The IPCC's Fifth Assessment Report

What's in it for Africa?

Executive Summary

CDKN

Climate & Development Knowledge Network

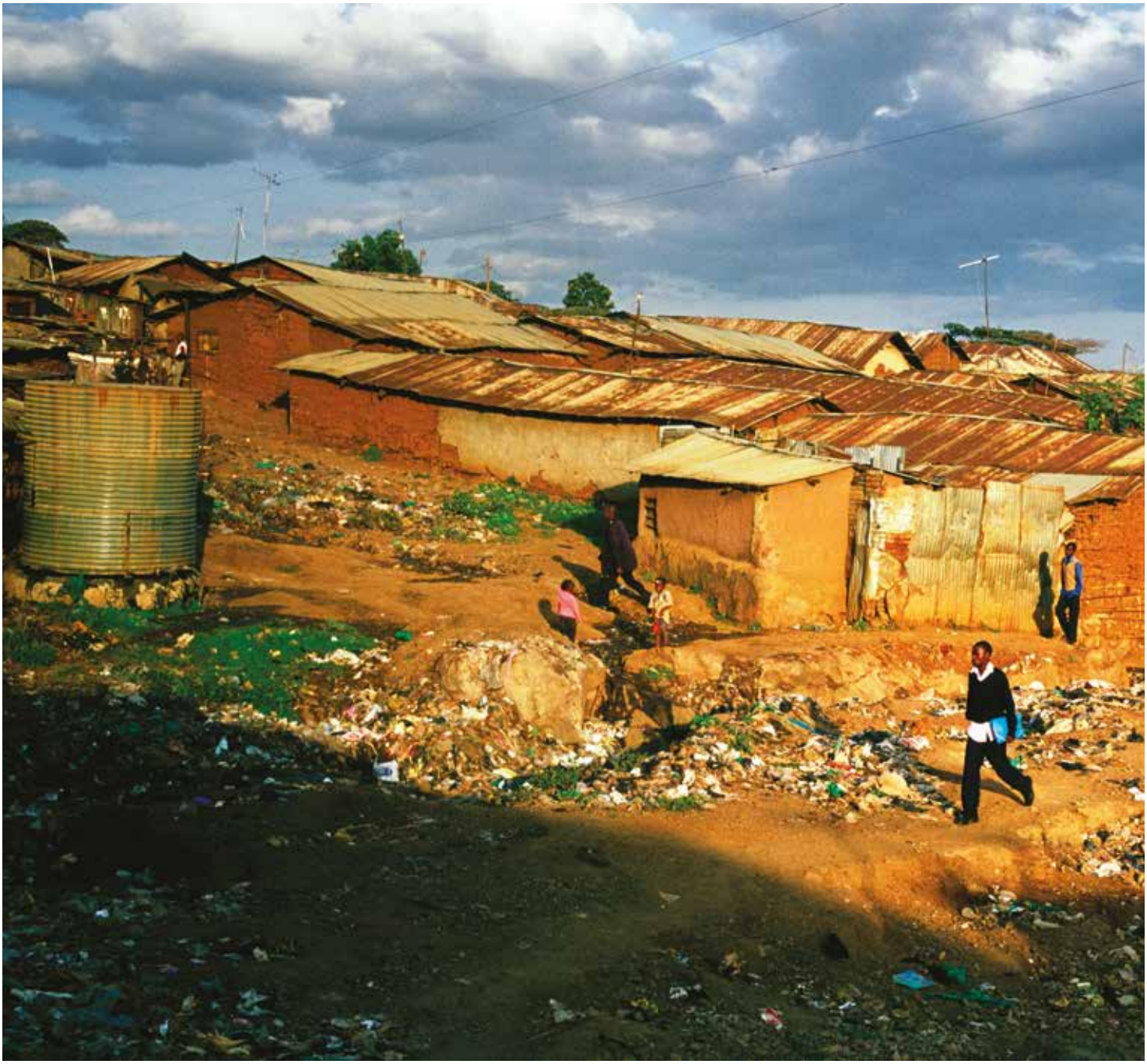


Image: © Jonas Bendiksen/Magnum Photos | Kibera, Nairobi, Kenya

Cover image:
Neil Palmer (CIAT) | A farmer in a maize field in Nyagatare, Rwanda

The IPCC's Fifth Assessment Report offers the following key messages for Africa:

