets. The chapter ordering and a set of cross-chapter boxes were also agreed. The proposed WGII outline was presented to all AR6 Scoping participants in an afternoon plenary session and minor adjustments were subsequently made in response to comments. The final proposed outline from the WGII AR6 is presented in Box 1.

BOX 1: WGII AR6 PROPOSED OUTLINE

Summary for Policy Makers [20 pages]
Technical Summary [40 pages]

Chapter 1: Point of departure and key concepts [30 pages]

THEME I: Risks, adaptation and sustainability for systems impacted by climate change

Chapter 2: Terrestrial and freshwater ecosystems and their services [60 pages]
Chapter 3: Ocean and coastal ecosystems and their services [40 pages]
Chapter 4: Water [60 pages]
Chapter 5: Food, fibre and other services from managed ecosystems [60 pages]
Chapter 6: Cities, settlements and key infrastructure [60 pages]
Chapter 7: Health, wellbeing and the changing structure of communities [50 pages]
Chapter 8: Poverty, livelihoods and economic development [60 pages]

THEME II: Regions

Chapter 9: Africa [50 pages]
Chapter 10: Asia [50 pages]
Chapter 11: Australasia [40 pages]
Chapter 12: Central and South America [50 pages]
Chapter 13: Europe [40 pages]
Chapter 14: North America [40 pages]
Chapter 15: Small Islands [30 pages]

THEME III: Overview of sustainable development pathways: integrating adaptation and mitigation

Chapter 16: Key risks across sectors and regions [40 pages]
Chapter 17: Decision-making options for managing risk [40 pages]
Chapter 18: Climate resilient development pathways and transformation [40 pages]

Cross-Chapter Boxes
- Antarctica [5 pages]
- Arctic [10 pages]
- Biodiversity hotspots (land, coasts and oceans) [10 pages]
- Cities by the sea [10 pages]
- Deserts and semi-arid areas [5 pages]
- Mountains [5 pages]
- Tropical forests [10 pages]

Annex I: Regional Atlas
Annex II: Glossary
Annex III: List of Acronyms
Annex IV: List of Contributors
Annex V: List of Reviewers

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5. ANNOTATED PROPOSED OUTLINE OF CHAPTERS FROM THE SCOPING MEETING

The following text provides additional information on the annotated outline for the WGII AR6, developed by scoping participants based on discussions throughout the scoping meeting, and particularly those discussions during the individual chapter BOGs.

Chapter 1: Point of departure and key concepts

- Changing policy context (including Paris Agreement, SDGs, etc.); AR5 and SR findings and critical messages, goals of this report
- The significance of sectoral and regional climate risks to natural and human systems in the context of culture, values, ethics, identity, behaviour, and historical experience
- The climate risk framework used in this report encompassing hazard, exposure, and vulnerabilities
- The significance of adaptation (from incremental to transformational), in addressing climate change risks, including adaptation responses and outcomes
- Detection and attribution of both climate impacts and adaptation responses
- Understanding dynamic climate risks from scenarios that reflect multiple interacting drivers
- Enabling conditions for effective adaptation including governance and economic aspects
- Climate change responses and their interactions with sustainable development pathways
- Opportunities for enhancing climate resilient development pathways

The first bullet establishes the international institutional and research context, focusing on key findings and new issues that have emerged since the AR5 including from the AR6 Special Reports, and establishing the broad goals of this report. Discussion will highlight critical messages for understanding impacts, adaptation and vulnerability. Emphasis will be given to new international policy frameworks (including the Paris Agreement, Sustainable Development Goals, the Addis Ababa Action Agenda, the New Urban Agenda and the Sendai Framework for Disaster Risk Reduction), and how those institutional frameworks influence both the goals of this report and the narrative of the chapters that follow.

The second bullet point addresses the social context (including the psychosocial, political, cultural and economic aspects) of sectoral and regional risk for human and ecological systems. Given that audiences may understand key concepts differently, establishing shared cross disciplinary understanding of concepts is important especially for concepts such as culture, (including social norms, customs and conventions, and everyday social practices); ethics and values (from moral principles to reasoning); social identity, behaviour change, or institutional memory. Discussion will draw from disciplines including, but not limited to: sociology, psychology, political science and anthropology.

The third bullet point describes and explains the underlying risk framework as both a lens and methodology which will be used to assess hazards and conditions of exposure, asking in particular, risk and vulnerability for whom or what? This discussion will consider multiple exposure and compounding risks and will be aligned with the agreed approach to risk across all three IPCC Working Groups.

The fourth bullet notes the fundamental importance of adaptation as both a response to reduce vulnerability and to take advantage of opportunities as part of a risk management approach that includes the implications for emission-reduction actions. Discussion will develop shared understandings of the range of climate adaptation responses from incrementalism (including measurable change with long term cumulative or path dependency effects) to transformative change (including non-linear, systemic or novel shifts of regime and problem approach) addressing issues such as maladaptation.

The fifth bullet addresses the development of the evidence base for both the impacts of contemporary climate changes and the responses to these impacts and the concepts and methodologies for attribution to climate change.

The sixth bullet emphasises the consideration of interactions between climate change-based risks and other climatic, ecological and socio-economic changes so as to enhance policy-relevance.

The next bullet point highlights enabling conditions particularly; government capacity, political will, institutional regulatory frameworks, effective communication, and economic policy and practice (from local to international scales) that enable or act as barriers or limits to adaptation.

The final bullet point highlights the complex multiple interactions between climate change responses and sustainable development including policy trade-offs, co-benefits, possible tensions and policy and practice opportunities.

Chapter 2: Terrestrial and freshwater ecosystems and their services

- Point of departure, key findings of other reports, organised by biomes including freshwater systems, taking into account ecological disequilibria
- Historical and paleontological aspects of climate change impacts and risks
- Trends in critical ecosystems including detection and attribution of observed impacts and responses
- Projected hazards and exposure (link to WGI), including extreme events and interactions of multiple climatic, non-climatic and anthropogenic stressors at relevant temporal and spatial scales
- Projected impacts: species, ecosystem structure and biodiversity, emergence of novel communities, process rates, functions, and the implication for their services, at relevant temporal and spatial scales
- Vulnerability and resilience, enablers and limits to natural and planned adaptation, and maladaptation
- Assessing risks, opportunities, costs, and trade-offs including consideration of scenarios and impacts of adaptation and mitigation responses
- Planned adaptation and mitigation for management of risk within the SDG and other relevant policy contexts, informed by cultural, ethical, identity, economic and behavioural dimensions
- Lessons from case studies

The first bullet provides a brief summary of key findings regarding climate change effects on terrestrial and freshwater ecosystems from previous IPCC Assessment Reports (AR5 and earlier), IPCC Special Reports and relevant reports from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The section should consider biome classification that captures the emerging understanding of shifts in biome composition and structure. It should be noted that species within ecosystems are exposed to multiple drivers that may act on co-evolved ecological interactions and that responses can result in novel ecosystem composition.

The second bullet summarizes historical and paleontological evidence of the impacts on, and responses of, terrestrial and freshwater ecosystems to climate change. Of particular relevance, the section should focus on the identification of key tipping points and thresholds for ecosystem change, and on the implications of underlying climate shifts for terrestrial and freshwater ecosystems. Where possible, inferences from historical and paleontological records on the limits of adaptation should be included.

The third bullet assesses changing trends in terrestrial and freshwater ecosystems, and the detection of and attribution of climate change as driver in observed trends. Trends can manifest as shifts in abundance, phenology, distribution, community composition, etc., or combinations thereof. In particular, cases where climate-change impacts on terrestrial and freshwater ecosystems have been detected in ecosystems that play a critical role in the carbon budget and/or the provisioning of ecosystem services (“critical ecosystems”) should be considered, noting that provisioning services are assessed by Chapter 5. The term “critical ecosystems” is not intended to be a value judgement on the importance of terrestrial and freshwater ecosystems, but rather to assist in the selection of examples. Beside documented observed range shifts, geo-statistical models that can quantify the role of changes in the spatial distribution of suitable environmental habitat should be

considered. Such modelling approaches allow for the quantification of the contribution of shifting environmental variables to observed spatial shifts of species and ecosystems.

The fourth bullet provides two of the three elements of the IPCC's risk framework and acknowledges that climate change is expected to alter multiple interacting factors that influence terrestrial and freshwater ecosystems, which themselves are already exposed to non-climatic and other anthropogenic stressors. The section should consider the exposure of terrestrial and freshwater ecosystems to projected physical and chemical changes, including changes in extreme events. The hazards and exposure of freshwater and terrestrial ecosystems within this suite of interacting environmental drivers might be considered. It is recognized that the assessment of the relative exposure of biota to a multi-variate suite of stressors may vary by life stage, necessitating consideration of both time and space scales in the assessment. Furthermore, the incidence of hazards and the exposure of freshwater and terrestrial ecosystems to changing environmental conditions is expected to change spatially and temporally in response to climate change. An attempt to consider these shifting elements is encouraged with an evaluation of the hazards and exposure using the time frames selected for the AR6 (e.g., near-term and longer-term). Several researchers have noted that rates of change in the spatial distribution of suitable habitats can be utilized to predict the pace of spatial shifts in some species (e.g., "climate velocity"). Likewise, downscaled climate model data can be used to map the future distribution of suitable climatic space in the future. The scoping team anticipates that the author teams will consider these products when discussing future exposure.

The fifth bullet assesses the projections of climate change and implications on the full range of ecosystem and species-specific attributes, facilitating comparison across regions. It is anticipated that in several regions, case studies of projected impacts on system attributes will be derived from studies that employed coupled bio-physical models that dynamically projected impacts across a suite of RCPs and SSPs. Where possible, projected impacts on system attributes with and without planned adaptation should be assessed. The spatial scales of the impacts and models of varying levels of ecological complexity, from single-species bioenergetics models to fully-coupled dynamic ecosystem models, should be considered when developing this section. The implications of projected impacts on the delivery of ecosystem services (noting that provisioning services will be covered in Chapter 5) under alternative scenarios and a suite of time scales (e.g., near-term and longer-term) should be included. The implications for ecosystem services should be documented, including an assessment of the results of socio-ecological projection models.

