

IPCC WGII FIFTH ASSESSMENT REPORT (AR5): EXPANDING THE SOLUTION SPACE FOR ADAPTATION

Elisa Sainz de Murieta, Marc B Neumann, Anil Markandya

Introduction

Working Group II of the United Nations Intergovernmental Panel on Climate Change (IPCC) has published its latest report titled *Climate Change 2014: Impacts, Adaptation, and Vulnerability* on 31 March 2014 [www.ipcc.ch]. It is the Second Volume of the 5th edition of the Assessment Report (WGII AR5). It follows the recent publication of the First Volume which covers the physical science basis of climate change (WGI AR5) and is succeeded by the Third Volume which addresses mitigation of climate change (WGIII AR5).

The report consists of 30 chapters analysing impacts and adaptation across different sectors and regions. The report starts out by stating that there is strong evidence that climate change is already affecting ecosystems and humans systems. Also, improved understanding on the high sensitivity of these systems to regime shifts in climate and to extreme weather events has been gained in recent years.

Adaptation has become the centre of attention in both climate change research as well as policy. This is due both to responses to recent extreme climatic events, and the realisation that if the mitigation efforts continue to be modest then significant anthropogenic climate change can be expected for the 21st century.

Recent extreme climatic events such as heat waves, droughts, floods and wildfires have shown significant exposure and vulnerability of human systems. By revealing adaptation deficits these recent events have given indications to societies on how to plan for adaptation in a future world where the frequency of such

Key Points

- *The IPCC Report shows increasing confidence of current impacts of anthropogenic climate change, including migration of species in oceans and diminishing crop yields.*
- *Adaptation is widely occurring and has become the central focus for dealing with climate change. If done in an effective way, taking account of the wide range of options and opportunities it offers a positive prospect to addressing the climate challenge.*
- *The scope for adaptation can be significantly widened by emphasising the important contributions of exposure and vulnerability as opposed to focusing on hazards when facing climate risks.*
- *Mainstreaming adaptation into other domains of public action such as sustainable development or poverty alleviation while identifying synergistic low-regret options leads to an even larger solution space.*
- *As there are limits to adaptation stronger mitigation efforts are required to prevent the occurrence of irreversible impacts and the crossing of tipping points .*

IPCC WGII Report in numbers

- **243 lead authors and 66 review editors from 70 countries**
- **436 contributing authors from 54 countries**
- **Over 12,000 scientific references cited**
- **More than 50,000 comments**
- **1729 expert reviewers from 84 countries**

events is expected to considerably increase in many regions.

All findings in the report are accompanied by stating the degree of confidence as a combined measure of amount of evidence and the degree of agreement.

Hazards, vulnerability and exposure as determinants of risk

The report emphasises that when dealing with climate risks it is not sufficient to address only hazards such as heat waves, flooding and droughts. Far more, risk arises through the superposition of hazards, exposures and vulnerabilities (Fig. 1).