1. Africa's climate is already changing and the impacts are already being felt
2. Further climate change is inevitable in the coming decades
3. Climate change poses challenges to growth and development in Africa
4. Adaptation will bring immediate benefits and reduce the impacts of climate change in Africa
5. Adaptation is fundamentally about risk management
6. Adaptation experience in Africa is growing
7. Some low-carbon development options may be less costly in the long run and could offer new economic opportunities for Africa
8. Africa stands to benefit from integrated climate adaptation, mitigation and development approaches
9. International cooperation is vital to avert dangerous climate change and African governments can promote ambitious global action

"Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850."
IPCC[12]

Africa's climate is already changing and the impacts are already being felt

The *Fifth Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC) finds, beyond reasonable doubt, that the Earth's climate is warming.[1] Climate change will have widespread impacts on African society and Africans' interaction with the natural environment.[2]

Since the 1950s, the rate of global warming has been unprecedented compared to previous decades and millennia.[3] The *Fifth Assessment Report* presents a long list of changes that scientists have observed around the world. Since the mid-19th century, the average increase in the temperature of the Earth's surface has been 0.85 degrees Centigrade (°C).[4] Sea levels have risen faster than at any time during the previous two millennia.[5] In many regions, including Africa, changing rainfall or melting snow and ice are altering freshwater systems, affecting the quantity and quality of water available.[6]

The IPCC finds that there is 95% scientific certainty (Box 1) that human activity, by increasing concentrations of greenhouse gases in the atmosphere, has been the dominant cause of the observed warming since the mid-20th century.[7] Current science provides the clearest evidence yet that human activity is changing our climate.[8]

The impacts of climate change will affect food security, water availability and human health in Africa significantly.[9] The following pages explore these impacts in more depth. Given the interdependence between countries in today's world, the impacts of climate change on resources or commodities in one place will have far-reaching effects on prices, supply chains, trade, investment and political relations in other places. Thus, climate change will progressively threaten economic growth[10] and human security.[11]

Box 1: How the IPCC's *Fifth Assessment Report* defines scientific certainty[14]

The IPCC assigns a degree of certainty to each key finding based on the type, amount, quality and consistency of evidence (e.g., data, theory, models, expert judgment), and the degree of agreement among scientists. The terms to describe evidence are: limited, medium or robust; and to describe agreement: low, medium or high.

When the *Fifth Assessment Report* talks about 'confidence' in a finding, the level of confidence derives from a synthesis of the evidence that exists and the degree of scientific agreement on what the evidence means. The levels of confidence IPCC assigns are: very low, low, medium, high and very high.

It is extremely likely that human activities have been the dominant cause of observed warming.

IPCC describes the likelihood or certainty of an outcome having occurred or occurring in the future in terms of percentages:

Virtually certain	**99% or more**
Extremely likely	**95% or more**
Very likely	**90% or more**
Likely	**66% or more**
More likely than not	**more than 50%**
About as likely as not	**33–66%**
Unlikely	**33% or less**
Very unlikely	**10% or less**
Extremely unlikely	**5% or less**
Exceptionally unlikely	**1% or less**

On this scale, the world's leading climate scientists consider it extremely likely that human activities have been the dominant cause of observed warming. Scientists consider 95% confidence as the 'gold standard', the standard at which theories are accepted as valid. For example, the theory of evolution, the theory on the age of the Earth and the Big Bang theory all meet this standard of scientific confidence.