The sixth bullet considers an assessment of vulnerability which is the third component of risk the IPCC risk assessment framework. Vulnerability encompasses the sensitivity of a species or ecosystem as well as the adaptive capacity of the species or ecosystem. This assessment of adaptation and should include consideration of limits to natural adaptation to the impacts of climate change (i.e., adaptation of natural systems or species) as well as the adaptive capacity under planned climate-change adaptation and maladaptation. The assessment should consider the capacity of terrestrial and freshwater ecosystems to cope with a hazardous event, trend or disturbance by responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation and transformation. Where possible, the cost of impacts should be quantified. Existing and future attributes (e.g., ecosystem structure, biodiversity, functional redundancy and other relevant factors) should be considered when evaluating the potential impact of climate change on the presence and future resilience of terrestrial and freshwater ecosystems.

The seventh bullet should estimate present and future risk as a combination of exposure, hazards and vulnerability of freshwater and terrestrial systems, accounting for both climate and anthropogenic stressors. The previous sections should provide a clear pathway for the assessment of risk under different scenarios (RCPs and SSPs). The costs and trade-offs associated with different future pathways should be documented qualitatively or quantitatively. For example, assessment of the outcomes of integrated modelling studies that have utilized coupled bio-physical models to conduct management strategy evaluations (MSEs) to evaluate the utility of different adaptation and mitigation responses.

The eighth bullet summarizes the literature relevant to planned adaptation and mitigation measures within the framework of the Sustainable Development Goals and other relevant policies. The evaluation of management strategies noted above will provide quantitative assessments of the utility of proposed strategies within a multi-stressor environment. These studies should take into account regional differences in cultural, ethical and economic factors that would influence the types of adaptive and mitigation strategies considered acceptable for a given geographic region. These cultural, ethical and economic drivers may create a spatial mosaic of current and projected risk to terrestrial and freshwater systems.

Chapter 3: Ocean and coastal ecosystems and their services

- Point of departure, key findings of other reports, organised by systems, taking into account ecological disequilibria
- Historical and paleontological aspects of climate change impacts and risks
- Trends in critical ecosystems including detection and attribution of observed impacts
- Projected hazards and exposure (link to WGI), including extreme events and interactions of multiple climatic, non-climatic and anthropogenic stressors at relevant temporal and spatial scales
- Projected impacts: species, ecosystem structure and biodiversity, emergence of novel communities, process rates, functions, and the implication for their services, at relevant temporal and spatial scales
- Vulnerability and resilience, enablers and limits to natural adaptation
- Assessing risk, opportunities, costs, and trade-offs including consideration of scenarios and impacts of adaptation and mitigation responses
- Planned adaptation and mitigation for management of risk within the SDG and other relevant policy contexts, informed by cultural, ethical, identity, economic and behavioural dimensions
- Lessons from case studies

The first bullet provides a brief summary of key findings regarding climate change effects on ocean and coastal ecosystems that were derived from IPCC Assessment Reports (AR5 and earlier), IPCC Special Reports and relevant reports from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the recent FAO Report on Climate Change Effects on Fish and Fisheries. The regional classification used in AR5 for ocean ecosystems should be discussed considering regional partitions of coastal systems to link to the regional chapters. The description of the ocean and coastal regions should briefly consider the emerging shifts in species composition and community structure. It should be noted that species within ecosystems are exposed to multiple drivers that may act on co-evolved ecological interactions and that responses can result in the development of novel ecosystems.

The second bullet summarizes historical and paleontological evidence of the impacts on, and responses of, ocean and coastal ecosystems to climate change. The section should focus on the emergence of new insights within the framework of literature cited in previous reports. Where possible, inferences from historical and paleontological records on the limits of adaptation should be considered. Of particular relevance to this chapter, the section should focus on the identification of key tipping points and thresholds for system change and the implications of those climate shifts for ocean and coastal systems.

The third bullet highlights recent papers that assess changing trends in ocean and coastal ecosystems and the detection and attribution of climate change as driver in observed trends such as changes in abundance, phenology, distribution, community composition or combinations thereof. Cases where climate change impacts have been detected in ocean and coastal ecosystems that play a critical role in the carbon budget and provisioning ecosystem services (thus providing links to Chapter 5) should be highlighted. The term “critical ecosystems” is not intended to be a value judgement on the importance of ocean and coastal ecosystems, it is intended to assist in the selection of examples. Beside documented observed range shifts, geo-statistical

models that can quantify the role of changes in the spatial distribution of suitable environmental habitat should be considered. Such modelling approaches allow for the quantification of the contribution of shifting environmental variables to observed spatial shifts of species and ecosystems.

The fourth bullet considers the likelihood or probability of occurrence of hazardous events including extreme events as well as an assessment of the exposure of ocean and coastal ecosystems to projected physical and geochemical changes. The assessment should acknowledge that climate change is expected to alter multiple interacting factors that affect ocean and coastal systems that are already exposed to non-climatic and anthropogenic stressors. The hazards and the exposure of ocean and coastal systems within this suite of interacting environmental stressors should be considered. It is recognized that the assessment of the relative exposure of biota to a multi-variate suite of stressors may vary by life stage necessitating the need to consider both time and space scales in the assessment. The spatial and temporal changes in incidence of hazards and the exposure of ocean and coastal ecosystems to changing environmental conditions in response to climate change should be considered under multiple time frames (e.g., near-term and longer-term). Consideration of future exposure could include the rates of change in the spatial distribution of suitable climatic habitats to predict the pace of spatial shifts in some species (e.g., “climate velocity”) and downscaled climate model data to map the future distribution of suitable habitat.

The fifth bullet synthesizes projections of the implications of climate change on the full range of ecosystem and species-specific attributes. Projected impacts on ecosystem attributes will be identified and compared across regions. It is anticipated that in several regions, case studies of projected impacts on system attributes will be derived from studies that employed coupled bio-physical models that dynamically projected impacts across a suite of RCPs and SSPs and spatial and temporal scales. Where possible, consideration of projected impacts on system attributes with and without planned adaptation should be considered. Models of varying levels of ecological complexity should be considered when developing this section. Single- or multi - species bioenergetic models that incorporate climate and anthropogenic stressors may be useful in projecting climate impacts on future key vital rates and phenological shifts, complex full ecosystem models may be useful in projecting climate impacts on ecosystem structure and function and biodiversity, and fully coupled dynamic ecosystem models that incorporate shifting spatial patterns in exposure may be useful in projecting spatial temporal changes in ocean and coastal ecosystems. The implications of projected impacts on the delivery of ecosystem services under alternative scenarios and time scales (e.g., near-term and longer-term) should be documented, including an assessment of the results of socio-ecological projection models.

The sixth bullet is an assessment of adaptation and should include natural limits to adaptation to the impacts of climate change as well as the adaptive capacity under planned adaptation and maladaptation. The capacity of ocean and coastal systems to cope with a hazardous event or trend or disturbance, by responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation and transformation should be assessed. Existing and future attributes (e.g., ecosystem structure, biodiversity, functional redundancy and other relevant factors) should be considered in an evaluation of the potential impact of climate change on the presence and future resilience of ocean and coastal ecosystems.

The seventh bullet estimates present and future risk as a combination of exposure, hazards and vulnerability of ocean and coastal ecosystems accounting for both climate and anthropogenic stressors. The previous sections should provide a clear pathway to assess risk under different scenarios (RCPs and SSPs). The costs and trade-offs associated with different future pathways should be documented qualitatively or quantitatively, thus providing links to WGIII. Studies using an integrated modelling approach that utilizes coupled bio-physical models to conduct management strategy evaluations (MSEs) to evaluate the utility of different adaptation and mitigation responses might be considered where possible.

The eight bullet summarizes the literature relevant to planned adaptation and mitigation measures within the framework of the Sustainable Development Goals and other relevant policies. The management strategy evaluations noted above will provide quantitative assessments of the utility of proposed strategies within a multi-stressor environment. These studies should take into account regional differences in cultural, ethical and economic factors that would influence the types of adaptive and mitigation strategies that would be acceptable for a given geographic region. These cultural, ethical and economic drivers may create a spatial mosaic of current and projected risk to ocean and coastal ecosystems.

Chapter 4: Water

- Observed and projected hydrological changes on basin and watershed scales and water related hazards including floods, droughts and landslides
- Key short, medium and long term risks to water security in the context of critical sectors (including food-energy-water-health nexus) and different users and systems under alternative scenarios
- Adaptation responses including cooperation in different climatic zones to water security risks with co-benefits for sustainable development including consideration of impacts of adaptation and mitigation responses
- Attribution of transboundary and other international and intra-national problems relating to shared water resources
- Approaches to achieving resilience in water systems and assessments of outcomes, costs, benefits, and where maladaptations were evident
- Lessons from case studies

In recent years, water issues have come to claim a firm position among the top challenges facing global leaders. The significance of water issues has been evident in the Global Risks Report published by the World Economic Forum 2014, where “water crisis” is named the top risk in the coming decade. Water is recognized as a major component of the new sustainable development agenda through Sustainable Development Goal (SDG) #6 “Ensure access to water and sanitation for all,” which notes that water scarcity, poor water quality and inadequate sanitation negatively impact food security, livelihood choices and educational opportunities for poor families across the world, with drought afflicting some of the world’s poorest countries, worsening hunger and malnutrition, and further highlighting that by 2050, at least one in four people is likely to live in a country affected by chronic or recurring shortages of freshwater. Water related disasters are also addressed through SDG #11, Target 4. Indeed, water cuts across many more, if not all, of the SDGs, as achievements in any sector will influence and be influenced by water quality, quantity and management. Further validation of the global significance of water issues is provided by UN-Water which coordinates the efforts of 30 UN entities and international organizations working on water and sanitation issues.