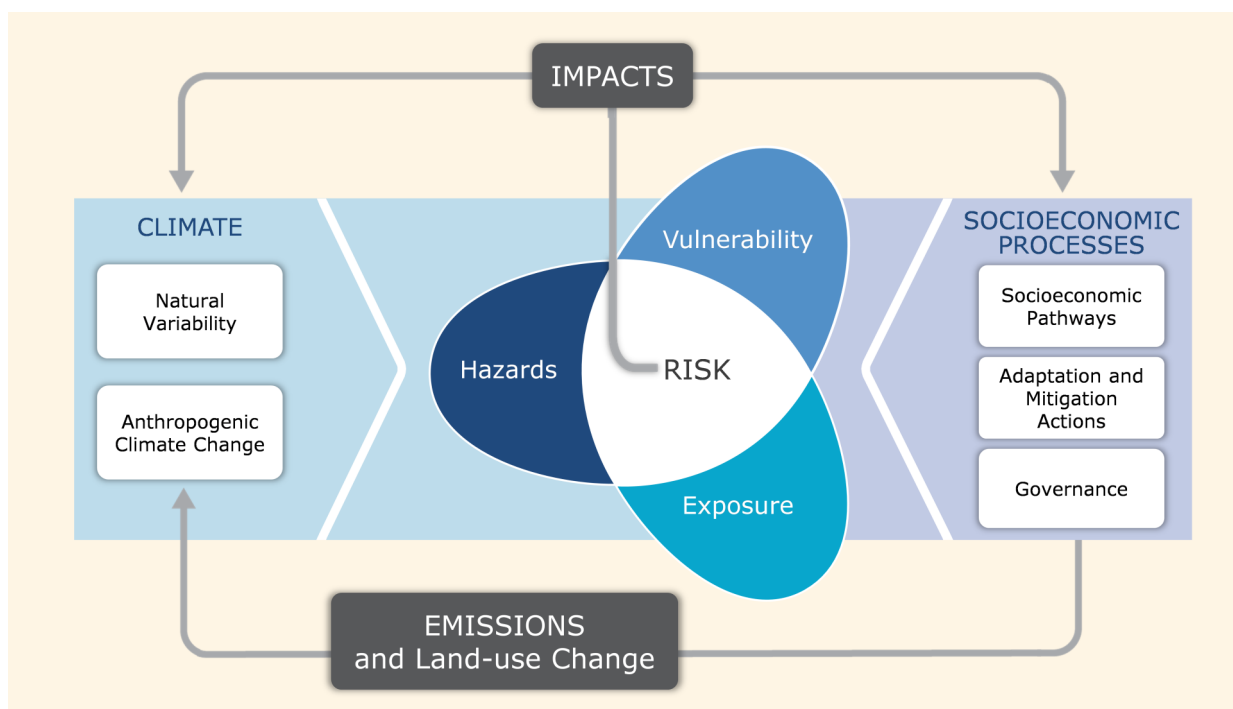


Fig. 1 Climate-related hazards, exposure, and vulnerability interact to produce risk. Changes in both the climate system (left) and socioeconomic processes including adaptation and mitigation (right) are drivers of hazards, exposure, and vulnerability [source: WGII AR5 2014, Technical Report, Figure TS.1].

“Why should the world pay attention to this report? We have assessed impacts as they are happening, impacts on natural and human systems, on all continents and oceans. I would like to emphasise that in view of these impacts and those that we have projected for the future, nobody on this planet is going to be untouched.”

R. Pachauri (Chairman of the IPCC)¹

For example, overall flood risk is determined by changes in hazards (more frequent and more intense flooding events), exposure (population growth in flood plains) and vulnerability (people living in informal settlements at increased levels of poverty). Such a perspective significantly widens the scope for interventions reducing the focus on just providing solutions to combat the physical impacts. Actions and measures that reduce exposure and increase resilience of societies and individuals are stressed throughout the report. As marginalised societies and individuals are typically more vulnerable to climate risks addressing inequality itself becomes an adaptation action.

Current impacts of anthropogenic climate change and current adaptation

The report states that there is significant evidence that human systems and ecosystems are currently already being affected by anthropogenic climate change [see Box 1]. At the same time many non-climatic stressors interact with climate change impacts. For example, increased water demand due to population growth increases drought risk or deforestation decreases water retention capacity of river basins which in turn increases flood risk. Anthropogenic climate change amplifies these non-climatic stressors.

(1) Quote from the Press Conference given to present the IPCC WGII Report at Yokohama, Japan, 31 March 2014.

Since the last IPCC AR4 report, adaptation has evolved from a phase of awareness to a phase of planning and implementation. Observed adaptation is happening in very diverse and heterogeneous ways. This is because impacts differ geographically and because adaptation is highly context specific due to the knowledge, information, awareness, objectives and risk perceptions, which can strongly vary between countries, regions and cultures.

The decision making context

The report suggests that iterative risk management is a useful framework for decision making in view of the large potential consequences, persistent uncertainties, long time frames, potential for learning and multiple influences changing over time such as

BOX 1: OBSERVED IMPACTS OF CLIMATE CHANGE

- *Almost all **glaciers** world-wide have continued to shrink since AR4, affecting runoff and therefore water resources and availability downstream as well as sea level rise.*
- *Warming has caused migration in many terrestrial **species** and shifts in the abundance and geographic distribution marine species, with threats to ecosystems and food security.*
- ***Crop yields**, such as wheat and maize, have been impacted negatively especially in low latitudes. This is affecting and will affect food security and local livelihoods.*
- ***Extreme events** like flooding and heat waves have affected infrastructures and human health.*
- ***Economic losses**, especially due to extreme weather events, have multiplied globally.*

climatic and non-climatic stressors.

Despite the considerable uncertainties involved, there is high confidence that mitigation and adaptation options adopted in the short term will determine the extent of the impacts of climate change, particularly during the second half of the 21st century, when differences between emission scenarios lead to large divergence of expected impacts (see Figure 2).