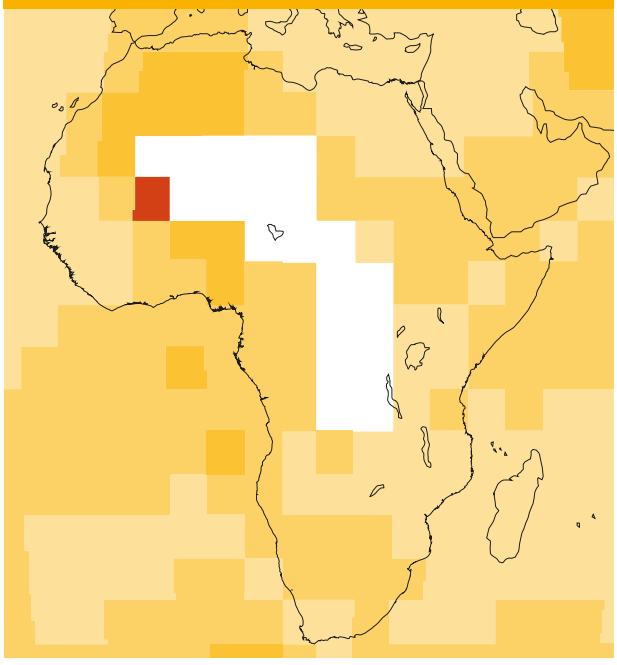
"Extreme precipitation changes over eastern Africa such as droughts and heavy rainfall have been experienced more frequently during the last 30–60 years." IPCC[13]

The *Fifth Assessment Report* presents strong evidence that warming over land across Africa has increased over the last 50–100 years.[15] This warming trend is very likely to continue (see page 11). Surface temperatures have already increased by 0.5–2°C over the past hundred years[16] (Figure 1). However, as shown by the white space covering much of the map in Figure 1, over large areas of Africa there is not enough historical data to show observed trends. The absence of this data is problematic. Planners have to deal with considerable uncertainty about future conditions. Investment in strengthening climate services – such as climate monitoring and national meteorological agencies – is, therefore, money well spent.

Most areas of Africa lack sufficient data to draw conclusions about trends in annual rainfall over the past century. But where data is available, these indicate that rainfall patterns are changing.[17] A very likely decrease in average annual rainfall has occurred in some parts of western Africa, with an observed drop in average annual rainfall of approximately 25–50 mm each decade from 1951–2010.[18] Some parts of southern and eastern Africa have very likely experienced increases in average annual rainfall of 5–50 mm each decade (Figure 2). However, rainfall trends in eastern Africa vary greatly over time and location. Some assessments suggest that wet seasons will be more intense and droughts less severe over eastern Africa by the end of the century, which indicates a reversal of the observed increase in droughts and heavy rainfall during the past 30 to 60 years.[19]

The implication of the changing rainfall trends is that it will become increasingly important to put adaptation measures in place to manage and reduce the risks of changing rainfall on productive systems such as agriculture and forestry – and to build resilience.

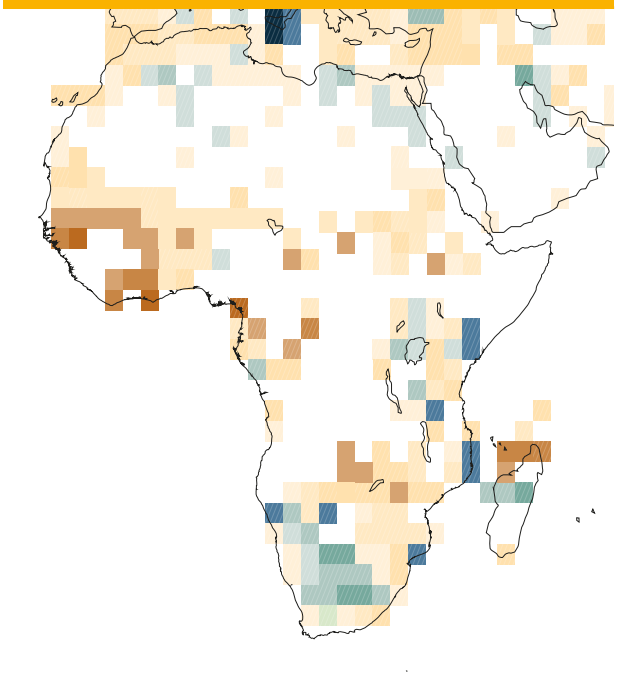
Figure 1: Change in annual average temperature in Africa, 1901–2012[20]



Change in annual temperature, °C

0 2 4 6

Figure 2: Change in annual average rainfall in Africa, 1951–2012[21]