The international responses noted above reflect the growing reality that the current use, development and management of the planet’s finite freshwater resources, and the services they provide, are unsustainable at local, regional and the global scales, and this is creating pressures for the security of current and future generations. Prospects of meeting the international community’s aspiration of clean water for all are further threatened by the disruptions to the global water cycle arising from anthropogenic forced climate change. Understanding the impacts climate change are having, and are projected to have, on hydrological systems at multiple scales including regional water basin and local water shed scales, and the adaptations people can take to reduce associated risks, is therefore of paramount importance for sustainable livelihoods, national security and economic resilience.

Climate change will transform the hydrological patterns that determine the availability of water in various physiographic conditions with projections under a business-as-usual scenario pointing to, among other things: intensification of heavy precipitation over land regions, the contrast in precipitation between wet and dry regions and between wet and dry seasons increasing, and

extreme precipitation events over most of the mid-latitude land masses and over wet tropical regions becoming more intense and frequent. Thus, it is likely that the most water-stressed regions will get less water, and water flows will become more subject to extreme hydrological events including intense floods, droughts and landslides. Water stress is also likely to increase because of the changes in water demand and water quality associated with climate change.

It is clear therefore that watershed hydrological system responses to climate change and related key risks to water security at respective regions and adaptation/mitigation responses vary around the world depending on multiple interacting factors. This is why analysis of *observed and projected hydrological changes on watershed scales and water related hazards* as well as *key risks to water security in the context of critical sectors and their adaptation capacity* are the first three bullet points of the water chapter.

The first bullet addresses water-related natural disasters - including storms, floods and droughts – which are among the most economically damaging. Climate change is leading to direct and indirect effects on the whole of the hydrological cycle, with changes in runoff and aquifer recharge, and in water quality. Higher water temperatures due to warmer climate are expected to exacerbate many forms of pollution, including thermal pollution, with possible negative impacts on species, ecosystems and human health.

The second and third bullets discuss risks to water security and adaptation responses for sustainable development. Water is arguably the paramount cross-cutting climate change issue as its supply and quality underpins the sustainability of all human societies and the integrity of all ecosystems. Water underpins food security and is implicated in all forms of energy production and use. Human health, in turn, is intimately intertwined with water and food security. Water is essential to the production, distribution and consumption of food, it is linked to the causes of poverty, and its absence or presence can increase vulnerability to climate change impacts. It is critical therefore to consider climate change impacts on water in the context of the *food-energy-water*- health- poverty nexus and *sustainable development* more generally.

The fourth bullet considers problems related to shared water resources. About 40 percent of the world's population lives in drainage basins that are shared by two or more countries, and more than 90 percent lives in countries that share basins. There are at least 592 transboundary aquifers shared by 2-4 countries, for some of which groundwater is the main source for the resource. For countries whose basins lie wholly within their own territories, adapting to increasingly severe climate change will be difficult enough; however, when those basins cross borders, bringing in multiple political entities, sustainable management of shared water resources in a changing climate will be especially challenging. Thus, *Attribution of transboundary and other international and intranational problems relating to shared water resources* is among the important issues to be addressed in the water chapter.

The fifth bullet addresses resilience in water systems. Where water supply is limited by a lack of investment in infrastructure or insufficient regulation or pricing, an area is considered to be affected by economic water insecurity. Some 1.6 billion people live in areas affected by economic water insecurity and this number will increase with climate change. Solutions to this problem are associated with the implementation of integrated water resources management, the objectives of which is "the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems". Recognition of the need for integrated water resource management at all levels and across boundaries is also borne out in the SDG #6.5. Specific water management practice and realization of these principles fundamentally differ around the world. *Analyzing approaches to achieving resilience in water systems and assessments of outcomes, costs, benefits* are therefore also among the main foci of the water chapter.

Chapter 5: Food, fibre and other services from managed ecosystems

- Climate-driven historical changes in services provided by managed ecosystems, detection and attribution of impacts and responses, including impacts of adaptation and mitigation responses, considering key findings of other reports
- Current and projected risks for food and nutrition security, food systems on land and in the ocean, and the food-energy-water-health nexus
- Current and projected risks for wood, fibre and natural products, such as medicinal organisms, rubber and dyes
- Adaptation options for different managed ecosystems across scales and regions including limits and barriers, knowledge systems and aspects of sustainable development
- Competition for the use of land and ocean, including conflicts with indigenous rights to land and water bodies, and other tradeoffs in the context of adaptation and mitigation responses
- Current and projected risks for provisioning and cultural ecosystem services with considerations of ethics and identity
- Lessons from case studies

The seven bullets of this chapter aim to cover all aspects of past, current and future climate change effects on ecosystems that are managed by people to obtain provisioning and cultural services from them (the supporting and regulating services are covered in chapters 2 and 3). It includes all forms of low and high intensity production systems for food, fibre and other products including cropping systems, pastoral systems, aquaculture (marine and freshwater), fisheries (marine and freshwater), forestry and the production of any other materials or cultural services. The focus is on the integration of risks and adaptation experienced by people who benefit from such services from these ecosystems. Significant aspects of the assessment will be based on current work for the three Special Reports of the IPCC particularly the one on land management and food security, as well as ongoing assessments for the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). Authors are cautioned not to repeat but to update information available from such reports.

The first bullet assesses the historical relationship between climate fluctuations and human livelihoods, and addresses the degree to which recent climate change has caused changes in the provisioning and cultural services provided by managed ecosystems.

The second bullet addresses all climate-relevant aspects of changes in ecosystem experienced in the context of the production of food. Projected risks should be assessed for different climate and development scenarios. It aims for a comprehensive view on food security (availability, quality, access, utilization, stability, affordability) and includes all aspects of availability, quality of, and access to, food for people. The concept of food systems includes considerations of trade, markets, consumption patterns and food waste. It is important to emphasize the nexus of temperature, rainfall and productivity, and to considerate aspects such as pests and air and water pollution effects on these systems.

The third bullet aims at an assessment of climate change impacts on all non-food services derived from managed ecosystems, notably those associated with forestry and similar production systems. Projected risks should be assessed for different climate and development scenarios. Like the previous bullet, this one is also based on integration of sustainable use of the provided resources, and associated vulnerabilities by people to the impacts of climate change on these ecosystems, including the incidence of pests, changes of temperature and rainfall patterns, and other disturbances.

The fourth bullet evaluates the existing options and opportunities for adaptation to climate change on managed ecosystems, from very local to regional and continental scales. A specific focus is on adaptation options that include various forms of knowledge of managing ecosystem resources at the regional to global scale. Consideration should be given to ecosystem-based adaptation, agroforestry, agroecology, indigenous and other knowledge systems, gender issues, shifting consumption patterns, governance and institutions.

Land and sea resources are limited, and the competition between different forms of use is likely to impact the potential of managed ecosystems to deliver goods and services to people. This fifth bullet will assess the impact of climate change on issues of access to and use of land and water bodies. Management of ecosystems currently undergoes strong and potentially accelerating transformations; one of them is the possibility of very large-scale deployment and use of biomass for energy as a climate change mitigation measure. As these changes may impact the delivery of services from these ecosystems, the possible risks or synergies associated with these changes need to be assessed. Also other modifications of land and sea use systems, such as the management of methane-emitting livestock, will be assessed regarding their potential to modify the provisioning of ecosystem services.

Climate-driven changes in land and sea ecosystems may affect the integrity of ecosystems such as cultural landscapes and therefore also their capacity to provide opportunities for recreation or spiritual experiences. Such changes will be important for the economy and identity of people. Projected risks should be assessed for different climate and development scenarios in this fifth bullet.

For the case studies, it will be important to provide positive and negative examples of the impacts of climate change on the capacity of ecosystems to provide services to people.

Chapter 6: Cities, settlements and key infrastructure

- Changes in the international policy architecture for settlements since AR5
- Interactions of climate risks with urban and rural change processes including food-energy-water-health nexus
- Risk-reducing infrastructure and services (including ecological and social), their deficits, and implications for vulnerability, exposure and adaptation
- Detection and attribution of observed impacts and responses and projected risks from climate change under alternative scenarios including energy systems, transport and industry
- Adaptation options, adaptive capacity, responses and outcomes, including equity considerations and links to mitigation
- Institutional, financial, and governance structures that enable governance for climate resilient and sustainable settlements, cities and key infrastructure
- Lessons from case studies

The first bullet is intended to reflect the many changes that have taken place since AR5, and provides crucial information for understanding the rest of the chapter, including the international architecture of the SDGs, Sendai Framework, Paris Agreement, Addis Ababa Action Agenda, IPCC Special Reports, the New Urban Agenda and other emerging opportunities. These significant developments have important implications for the scale and nature of urban and rural change.

The second bullet considers how changes in settlements, cities and infrastructure have shaped the context for exposure, vulnerability and resilience to climate change impacts since AR5, including changes in consumption and investment, migration and changing demographic structures, land-use change, hot-spots of risk and conflict.

The third bullet describes the quality and coverage of basic and critical infrastructure provision in rural and urban settlements and implications for resilience to climate change impacts and risk. This includes access to potable water, sanitation, primary health care, social services such as education, community development and social safety nets, security and policing, rule of law and inclusive decision-making processes. Gaps and new coverage since AR5 and mechanisms for delivery determine a large part of human exposure to climate risk and describe the contribution of everyday development to climate change resilience and transformation.

The fourth bullet discusses the evidence of observed impacts and responses and projected risks from climate change under different scenarios, which consider energy systems, transport and industry.

The fifth bullet considers adaptation, including options, adaptive capacity, responses and outcomes. This also includes differential adaptive capacity and equity considerations. This bullet addresses anticipatory and responsive actions undertaken by individuals, local and national governments, low-income communities, private sector, international actors and civil society.

The sixth bullet addresses institutional structures that enable governance for climate resilient and sustainable settlements, cities and key infrastructure. This includes supporting institutional structures to allow cities to innovate, governance, politics and finance, including innovations on assessing risks, linkages between adaptation and disaster risk management, planning and building codes.

The final bullet focuses on case studies, such as positive case studies of the growing number of city governments and communities that have incorporated adaptation into their plans, including those that are also looking at mitigation. Case studies are indicative of the diversity of settlement form, growth, risk, risk management practices and their outcomes for adaptation equity and sustainable development.