In this context, climate and socioeconomic scenarios are viewed as useful tools, as climate change risks vary greatly across different development pathways, and at the same time socioeconomic scenarios can change among regions, sectors and time periods. Besides working with scenarios, considering flexible adaptation options may also play an important role, as they allow adjusting to impacts that are either more or less severe than predicted.

“We are at the point where we have so much information, so much evidence we can no longer plead ignorance. (...) Ignorance is no longer a good excuse. We know. Therefore, we have the information to make decisions and to act.”

Michel Jarraud (Secretary-General WMO)²

Future risks

The report analyses future risks (also limited potential benefits, especially affecting regions at high latitudes) across sectors and countries, but also the interrelation among climate risks and other anthropogenic stressors, such as land-use change, poverty, inequality, pollution, etc.

(2) Quote from the Press Conference given to present the IPCC WGII Report at Yokohama, Japan, 31 March 2014 .

(3) RCPs (Representative Concentration Pathways) are a new set of future climate scenarios. The four pathways are independent and have been developed by four individual modelling groups. The numbers represent the radiative forcing levels (global energy imbalances) by the year 2100: very low (RCP2.6), medium (RCP4.5 and RCP6) and very high (RCP8.5). (Source: IIASA – RCP Database and van Vuuren et al., 2011) .

Future risks are assessed under two emission scenarios³: the low emission scenario (RCP2.6) represents a world in which global temperature stays at 2°C above preindustrial levels. The high emission scenario (RCP8.5) implies a temperature increase of 4°C over that of the reference period. In the near term, up to 2040 approximately, both pathways are close to each other and significant differences are not expected among them (Figure 2, left panel). In fact, the report states that during this period non-climate anthropogenic stressors will be dominating. However, during the second half of the 21st century the two emission scenarios strongly diverge. In this case, the high emission scenario may lead to dramatic consequences, extensive impacts on natural and

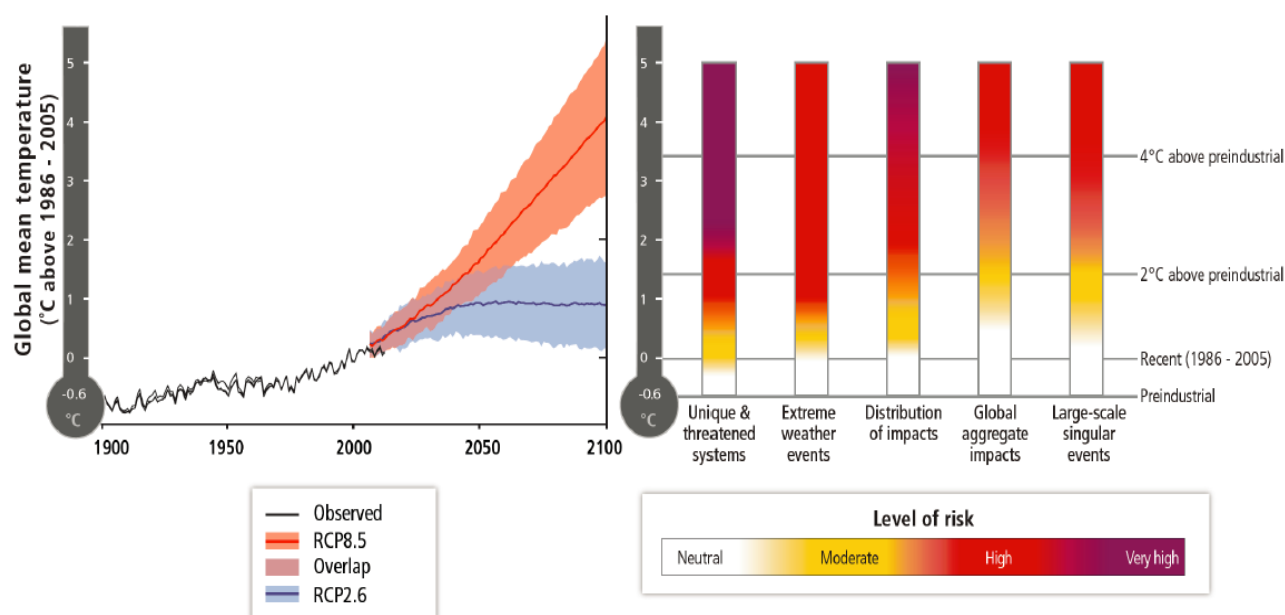


FIGURE 2. (Left) Observed and simulated variations in past and projected future global annual average temperature relative to 1986-2005. (Right) The dependence of risks associated with reasons for concern (RFC) on the level of climate change, updated based on assessment of the literature and expert judgments. Purple shading, introduced in this assessment, indicates very high risk of severe impacts and the presence of significant irreversibilities combined with limited adaptive capacity [source: WGII AR5 2014, Technical Report, TS. 5 Figure 1].