Change in annual precipitation, mm/year/decade

-100 -50 -25 -10 -5 -2.5 0 2.5 5 10 25 50

Image: Johanna Schwartz | Coastal fisheries, Ghana

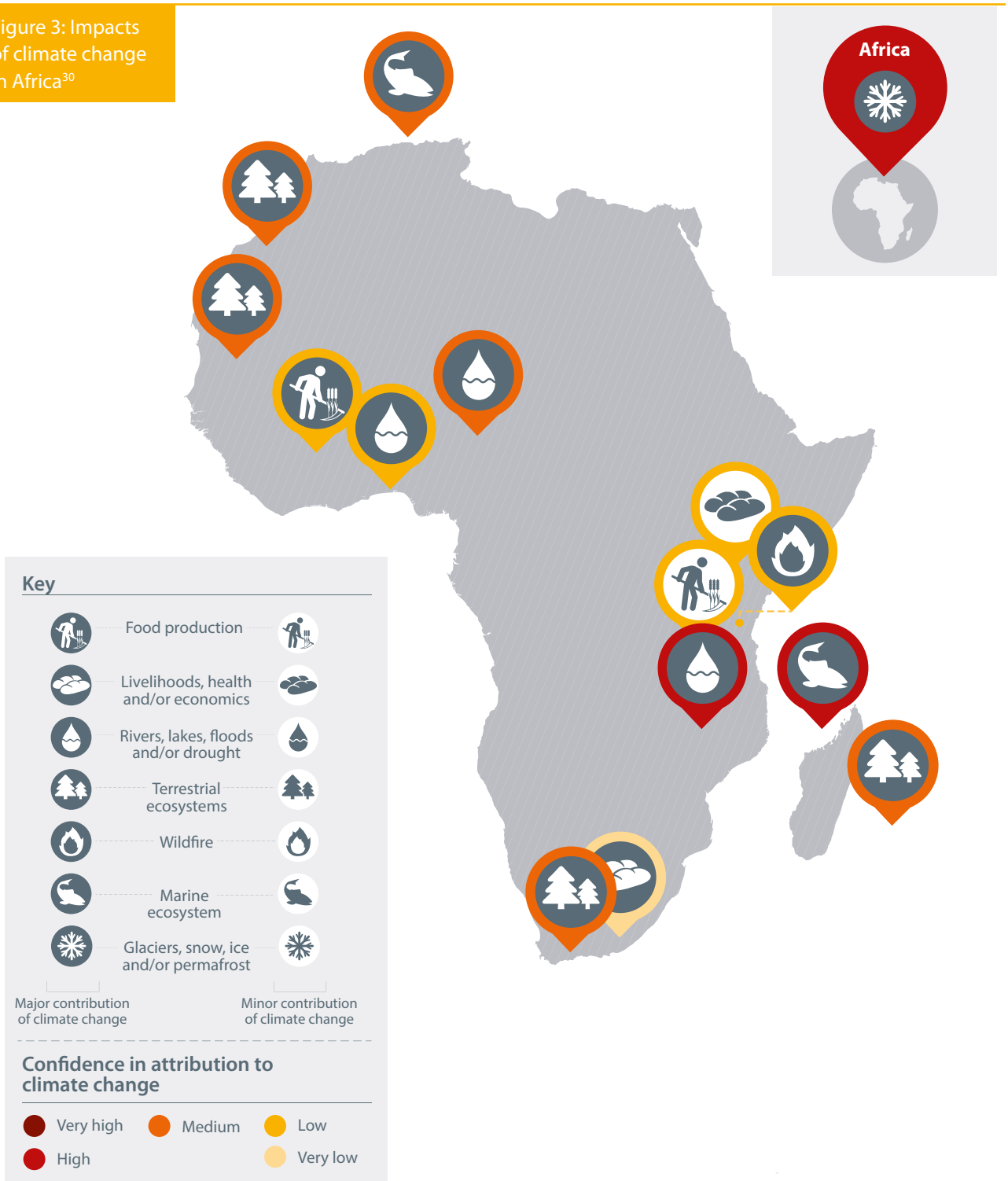
Even today, climatic risks threaten lives and prosperity across many parts of Africa and there are clear signs that the impacts of climate change are already being felt. The health, livelihoods and food security of people in Africa have been affected by climate change. There is evidence that temperature changes have played a role in the increased incidence of malaria in parts of eastern Africa, and have already driven changes in the practices of South African farmers.[22] Production of wheat and maize in parts of Africa has been impacted by climate change, as has the productivity of fisheries of the Great Lakes and Lake Kariba and fruit-bearing trees in the Sahel.[23]

The impacts from recent weather-related extremes, such as heat waves, droughts, floods, cyclones and wildfires, reveal the exposure and vulnerability of some African people and economies to climate (Box 2, Figure 3).