Chapter 7: Health, wellbeing and the changing structure of communities

- Health and wellbeing impacts, including detection and attribution
- Projected risks to health and wellbeing under alternative scenarios, including food-energy-water-health nexus
- Vulnerable populations and communities
- Adaptation options, limits to adaptation, and their social, environmental and economic implications
- Observed impacts and projected changes in migration, displacement, and trapped populations, and linkages to adaptation
- Psychological, social, and cultural dimensions
- Lessons from case studies

When assessing the scholarly literature with respect to impacts and projected risks to health and wellbeing, the terms ‘health’ and ‘wellbeing’ should be interpreted broadly. While continuing as in previous ARs to review studies emanating from the field of medical and epidemiological research authors should review relevant studies from other types of health and well-being research as well. Authors should, for example, continue to assess health impacts attributable to climate-related changes in the spatial distribution of infectious diseases, including vector-borne diseases, as well as non-infectious diseases, illnesses and conditions (e.g., heat stress, cardiovascular, respiratory & allergic diseases). In addition, authors should assess individual psychological and mental health impacts (e.g., anxiety, mourning, PTSD, cognitive skills), psychosocial impacts (e.g., aggressive behavior toward other individuals or collective responses such as civil unrest), and community and cultural integrity impacts (e.g., alteration of rituals, livelihoods, association with place, and changes to built and landscape heritages). The assessment of health and wellbeing effects attributable to climate change should include an assessment of the economic effects (including direct costs or anticipated direct costs), as well as non-monetary indirect costs (including social and environmental costs) where the literature permits.

Authors should consider both direct and indirect effects of the physical manifestations of climate change on health and well-being. Direct impacts are those caused by rapid onset climate events (extreme heat or cold, floods and other climate disasters) and by progressive climate events such as droughts and persistent dryness. Indirect impacts would include those that are a result of climate-related changes in the quality, quantity and general availability of critical resources like food, water, and air (e.g., malnutrition, gastro-intestinal illnesses, diarrhea in children, asthma),

anticipated impacts, and those that may be experienced as an indirect outcome of mitigation and adaptation activities (e.g., people displaced by reforestation or conservation initiatives). Impacts of climate change on cultural integrity that have extended consequences for health should also be assessed, effects include rituals, livelihoods, association with place, and changes to built and landscape heritages.

With respect to "vulnerable populations and communities", authors are requested to assess the peer reviewed literature that considers variations in vulnerability (to the direct and direct impacts of climate change and responses to it) across and within populations in the context of broader social and cultural wellbeing as linked to demographic characteristics including, but not limited to, age, ability, minority status, and income level. Special attention should be paid to the vulnerability of indigenous population, impoverished groups and populations, and the gender dimensions of vulnerability within groups and populations and key considerations for adaptation.
With respect to adaption options and implications, the assessments should include economic effects (including direct costs or anticipated costs) and non-monetary effects (including social and environmental costs) as the literature permits.

When assessing the observed impacts and projected changes in migration, displacement, and trapped populations attributable to climate change, authors should consider the direct and indirect linkages to adaptation, such as remittance seeking and seasonal or labour mobility as adaptation strategies, and the adaptation prospects of immobile (or 'trapped') populations. Linkages between migration and food and water security as relevant to future climate change impacts should be assessed. Authors should assess the evidence with respect to historical and current climate-migration linkages, as well as projected impacts of future climate change. Authors should assess current statistics and future projections/models of climate-related migration and displacement, the potential need for planned or organized relocations, and estimates of the associated financial and non-monetary costs (including impacts on social and cultural wellbeing of displaced populations), where literature permits. Such literature may include peer-reviewed publications as well as targeted studies commissioned by well-established multilateral agencies such as the World Bank and International Organization for Migration; authors are requested to treat with caution 'grey literature' from other sources, particularly that which is not based on a first-hand assessment of empirical data.

With respect to psychological, social, and cultural dimensions of climate change impacts and adaptations, authors are asked to assess how: a) individual and group differences in perceptions of and potentially resulting emotional responses to climate change, worldviews (e.g., values and moral principles), cultural heritage, individual resilience (e.g., future oriented thoughts and feelings, meaning-making, sense of place, social and cultural identity) and community resilience (e.g., social cohesion, social support networks, social capital and access to formal and informal health and mental health support systems) are b) associated with or alter selected coping responses (with special attention to mobility and migration) and/or associated with or alter direct and indirect effects of climate change on health and well-being . Authors are further asked to assess how the ability to adapt to climate change may be linked to the role of communications strategies regarding climate related risks and impacts, including disaster warning systems, should also be assessed.

This chapter should contain an assessment of the evidence regarding potential linkages between climate change (including its direct and indirect impacts, such as food and water scarcity) and conflict at local or regional levels, and the processes that may generate increased levels of vulnerability and undermine adaptation prospects in affected areas. Authors are encouraged to avoid bundling this assessment into chapter sections on demographic dimensions of vulnerability and adaptation or migration and mobility, and to treat 'grey literature' on this topic with considerable caution. This is a topic for which previous ARs were criticized for being internally inconsistent and for not reflecting the peer-reviewed scholarship closely enough.

Chapter 8: Poverty, livelihoods and economic development

- Detection and attribution of observed impacts and responses
- Projected climate change risks under alternative development scenarios as differentiated by economic opportunity and shifting livelihoods
- Observed and projected risks and losses and the challenges for equity and sustainability
- Adaptation options, adaptive capacity and actions, and their outcomes for resilience and transformation, focusing on low-income households and communities
- Opportunities for development including tradeoffs between adaptation and mitigation, economic diversification, equity, and sustainability
- Lessons from case studies

This chapter focuses on the ways in which differentials in wealth and poverty, livelihood fragility and economic opportunity influence risk, loss, adaptive capacity and action and their outcomes for resilience and justice. The chapter is framed by post IPCC AR5 changes in the international policy architecture including the SDGs, Sendai Framework, Paris Agreement, Addis Ababa Action Agenda, IPCC Special Reports, and other emerging opportunities.

The first bullet includes a discussion on the impacts of climate change on poverty, livelihoods and economic development, and responses to those impacts. This includes, e.g., the diversification of livelihoods in response to climate change impacts, strategies and constraints, including consideration of different economic sectors and financial services (e.g., insurance). It also includes household, community, local and national government strategies for resilience among low-income households and communities. It also considers the impacts of climate change and its management on national and sub-national political systems.

The second bullet draws on information on projected climate change risks under alternative development scenarios to understand how differentiated by economic opportunity and shifting livelihoods will influence these risks. This bullet seeks to
highlight unequal social, spatial and temporal distributions, and linkages to absolute and relative poverty, conflict, discrimination and state fragility.

The third bullet then looks at risks and losses, both observed and projected, to determine what this means for equity and sustainability including assessment of the impacts of climate change and climate change impacts and adaptation for the distribution of poverty and wealth. Loss focus is on differential and compounding effects by livelihood, poverty class and economic sector.

The fourth bullet focuses on adaptation in low-income households and communities, including options, capacity and actions, leading to resilience and transformation. The emphasis is on the decision-making space and governance for low-income households and communities.

The fifth bullet addresses opportunities for development, including trade-offs between adaptation and mitigation, economic diversification, equity, and sustainability. Trade-offs flag implications for achieving climate justice as it impacts the distribution of poverty, livelihoods and development sector.

The final bullet deals with case studies, which highlight strategies to identify and address those most at risk and living in poverty, with fragile livelihoods or economic sector, including respect for culture and identity.

THEME 2: Regions

Chapter 9: Africa [50 pages]
Chapter 10: Asia [50 pages]
Chapter 11: Australasia [30 pages]
Chapter 12: Central and South America [50 pages]
Chapter 13: Europe [40 pages]
Chapter 14: North America [40 pages]
Chapter 15: Small Islands [30 pages]

Common elements across all *regional* chapters (guidance points not an outline)

- Information on selected regional and sub-regional climate characteristics and zones
- Summary Table and/or figures with WGI and WGII information, combined with risk assessment (e.g., SREX SPM.1)
- Detection and attribution of observed impacts and responses in natural and human systems on diverse time scales
- Current sectoral climate risks, including specific regional and sub-regional considerations related to land, coasts and regional oceans
- Cultural and psychological dimensions (values, attitudes, ethical aspects, identity, behaviours)
- Observed impacts and projected risks including identifying key risks and residual risks as well as development pathways depending on rate and level of climate change, including extremes and sea level rise
- Adaptation options, from incremental to transformational, including opportunities, enablers, limits, barriers, and adaptive capacity
- Governance and economic aspects including legal, institutional, financing, price responses, and trade
- Cross sectoral, intra-regional, and inter-regional issues including consideration of temporal scale
- Interaction of risks and responses to climate change with sustainable development pathways
- Lessons from case studies

The first bullet covers provision of succinct information that will inform the reader in relation to subsequent elements covered in each regional chapter.

The second bullet is aimed at creation of a visual, integrative summary of new findings from WGII and III (since AR5) on the effect of regional changes on human and natural systems combined and assessments of risk.

The third bullet addresses the development of the evidence base for both the impacts of climate changes and the responses to these impacts across systems in each region and taking into account both contemporary and past evidence.

The fourth bullet brings together the array of existing climate risks to establish a baseline for subsequent policy-relevant assessments of the local and regional impacts of global climate change including potential nexus effects.

The fifth bullet addresses the social context (including the psychosocial, political, cultural and economic aspects) of climate-related risk for human and ecological systems in each region. Drawing from Chapter 1, it will address key issues around regional culture, (including social norms, customs and conventions, and everyday social practices); ethics and values (from moral principles to reasoning); social identity, behaviour change, or institutional memory. Discussion will draw from disciplines including, but not limited to: sociology, psychology, political science and anthropology.

The sixth bullet identifies the regionally-important climate risks now and into the future including the inherent and net or residual risks after climate adaptation has occurred.