BOX 2: SUMMARY OF RISKS ACROSS SECTORS AND REGIONS: FIVE REASONS FOR CONCERN

- 1. Unique and threatened systems** are a wide range of physical, biological and human systems that are restricted to relatively narrow geographical ranges and are threatened by future changes in climate. E.g. polar human and natural systems, coral reefs, unique alpine ecosystems and species.
- 2. Extreme weather events:** there is medium confidence that risks associated with coastal and river flooding, heat waves, cyclones, droughts and other extreme events will increase with increasing global temperatures.
- 3. Distribution impacts:** impacts will not be equally distributed among regions, nations or time. Unfortunately, the most vulnerable areas and people are often the most exposed and developing countries which have contributed less to climate change will suffer most from its impact. However, this unequal distribution not only happens at the international level: the most vulnerable groups and sectors of developed country are also at stake.
- 4. Global aggregate impacts** include risks that are aggregated globally into a single metric, such as monetary damages, lives or species or ecosystems lost. Moderate risks to the global economy and biodiversity have been estimated for a temperature increase of 1-2°C. Risks are high if temperature increases beyond 3°C (low agreement for risks on the economy and high confidence on biodiversity).
- 5. Large-scale singular events** are abrupt and drastic changes in physical, ecological, or social systems in response to smooth variations in driving forces. The precise level of climate change needed to cross critical thresholds or tipping points remains uncertain, but a temperature increase between 1°C and 4°C implies a high risk of crossing tipping points. An example of this large scale singular event is the deglaciation of the Greenland ice-sheet, which could cause up to 7m of sea-level rise during the next centuries and millennia.

socioeconomic systems, as well as possible crossing of tipping points. The report clearly states that increasing the magnitude of global warming, will increase the likelihood of severe and irreversible impacts.

A summary of future risks across sectors and regions is provided grouped into five reasons for concern (RFCs) (Figure 2, right panel). First introduced in the IPCC TAR, they represent risks that are determined by both climate-related hazards and the vulnerability and exposure of social and ecological systems to climate change stressors (see Box 2).

Nevertheless, it is emphasised throughout the report how the overall risk of climate change will depend largely on the mitigation and adaptation actions to be adopted in the near term. The report stresses that today's mitigation efforts will define the severity of climatic pressures we will be dealing with during the second half of the 21st century. Mitigation cannot only reduce the overall warming, but also the rate at which it occurs. Furthermore, it provides extra time for adaptation. It is also important to underline that even if adaptation is extensively mainstreamed into planning and implementation, it will not be enough to cope with all climate change effects, and residual damages are expected in any case. This is due to both biophysical and socioeconomic limits of adaptation: some adaptation options will simply be too costly or resource intensive or will be cost-ineffective until climate change effects grow to merit investment costs.

“There's no doubt that there's a lot of cause for concern in the report, about what we can expect in terms of impacts around the world. But there's also a lot in it about what we can do in terms of generating solutions. I think that's the big difference compared to past reports. In this one, we know a lot more about what you might call the “solution space” — about where adaptation works, where mitigation works and how they can work together.”

Chris Field (IPCC WGII Co-Chair)⁴

Opportunities for adaptation: expanding the “solution space”

Most of current adaptation efforts are based on infrastructural or technical measures, even though there is increasing evidence of other options being implemented, such as ecosystem-based, institutional or social adaptation. Within structural or physical adaptation, ecosystem-based measures like wetland or mangrove restoration for flood protection are being progressively used.

In fact, not all adaptation options require direct investments. Institutional actions, e.g. research and development funding, environmental regulation or economic instruments, are

valuable adaptation tools. Economic instruments have high potential as flexible tools because they directly and indirectly provide incentives for anticipating and reducing impacts in efficient ways. There is also another group of adaptation alternatives related to information, education, raising awareness and behavioural change.

The report stresses the importance of potential synergies between adaptation and development, as the latter contributes to reduce vulnerability through improved health care access, education or poverty alleviation. Finally, changes in paradigms and transformation of political, economic and social systems to overcome and facilitate adaptation limits mitigation efforts.

Table 1 gives an overview over a wide range of adaptation options and shows how these are complemented by development and transformational change of societies and



Zarautz, February 2014 (Lorena Lopez de Lacalle).

overview over a adaptation options these are in human planning, change of mitigation efforts .