The seventh bullet notes the fundamental importance of adaptation as both a response to reduce vulnerability and to take advantage of opportunities as part of a risk management approach that includes the implications for emission-reduction actions. Discussion will develop shared understandings of the range of climate adaptation responses from incremental (including measurable change with long term cumulative or path dependency effects) to transformative change (including non-linear, systemic or novel shifts of regime and problem approach). Elements addressed will include maladaptation, adaptive capacity, enabling conditions particularly government capacity, political will, institutional regulatory frameworks, effective communication as well as economic policy and practice from local to international scales that enable or act as barriers or limits to adaptation.

The eighth bullet includes the regionally-important and/or regionally-specific governance and economic aspects that could be influential in terms of climate impacts and adaptation including the potential for policy innovation, regulation and cross scale collaboration.

The ninth bullet brings into consideration issues where impacts or adaptation responses in one sector impact on other sectors, or in one region or part of a region impact on other regions or parts of regions.

The tenth bullet highlights the complex multiple interactions between climate change responses and sustainable development including policy trade-offs, co-benefits, possible tensions and policy and practice opportunities.

The final bullet covers the lessons that can be learnt in each region from case studies in that region.

Chapter 16: Key risks across sectors and regions

- Synthesis of observed impacts and responses, including detection and attribution
- Key risks and avoided impacts under a range of climate and development pathways, across temporal and spatial scales
- Limits to adaptation and residual risks in natural and human systems
- Reasons for Concern across scales
- Lessons from case studies at different scales, including trans-boundary risks

This chapter synthesizes the WGII sectoral and regional chapters, focusing on observed impacts and responses, key risks and avoided impacts under a range of climate and development pathways, limits to adaptation and residual risks in human and natural systems, the reasons for concern, and case studies at different scales, including transboundary risks.

The first bullet summarizes new findings on observed impacts and responses, including detection and attribution, from the perspective of what these findings mean about the ability to manage the current impacts of climate variability and change across sectors and regions. The bullet also summarizes key findings on adaptation to observed impacts, including metrics of the effectiveness of adaptation. Together, these provide insights into current climate-related risks and what recent impacts and responses mean for managing additional climate change, including path dependencies that could influence adaptive capacity.

The second bullet synthesizes key risks associated with the interaction of a range of possible future climates with a range of development pathways, identifying integrated, amplified, cascading, compound, and multi-dimensional risks at global, regional, and sub-regional scales and across temporal scales. The sub-regional scales could be covered by illustrative examples that highlight how key risks at those scales are defined by place-based values and priorities and to what extent

they are perceived as acceptable or tolerable. The time at which future temperature changes are reached, and the level and pattern of socio-ecological development, are determinants of the magnitude and pattern of possible future risks. This bullet summarizes the projected magnitude of future key risks, how they vary with the level of climate change (e.g., avoided impacts) and development pathway, and the extent to which adaptation could reduce those risks. The authors should revisit the definition of key risks used in the IPCC WGII AR5 report, to determine whether the definition should be updated based on new literature published since the AR5.

The third bullet synthesizes what has been learned since the AR5 on the limits to adaptation across temporal and spatial scales, and risks that are likely to remain after implementation of adaptation and mitigation options (e.g., residual risks). There will be locations and populations who will not be able to adapt, with the locations and populations changing over coming decades depending on the magnitude and pattern of climate change and on development choices. Adaptation will not be 100% effective in all locations across all temporal scales. Even after adaptation and iterative risk management are implemented, risks will remain. Some of these residual risks can be quantified in monetary terms while others, especially those related to culture, identity, and livelihoods, will be more intangible. If these risks are large, then they will challenge the abilities of local to national institutions and governance to prepare for and manage them.

In the fourth bullet, the judgments about risk indicated by the "Reasons for Concern" should be updated based on the synthesis of observed impacts, key risks, impacts that could be avoided by adaptation, the limits to adaptation, and residual risks, under different temperature targets and time slices and taking into account various spatial scales. The authors should also revisit the entire Reasons for Concern framework used in the IPCC WG2 AR5 report, to determine whether it should be modified based on new literature published since the AR5.

The final bullet considers case studies to highlight lessons learned with respect to key risks and intolerable risks based on place-based values and priorities, including risks crossing national boundaries.

Chapter 17: Decision-making options for managing risk

- Decision-making and governance for managing risk across multiple scales, institutions, and systems
- Drivers of decision-making: values, perceptions, differential power and influence, behaviour, and incentives
- Costs and non-monetized loss, benefits, synergies, and trade-offs, including distributional aspects and the social cost of carbon
- Lessons from case studies at different scales, including issues of governance and finance

This chapter examines decision-making and governance for managing risk across multiple scales, institutions, and systems as well as their drivers. The costs and non-monetized loss, benefits, synergies, and trade-offs, including distributional aspects and the social cost of carbon are also considered.

The first bullet examines how individuals, households, governments, non-governmental organizations, and private sector make decisions with respect to the key risks, impacts, and reasons of concern discussed in the previous chapter. This process of decision-making at multiple levels from local to global assumes inherent adaptation efforts to manage climate risk. The chapter then assesses how relevant institutions including financial entities across varying natural and human systems make decisions on risk management. Ways to enhance adaptation by identifying conditions and mechanisms to reduce risk will also be considered. Conditions refer to particular contexts that these risks occur as well as trust and performance measures with respect to governance. Mechanisms, for example, include different types of procedures, tools and measures to implement risk management and adaptation strategies. Further risk management options can

be identified. They can be assessed under different scenarios, particularly in relation to the dynamic interactions of hazard, exposure and vulnerability.

The second bullet discusses drivers of decision-making at different levels. It includes assessing different values, perceptions, differential power and influence, behavioral patterns, incentives, and disaster experience. It explores ways to generate effective, fair, and inclusive decision-making.

The third bullet assesses the economic as well as social cost inclusive of non-monetized loss and benefit of risk management strategies/measures. It also examines co-benefits and trade-offs of different risk management/adaptation options by sector and region, and the role of the social cost of carbon in decision-making. These options, measures, and strategies are also evaluated in terms of distributional issues such as equity and environmental justice.

The fourth bullet draws lessons from case studies that rely on evidence-based stories of opportunities and barriers related to climate risk management and adaptation including finances. They provide concrete examples of how individuals and organizations make decisions and what drives and governs decision-making. Illustrations of how hazard, exposure, and vulnerability interact to produce risk and affect adaptation and management currently and under different scenarios are also encouraged.

Chapter 18: Climate resilient development pathways and transformation*

- Synergies and trade-offs of sustainable development (including SDGs), adaptation and mitigation
- Strategies that strengthen resilience and reduce inequalities
- Assessing progress, including adaptation, in the context of the Global Stocktake
- Lessons from case studies at different scales

**connection to WG III*

This chapter will examine how adaptation and mitigation interact with, and can support, efforts to pursue and achieve sustainable development, and which climate and socio-economic pathways could lead to climate-resilient development and inclusive transformation. The findings of WG III (Chapter 17) should be closely examined and taken into account where relevant to ensure harmony across the reports.

The first bullet examines how sustainable development (incl. the SDGs) evolves in a changing climate, and is strengthened or challenged by adaptation, mitigation and possible geoengineering measures. This includes the extent to which sustainable development would limit climate risks. Climate risks are strongly affected by the reductions in poverty and inequalities and achievement of other SDGs, but also by adaptation and mitigation. There are benefits (avoided climate change impacts), co-benefits (for other issues) and risks from mitigation measures, as well as from adaptation (such as maladaptation). For example, mitigation from an emissions pathway leading to 3°C warming to one limiting warming to 2°C would avoid many climate risks, and some of the mitigation efforts may also reduce air pollution, enhancing human health. In addition, a particular mitigation measure such as bioenergy and carbon capture & storage may generate new risks by increasing food insecurity and triggering displacement, hence undermining options to achieve sustainable development. Similarly, geoengineering options may be used to reduce the degree of climate change and its associated risks but also generate new risks. This bullet will also examine which development pathways likely promote climate-resilience (as defined in Ch05 of the Special Report on 1.5°C Global Warming), understood as those pathways that enhance adaptation, reduce vulnerabilities and risk, and ensure equity while implementing emission reductions. This will entail examining whether such pathways could be achievable across all warming levels or are limited to those of lower levels of warming.

The second bullet identifies strategies, mechanisms, and pathways (observed and projected) that could reduce intersecting dimensions of inequality (including along the axes of gender, age, class, race, ethnicity, and (dis)ability within societies, and inequalities between countries) and enhance resilience, particularly among the most disadvantaged and vulnerable individuals and populations. Reducing inequalities is also SDG#10 and is considered a cornerstone for equitable and sustainable development. It will synthesize strategies, mechanisms, and pathways that are most conducive to facilitate inclusive social inclusiveness in societal transformation across countries of all levels of development. Enhancing resilience includes (social) learning, communication, and participation. This bullet will benefit from case studies that capture positive experiences, empowering processes, and obstacles at different scales, including at the level of households, communities, marginalized groups, and nations. These case studies may be based on what is already reflected in other chapters, or brought into this chapter based on clear criteria to be developed by the author team.

The third bullet examines metrics for assessing progress in enhancing adaptation, reducing inequalities and vulnerabilities, reducing risk, and facilitating inclusive societal transformation in the context of climate change. It also assesses adaptation finance and its effectiveness in enhancing adaptation and supporting sustainable development. This will include quantitative and qualitative indicators that are relevant for particular spatial scales and contexts. Assessing progress on these dimensions is useful for understanding the position of communities and nations on trajectories toward climate-resilient development. It also will contribute to the Global Stocktake under the Paris Agreement (a five-yearly of the impact of climate change actions undertaken by individual countries, the first to occur in 2023).

The fourth bullet highlights the usefulness of case studies for providing evidence for the above three bullets from different scales, i.e. households, communities, groups of populations, and nations. These case studies may be based on what is already reflected in other chapters, or brought into this chapter based on clear criteria to be developed by the author team. These could include success stories toward 'The Future We Want'/'Leaving No One Behind' (as specified in the Preamble of 2030 Agenda for Sustainable Development) that combine desirable pathways with equitable outcomes (from local to global), but also longer-term perspectives.

CROSS-CHAPTER BOXES

- **Antarctica**
- **Arctic**
- **Biodiversity hotspots (land, coasts and oceans)**
- **Cities by the sea**
- **Deserts and semi-arid areas**
- **Mountains**
- **Tropical forests**

The cross-chapter boxes are intended to be between 5 to 10 pages each to allow sufficient integration across chapters and/or updates of new literature since the AR6 Special Reports.

6. INCORPORATION OF CROSS-CUTTING THEMES

It was recognised that several themes would sit across WG and require "handshakes" among WG and thus formed a number of breakout groups (BOGs). Themes were regional aspects; risk and uncertainty; adaptation-mitigation interactions; cities and climate change; geoengineering; the Global Stocktake; scenarios; and processes for integration during the AR6 cycle. Summaries of the cross-cutting BOGS are given in (IPCC-XLVI/Doc. 6) and relevance for WGII and linkages to WGI and WGIII are given below, with the exception of the BOG on processes for integration which is presented in IPCC-XLVI/Doc. 6.

Regional Aspects

Regional aspects are integral to the WGII AR6 report and will require consistent treatment across all WGs which will require cross WG cooperation, including a need to better understand the different scientific cultures, and the complications of different use of language and the application of different regionalisations in AR5; climate zones in WGI and continental/ocean regionalisation in WGII. The proposed outline of WGII AR6 contains seven regional chapters (Chapters 9-15, Box 1) which will require the assessment of impacts, risks and other issues at regional and sub-regional scales. Regional considerations are also included in the remaining chapters of WGII. This will require a handshake among the regional treatment of climate information in WGI and the regional assessments of impacts and risks in WGII. To facilitate this, the cross-cutting BOG recommended regular meetings between WGI and WGII facilitated by a cross-WG Task Group. The Task Group may also require participants from WGIII. It was suggested that the transfer and assessment of data could be facilitated by via DDC / new TGICA. The inclusion of WGI expertise in the author team of the WGII regional chapters would also facilitate the handshake between WGI and WGII.

The development of a cross WGI-WGII regional Atlas with a dedicated author team was also recommended. Specifically, coordination would be necessary for mapping risk and the determinants of risk and its dynamics, including a discussion on end-to-end treatment of uncertainty and underlying data and information needs (e.g., addressing different nature and scales of data). Such an Atlas would facilitate the assessment of multi-scale impacts, e.g., cities and regions, transboundary issues.

Specific recommendations are listed below:

- Attributes of climate information (variables and processed derivatives, resolution in time and space) need to be determined by characteristics of impacted systems and regions
- Provide transparent assessment of robustness of information/observations as a team, including assessment of the principles and approaches to interpretation
- Align/harmonize information from WGI with assessment of regional literature by WGII
- Distinguish more clearly between attribution to human influence on climate and attribution to observed climate change (the former applies to climate variables while the latter applies to impacts)
- Define extreme events from the perspective of impacts

Risk and Uncertainty

The treatment of risk is central to the WGII report as highlight by the three proposed risks chapters in the WGII outline (Chapters 16-18; Box 1). WGII AR5 developed a risk framework to conceptualize risks and impacts and feedbacks to the climate system and socio-ecological systems. The cross-cutting BOG recommended adopting and elaborating the WGII AR5 definitions of risk, hazard, vulnerability and exposure, and standardising definitions and their use across WGs to present a unified concept of risk and treatment of risk in the context of uncertainty. Specifically, in the context of the risk assessment framework, coordination would be necessary across WGs for mapping risk and the determinants of risk and its dynamics, including a discussion on end-to-end treatment of uncertainty and underlying data and information needs (e.g., addressing different nature and scales of data). WGII can supply information on the distribution of potential consequences from hazards and clarity on time-scales and uncertainty.

The BOG recommended the following characteristics are considered for developing a climate risk framework:

- Assesses the knowledge base of risk, not just the risk
- Enables different degrees of quantification
- Broadens the view of risk, but still remains within IPCC boundaries
- Enables better WGI/WGII coordination to produce probabilistic information on climate events that is useful for risk calculations

- Expands on the application of risk assessment to WGIII topics, such as the risks of application of new technologies to mitigation
- Gives visibility to the human and social factors and the social impacts, especially the risks to the most vulnerable people, including ethical considerations
- Speaks to (and listens to) many stakeholders – including the business community, including finance and insurance
- Considers the flipside of risks – opportunities, and enables inclusion of solutions to climate risk problems
- Combines mitigation and adaptation measures as means of reducing risk

Adaptation-mitigation Interactions

In AR5 adaptation-mitigation interactions will be addressed in the context of sustainable development and will require interaction among WGs particularly WGII and WGIII. In WGII adaptation and mitigation are addressed in sectoral chapters (Chapters 2-8, Box 1) including impacts of mitigation and the interactions among adaptation-mitigation. Synergies and trade-offs of sustainable development, adaptation, and mitigation are assessed specifically in Chapter 18. Participants in the scoping meeting recommended the creation of cross WG task groups to deal with synergies and trade-offs between adaptation and mitigation: (i) analysis of the economic and social benefits of mitigation and adaption including avoided impacts in the context of sustainable development (the work of this group could lead to a potential joint chapter of WG II and WG III); and (ii) social aspects (e.g., geopolitical, gender, ethnic, equity) of the impacts of adaptation and mitigation in the context of sustainable development. Adaptation and mitigation responses vary at regional and local scales and understanding of impacts and feedbacks can be developed across WGs.

Cities and Climate Change

As highlighted in the WGII contribution to the AR6 Chair's Vision Document, urban areas are increasingly important in understanding impacts and risks of climate change and innovate and manage global climate risk. Cities are a cross-cutting theme with the WGII report, with a dedicated chapter (Chapter 6, Box 1) and a cross-chapter box proposed on "Cities by the sea". Thus there is a need to advance understanding of risks and develop an understanding of how adaptation and mitigation co-benefits align at sub-national levels which will require treatment across WGs. To harmonise concepts and methodological aspects, participants agreed that there should be strong coordination among the WGs on the assessment of the urban literature related to climate change. Recommendation included a cross WG Task Group. The IPCC co-sponsored Cities and Climate Change Science conference in 2018 offers a platform to focus and coordinate among WG. From a WGII perspective, the treatment of cities, from small settlements to megacities, with a focus on socio-ecological systems offers opportunity to integrate aspects related to human health, technology development, urbanization, sustainable development, and climate change adaptation and mitigation across WGs.

Geoengineering

The cross cutting BOG highlighted the need to consistency in definitions and terminology of geoengineering across WGs and defining the categories within the term (e.g., carbon dioxide removal (CDR) and solar radiation management (SRM). The treatment of geoengineering is primarily a WGI-WGIII interaction, will require coordination with WGII for aspects such as impacts and feedbacks from geoengineering consequences on permafrost, carbon cycle, land use and change and blue carbon in the context of adaptation and mitigation impacts and interactions. Issues such as the social acceptability, governance and risks of geoengineering will involve WGII.

Global Stocktake

As highlighted in the Chairman's Vision Document, the AR6 is intended to align with the requirements of the Global Stocktake (GST). The treatment mitigation, adaptation and financing and support should be considered across WGs to provide inform relevant for the GST. Of particular relevance for WGII is assessment of guidance and development of metrics for adaptation

progress across scales, and assessment of adaptation needs and costs, risks and vulnerability and past and future adaptation policy options. The interactions among adaptation needs and limits and mitigation efforts will require coordination across WGII and WGIII.

Scenarios

The scenario cross-cutting BOG highlighted the necessity of integrating and coordinating across WGs to facilitate cross-WG communication, avoid redundancy and facilitate the WG assessments and recommendations. Integration among WGI and WGII would benefit from consistency in model projections and elements e.g., CMIP and SSPs, treatment of uncertainty, temperature levels assessed, baselines, regions.

The cross-cutting BOG recommendations include:

- Identification of a common set of scenarios across WGs
- Development of a consistent set of indicators to use across WGs
- Development of a guidance document on scenarios and their uses
- Creation of a cross-WG scenario team.

From a WGII perspective, recommendations included being explicit about the use of scenarios in chapters and include scenario approaches in framing chapter, and ensure coordination across chapters.

7. LINKAGES ACROSS THE AR6 SPECIAL REPORTS

The proposed content of the Special Reports was taken into account during scoping of the WGII contribution to the IPCC Sixth Assessment Report (WGII AR6). The proposed structure of the WGII AR6 allows for links to the Special Reports and an update of key issues assessed in the Special Reports.

The Special Report on Oceans and Cryosphere in a Changing Climate (SROCC, due September 2019) includes a chapter dedicated to *High Mountain Areas* and one on *Polar Regions*. Therefore, cross-chapter boxes on the *Arctic*, *Antarctica* and *Mountains* of between 5-10 pages each, have been included in the proposed WGII AR6 outline for such an update. Similarly, the Special Report on Climate Change and Land (SRCCL, due September 2019) includes a chapter of Desertification and space has been made to update findings in the WGII AR6 in a cross-chapter box on *Deserts and Semi-Arid Regions* of approximately 5 pages. Interactions among climate change land use change and land cover are also addressed in SRCCL, and therefore opportunity to update findings is available in the proposed cross-chapter box on *Tropical Forests*. Impacts and risks to freshwater, marine and terrestrial biodiversity is considered across all three Special Reports to some degree and findings will be updated in the cross-chapter box on *Biodiversity hotspots*.

Risks, vulnerabilities and adaptation from sea level rise are addressed in Special Report of Global Warming of 1.5°C (SR1.5, due September 2018) and at global to regional scales in SROCC, including implications for Small Island Developing States, coastal cities and infrastructure, deltas and low-elevation areas. The proposed structure of WGII AR6 keeps the focus on sea level rise issues with observed impacts and projected risks from sea level rise identified as a common element across all regional chapters and in a cross-chapter box of around 10 pages on *Cities by the Sea*. Similarly, linkages among adaptation and mitigation efforts and Sustainable Development pathways are addressed specifically in SR1.5 and regional perspectives will be updated in the WGII AR6 regional chapters.