(4) Quote from the interview given to Bloomberg BNA Climate Blog (<http://www.bna.com/qa-ipcc-official-b17179889363/>).

Entry points	Category	Examples of measures
Development and planning	Human development	Improved access to education, nutrition, health facilities, energy
	Poverty alleviation	Insurance schemes, social safety nets and social protection; disaster risk reduction; improved access to and control of local resources, land tenure, and storage facilities.
	Livelihood security	Income-, asset- and livelihood diversification, access to technology...
	Disaster risk management	Early warning systems, hazard and vulnerability mapping...
	Ecosystem management	Maintaining wetlands, urban green spaces, maintenance of genetic diversity;
	Spatial or land-use planning	Managing development in flood prone areas, provisioning of adequate housing, infrastructure and services...
Adaptation	Structural/physical	Engineered & built-environment options: sea-walls, flood levees; water storage; improved drainage; building codes; storm- and waste-water management
		Technological options: new crop varieties, efficient irrigation, hazard mapping and monitoring...
		Ecosystem-based options: ecological restoration, afforestation, green infrastructure, fisheries co-management...
		Services: Food banks and distribution of food surplus; municipal services including water, sanitation and health; vaccination programs
	Institutional	Economic options: financial incentives including taxes and subsidies, insurance, payment for ecosystem services, disaster contingency funds, catastrophe bonds.
		Law and regulations: land zoning laws, building standards, water use agreements, defined property rights & land tenure security, patent pools and technology transfer
		Government policies and programmes: adaptation plans at all scales, coastal zone management, urban upgrading programs; disaster planning and preparedness; Integrated water resource management;
	Social	Educational options: awareness raising, gender equity, sharing traditional knowledge...
		Informational options: hazard and vulnerability mapping, monitoring and remote sensing, use of indigenous climate observations; Behavioural options: household preparation and evacuation planning, migration, livelihood diversification, soil and water conservation;
Transformation	Spheres of change	Practical: social and technical innovations, behavioural shifts, or institutional and managerial changes
		Political: Changes in the political, social, cultural, and ecological systems or structures that currently contribute to risk and vulnerability or impede practical transformations.
		Personal: changes in individual and collective assumptions, beliefs, values, and worldviews that influence climate change responses
Mitigation	See IPCC AR5-WGIII	

Table 1. Managing the risks of climate change: entry points, strategies, and adaptation options. These approaches should be considered overlapping rather than discrete, and they are often pursued simultaneously. Examples given can be relevant to more than one category [source: WGII AR5 2014, Technical Report, Table TS.7].

(5) According to the report, transformation is the "change in the fundamental attributes of a system, often based on altered paradigms, goals or values. Transformations can occur in the technological or biological systems, financial structures and regulatory, legislative, or administrative regimes".

Conclusions

The IPCC WGII report shows that adaptation needs to focus at the regional and even local levels due to the spatial variability of impacts, exposures and vulnerabilities. Also differences in principal objectives and value systems lead to differences in risk evaluation. This is one reason why the report recognises local and regional governments as well as the private sector as increasingly critical entities in enabling adaptation.

Significant synergies and trade-offs exist between different mitigation and adaptation actions. The complexity increases when simultaneously addressing multiple sectors in multiple regions with a dynamic and long-term perspective. The report states that there is need for the development of scientific methods to address this complexity.

The report shows that there is a very wide scope for action available (Fig.1) and recommends a multipronged strategy that reduces exposure and vulnerability while simultaneously increasing resilience and adaptive capacity of human societies. In view of the long lead times and uncertainties it recommends incremental adaptation and identifying low regret measures with co-benefits for other societal challenges such as sustainable development, poverty alleviation, health and sanitation. This should be facilitated by mainstreaming climate change adaptation issues into general planning activities across all sectors (e.g. town planning, water infrastructure, transport, health etc.).

The report does acknowledge limits to adaptation in the case of continued high and increasing greenhouse gas emissions. Therefore mitigation as an effective control at source measure will be required together with ongoing adaptation efforts to transition to sustainable societies.

Additional notes to the reader

Anil Markandya is a lead author of WGII AR5 Chapter 17: The Economics of Adaptation and co-author of the Summary for Policymakers.

bc³
BASQUE CENTRE
FOR CLIMATE CHANGE
Klima Aldaketa Ikergai

*This Policy Briefing was written by Elisa Sainz de Murieta¹, Marc B Neumann¹ and Anil Markandya¹.
[BC3, Basque Centre for climate Change]
Corresponding author address: elisa.sainzdemurieta@bc3research.org*

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