ANNEX I: REPORT ON THE SELECTION PROCESS FOR THE WORKING GROUP II CONTRIBUTION TO THE AR6 SCOPING MEETING

AI.1 Nominations Received

Following the close of nominations, the full list was divided into three– one for each WG – according to the areas of expertise indicated by each nominee. Nominations may thus fall into more than one WG. For the 778 experts (after removing duplicates) indicating expertise in an area of WGII, the WGII Technical Support Unit compiled those nominations and prepared overview statistics of the nominations. Of the 778 nominations, based on the citizenship provided 55% of nominated experts were from developed countries and 45% were from developing countries or countries with economies in transition. The majority were from Europe (33%) with least nominations from Africa (10%) and South America (9%). 71% were male and 29% female. 31% has previous IPCC experience, defined as a role as a Coordinating Lead Author, Lead Author or Review Editor in an IPCC Report, and 69% had no IPCC experience.

AI.2 Construction of the Short List

Each WGII Bureau Member was asked to follow a 'ranking' process, focusing on the selection of a core set of participants for the scoping of the WGII contribution to the AR6, based on their own area of expertise, providing a regional perspective on nominees, and considering all criteria as stated in Appendix A of Principles Governing IPCC Work. Each WGII Bureau Member was asked to consider the nominations carefully and provide up to ten '1' rankings, which indicates a 'high priority', and up to fifteen '2' rankings, which indicates a 'secondary priority'. It should be noted that there was purposely no '3' or 'low priority' as the intention was not to produce a hierarchical ranking, but rather a focused identification of key individuals that would address the criteria of the scoping process.

The ranking process applied has been previously used in selection processes as a way to identify gaps and agreement across the selection undertaken by WG Bureau Members. In addition to the individual ranking, each Member also provided comments, where relevant, to give additional details not captured in the nomination process that would be useful to consider during the next stage of the selection process.

A1.3 Construction of Core List

All input (rankings and comments) received from the WGII Bureau Members was compiled to build a short list. A score was calculated for each nominee by converting a rank of '1' to 2 points and a rank of '2' to 1 point and summing the total points received from the WGII Bureau Members selections. Thus, the nominations considered highest priority received the highest scores. From this step, 189 nominees received a ranking, with 69 receiving a score of 2, 16 received a score of 3, and 13 received a score of 4 or higher.

For the next phase of the selection process, the 13 highest rankings were used to define the first pass core list of participants. The 189 ranked nominees were sorted by score and the sorted short list returned to the WGII Bureau, with the core list identified, and overview statistics of the short list were also supplied. Each WGII Bureau Member was asked to select two additional experts from the short list to build-up the core list. At this stage, WGII Bureau Members were also informed of the ability to submit additional nominations in the event that key gaps were identified. A further 9 experts were nominated by WGII Bureau Members.

This step resulted in the core list increasing from 13 to 32 nominees. WGII Bureau Members submitted a number of comments and suggestions to identify experts to ensure appropriate coverage of the areas of expertise, broaden geographic representation and increase both gender balance and experts with and without previous IPCC experience. Two WGII Bureau

teleconferences were held to refine the final core list as well as to identify a further list of experts that are cross-cutting across Working Groups. A proposed final list of 40 core and 20 cross-cutting experts were agreed, along with a listing of reserve experts. The proposed final list was circulated among all WGII Bureau Members along with overview statistics.

A1.4 Construction of the Final List

The three WG lists were compiled and a cross-WG Co-Chair teleconference was held to address any overlaps and finalise the list. The final list was then circulated to the full IPCC Bureau for agreement. The IPCC Bureau agreed the final list on 22 February 2017 and invitations were extended to the 60 experts by the IPCC Secretariat on 3 March 2017. In response to 13 regrets received, an additional of 13 experts from the reserve list were invited resulting in 73 invitations issued in total. Of the total 73 invited, 52% were from developed countries and 48% were from developing countries or countries with economies in transition (Figure 1). The majority were from Europe (27%) with least from Africa (12%) and South America (11%; Figure 2). 60% were male and 40% female (Figure 3). 60% has previous IPCC experience and 40% had no IPCC experience (Figure 4).

A1.5 Participant List

Of the 73 experts invited, 52 attended the AR6 Scoping Meeting, together with 7 WGII Bureau Members, giving a total of 59 participants to support the scoping of the WGII contribution (Annex I). Of these, 49% were from developed countries and 51% were from developing countries and countries with economies in transition (Figure 1). The majority were from Europe (32%) with least from South-west Pacific (10%) and South America (10%; Figure 2). 69% were male and 31% female (Figure 3). 68% has previous IPCC experience and 32% had no IPCC experience (Figure 4).

The final balances for developed / developing and economies in transition (by citizenship), geographic region (by citizenship) and gender generally reflect the balances in the nominations albeit with some slight improvement (Figures AI.1–4). Table AI.1 provides a breakdown of participants by country.

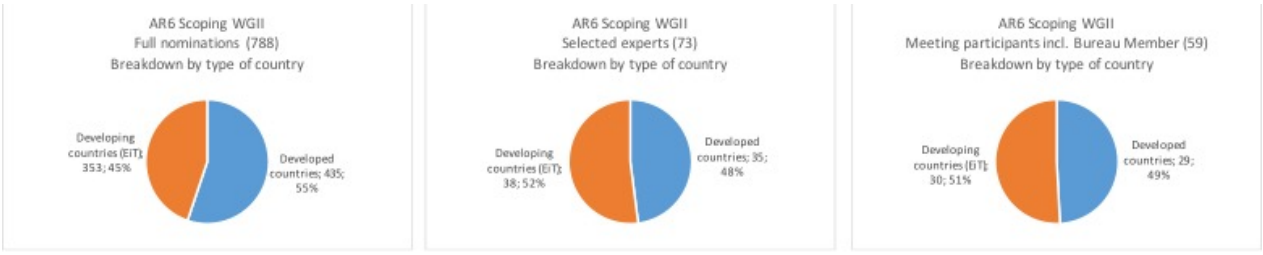

Figure AI.1: Balance in developing countries/countries with economies in transition vs. developed countries (based on citizenship only) in the full list, invited expert list and attendance list from the AR6 WGII Scoping Meeting.

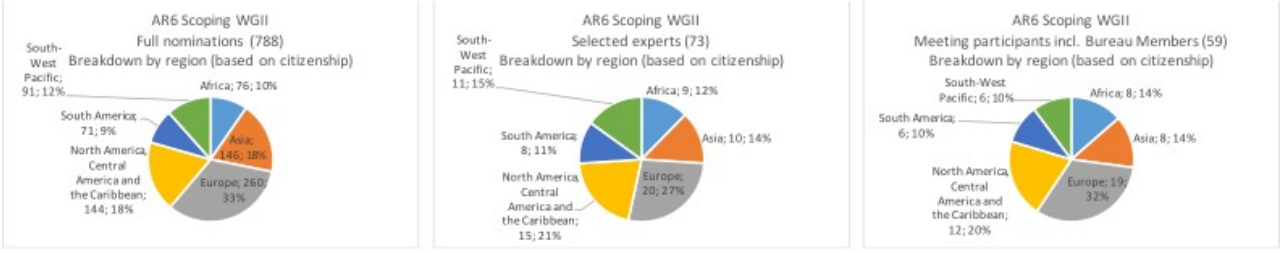

Figure AI.2: Distribution across WMO regions (based on citizenship only) in the full list, invited expert list and attendance list from the AR6 WGII Scoping Meeting

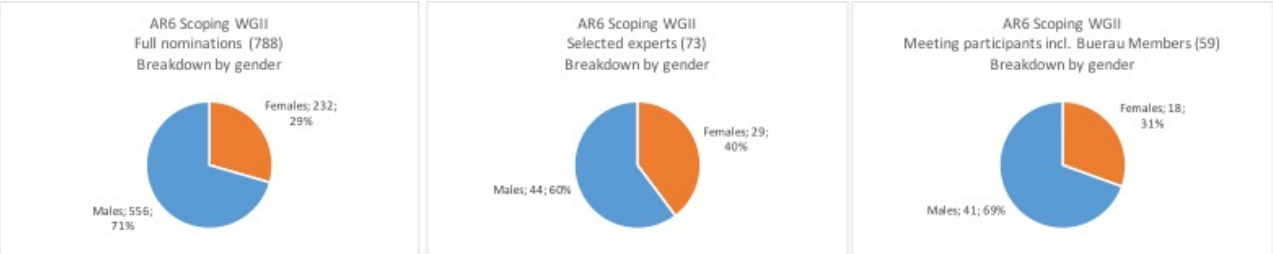

Figure AI.3: Gender balance in the full list, invited expert list and attendance list from the AR6 WGII Scoping Meeting

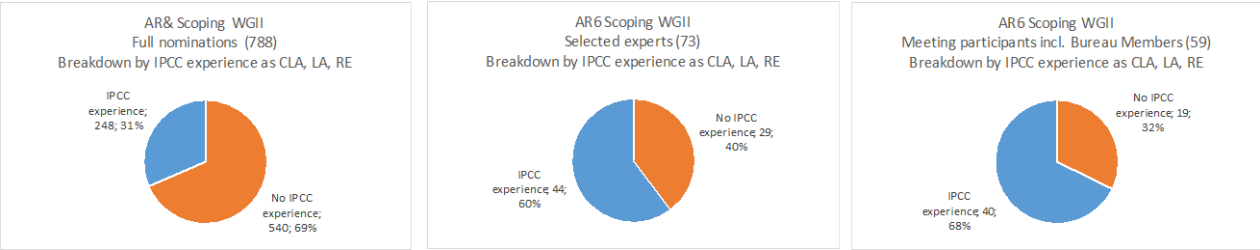

Figure AI.4: IPCC experience, defined as a Coordinating Lead Author (CLA), Lead Author (LA) or Review Editor (RE) role in previous IPCC assessment and special reports, in the full list, invited expert list and attendance list from the AR6 WGII Scoping Meeting

Table AI.1: Country distribution of participants (based on citizenship) in the full list, invited expert list and attendance list from the scoping meeting

Country	**Full Nominations (788)**	**Selected Experts (73)**	**Meeting Participants including WGII Bureau Members (59)**
Argentina	11	1	-
Australia	45	4	3
Austria	5	1	1
Bangladesh	4	-	-
Belgium	5	-	-
Bosnia and Herzegovina	2	-	-
Brazil	42	3	1
Burkina Faso	2	-	-
Canada	17	1	1
Chile	9	2	2
China	33	2	1
Costa Rica	1	-	-
Cuba	6	1	1
Cyprus	1	-	-
Czech Republic	5	-	-
Denmark	3	-	-
Ecuador	4	1	1
Egypt	4	1	1
Finland	3	-	-
France	19	-	-

Germany	55	7	7
Ghana	3	1	1
Greece	3	-	-
Guatemala	1	1	1
Hungary	1	-	-
India	30	2	1
Indonesia	25	-	-
Iran	3	1	1
Ireland	5	-	-
Israel	6	-	-
Italy	26	2	1
Jamaica	2	1	1
Japan	16	1	1
Jordan	4	-	-
Kenya	6	1	-
Malaysia	2	1	1
Maldives	1	1	1
Mauritius	3	-	-
Mexico	5	1	1
Morocco	8	-	-
Myanmar	4	-	-
Nepal	6	-	-
Netherlands	7	1	1
New Zealand	8	2	1
Niger	1	-	-
Nigeria	4	-	-
Norway	5	1	-
Pakistan	4	-	-
Peru	1	-	-
Philippines	7	2	-
Portugal	1	-	-
Republic of Korea	12	1	1
Romania	4	-	-
Russian Federation	8	3	3
Rwanda	1	-	-
Saint Kitts and Nevis	1	-	-
Senegal	10	-	-
Singapore	3	1	1
Slovakia	1	-	-
Slovenia	2	-	-
Solomon Islands	1	-	-
South Africa	7	4	4
Spain	6	2	1
Sudan	6	1	1
Sweden	8	1	1
Switzerland	12	-	1
Thailand	16	1	1
Togo	1	-	-
Trinidad and Tobago	1	-	-
Turkey	5	-	-

Uganda	1	-	-
Ukraine	11	-	-
United Kingdom (of Great Britain and Northern Ireland)	57	4	3
United Republic of Tanzania	18	2	2
United States of America	110	9	7
Venezuela	4	1	2
Vietnam	6	-	-
Zimbabwe	2	-	-

ANNEX II: WGII CONTRIBUTION TO THE AR6 SCOPING MEETING PARTICIPANT LIST

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ANNEX III: WGII CONTRIBUTION TO THE AR6 SCOPING MEETING PROGRAMME

Day 1: Monday, 1 May 2017

09:00	PLENARY (Main CR 2)	
09:00	Opening Ceremony	
09:45	Informal Q&A for Participants New to the IPCC	IPCC Vice-Chairs, Co-Chairs, Secretary
10:15	Break	
10:45	AR6 Vision and Meeting Objectives - Presentation of AR6 vision - Expectations expressed by governments -Expected results of this meeting: 3 WG report outlines + vision for SYR	IPCC Chair
11:00	Working Group Visions	
11:00	WGI	WGI Co-Chairs
11:25	WGII	WGII Co-Chairs
11:50	WGIII	WGIII Co-Chairs
12:15	Synthesis Report and Cross-Cutting Issues	Ko Barrett
12:30	Role and structure of the meeting - How this meeting feeds into IPCC work flow for the AR6 cycle - The scoping process: week will proceed using plenary session, BOGS, etc.	IPCC Chair
12:45	Information on Afternoon Session and Room Allocation	Secretariat
13:00	Lunch break	
14:30	**WGII Plenary 1** (Room CR 5)	**Co-Chairs: Hans-Otto Pörtner, Debra Roberts Facilitator: Melinda Tignor**
14:30	**Welcome from Co-Chairs and Introduction to WGII Sessions**	**Hans-Otto Pörtner, Debra Roberts**
14:40	**Scene-setting Presentations:**	
14:40	***Terrestrial Ecosystems***	**Guy Midgley**
14:50	***Marine Ecosystems***	**Anne Hollowed**
15:00	***Human Systems and Climate Change: Established, Maturing and Emerging Themes***	**David Dodman**
15:10	***Adaptation Decision-making: Needs, Options and Limits***	**Bronwyn Haywood**
15:20	***Adaptation Decision-making***	**Aromar Revi**

15:30	**Clarification Questions and Discussion**	**Hans-Otto Pörtner**
15:50	**WGII BOG Session 1 Introduction + Clarification Questions**	**Elvira Poloczanska**
16:00	Coffee break	
16:30	**WGII BOG Session 1** **WGII BOGs 1A-1D** (Rooms CR 5, SBR, CC1, CC2) Aim: First step to brainstorm on themes for AR6 **WGII BOG1-A WGII BOG1-B WGII BOG1-C WGII BOG1-D**	**Facilitator: WGII Bureau Members** **Rapporteur: Selected from Experts**
17:30	**WGII Plenary 2** (Room CR 5) BOG Report back and discussion on themes	**Chair: Hans-Otto Pörtner** **Facilitator: Melinda Tignor**
18:30	End of Day 1	

Day 2: Tuesday, 2 May 2017

08:30	Informal Q&A for Participants New to the IPCC (CR2)	IPCC Vice-Chairs, Co-Chairs, Secretary
09:00	**WGII Plenary 3** (Room CR 5) **Scene-setting Presentations:**	**Chair: Debra Roberts** **Facilitator: Elvira Poloczanska**
09:00	***Multi-sector Impacts, Risks, Vulnerabilities, Opportunities and Challenges***	**So-Min Cheong**
09:10	***Multi-sector Impacts, Risks, Vulnerabilities, Opportunities and Challenges***	**Neil Adger**
09:20	***Palaeontological and Historical Records of Climate Change Impacts***	**Wolfgang Kiessling**
09:30	***What Archaeology can bring to the IPCC***	**Timothy Kohler**
09:40	**Clarification Questions and Discussion**	**Debra Roberts**
09:50	**WGII BOG Session 2 Introduction + Clarification Questions**	**Jan Petzold**
10:30	Coffee Break	
10:00	**WGII BOG Session 2** **WGII BOGs 2A-2D** (Rooms CR 5, SBR, CC1, CC2) Aim: Develop bullet points for content each theme and collect initial thoughts on chapters (i.e., grouping of content) and chapter titles. **WGII BOG2-A WGII BOG2-B WGII BOG2-C WGII BOG2-D**	**Chair: WGII Bureau Members** **Rapporteur: Selected from Experts**
11:00	**BOG Session 2 Stocktaking** (CR 5)	

12:30	Lunch	
13:30	Q&A on SYR - Lessons Learnt from AR5.	
14:00	**WGII BOG Session 2 (continued)**	
16:00	**WGII Plenary 4** (Room CR 5) Each BOG reports back	**Chair: Hans-Otto Pörtner** **Facilitator: Melinda Tignor**
16:30	PLENARY – All WGs (Main CR 2) Each WG reports back on issues cross-cutting WGs	
18:00	End of Day 2	
19:00	Reception	

Day 3 Wednesday, 3 May 2017

09:00	PLENARY – All WGs (CR 2) Report back on the content of the WG discussions - SSC is to report back on decisions regarding cross-cutting BOGs, and outline the plan for Day 3	
10:15	Coffee Break	
10:45	Cross-cutting BOGs	
12:15	Lunch	
13:45	Cross-cutting BOGs	
15:15	Coffee Break	
15:45	**WGII Plenary 5** (Room CR 5) Discussion: How the cross-cutting themes identified in the BOGs earlier in the day can be accommodated by WGII	**Chair: Debra Roberts** **Facilitator: Melinda Tignor**
16:30	**WGII BOG Session 2 (continued)**	
18:00	**WGII BOG2 Stocktaking** (CR5)	
18:30	Dinner Break	
19:00	Evening Session Brainstorm on SYR storyline	
20:00	WGII Bureau Meeting	

Day 4: Thursday, 4 May 2017

09:00	**WGII Plenary 6** (Room CR 5) Recap on emerging themes and proposed WGII chapter titles and content	**Chair: Hans-Otto Pörtner** **Facilitator: Elvira Poloczanska**
09:30	**WGII BOGs Continued (+SYR BOG)** **WGII BOGs A-D + CONTEXT** (Rooms CR 5, SBR, CC1, CC2) Aim: Develop bullet points for each chapter. **WGII BOG-A SBR** **WGII BOG-B&C CR5** **WGII BOG D CC2** **WGII BOG CONTEXT CC1**	**Chair: WGII Bureau Members** **Rapporteur: Selected from Experts**
10:30	Coffee Break	
11:00	**WGII BOGs Continued (+SYR BOG)**	
12:30	**Stocktaking** (CR 5)	
13:00	Lunch	
14:00	**WGII Plenary 7 (+SYR BOG)** (Room CR 5) Brief discussion on next steps	**Chair: Debra Roberts** **Facilitator: Melinda Tignor**
14:30	**WGII BOGs Continued (+SYR BOG)** All BOGs return final slides by 18:00	
16:00	Coffee Break	
16:30	PLENARY – ALL WGs (CR 2) Stocktaking Report back from SYR Session	
18:00	End of Day 4	

Day 5: Friday, 5 May 2017

09:00	**WGII Plenary 8** (Room CR 5) Overview of WGII outline (including chapter bullets) Discussion	**Co-Chairs: Hans-Otto Pörtner, Debra Roberts** **Facilitator: Elvira Poloczanska** **Editor: Melinda Tignor**
10:30	Coffee Break	
11:00	**WGII Plenary 8 (continued)** Agree outlines (including bullets)	
12:20	**Closing by Co-Chairs**	**Hans-Otto Pörtner, Debra Roberts**
12:30	Lunch	
14:00	CONCLUDING PLENARY – ALL WGs (Main CR 2) - Draft outlines for WG Reports - Preliminary vision for SYR - Suggestions for guidance notes	IPCC Chair/IPCC Vice-Chairs/IPCC Co-Chairs
17:30	End of the Meeting	