Following droughts in the 1970s and 1980s, recurrent droughts and floods affected the Sahel in the 1990s and 2000s, often destroying crops and compounding food security problems.[24] Floods in the Zambezi River Valley displaced 90,000 Mozambicans in 2008, some permanently.[25] The experiences of extreme weather events in different parts of Africa highlight the risks to human wellbeing. The *Fifth Assessment Report* expects such events to become more frequent and more intense as the climate changes, though with large regional variations and differing degrees of confidence depending on the type of climate event.[26] The economic losses due to extreme weather events are also rising with the increasing frequency of events and increasing exposure of assets.[27]

The impacts of recent extreme weather events also demonstrate the vulnerability of some African ecosystems (Box 2, Figure 3). The geographic range, seasonal activities and migration patterns of many terrestrial, freshwater and marine species have shifted in response to ongoing climate change.[28] The abundance of species has changed, as have interactions among species. The pace of change has been rapid. Climate change has already led to changes in freshwater and marine ecosystems in eastern and southern Africa, and terrestrial ecosystems in southern and western Africa (Figure 3).[29]

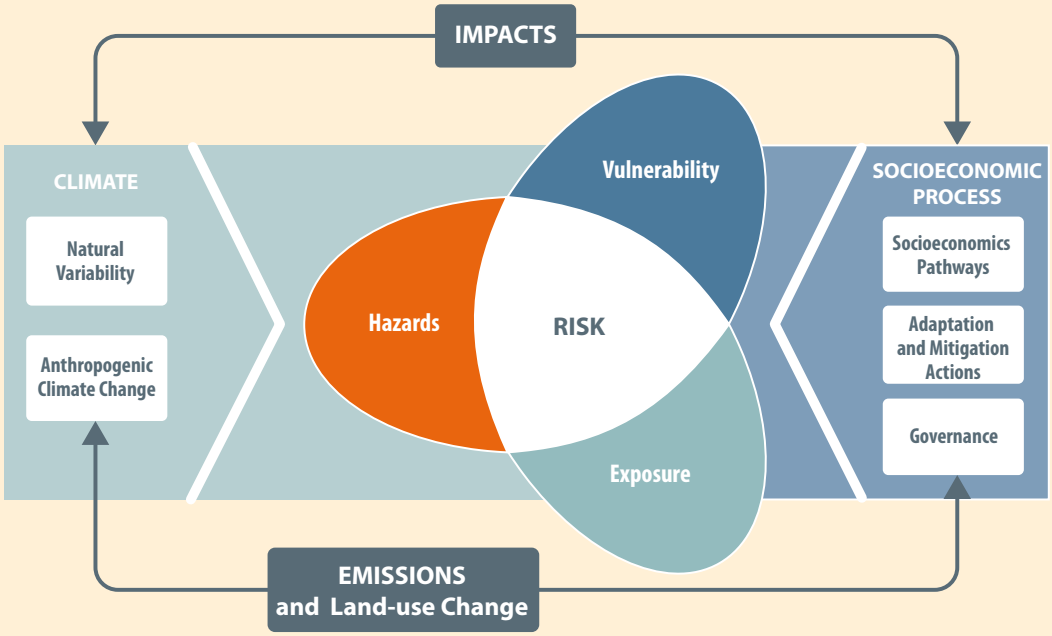
Figure 3: Impacts of climate change in Africa[30]



Box 2: Climate change poses risks to human and natural systems[31]

Risks related to climate change arise from climate-related hazards (climate trends and extremes) and the vulnerability of exposed societies, communities and systems (in terms of livelihoods, infrastructure, ecosystem services and governance). Effective measures to adapt to climate change and reduce the risks associated with climate change can address all three aspects of risk: hazard, vulnerability and exposure.

The vulnerability and exposure of societies and ecological systems to climate-related hazards vary constantly because of changes in economic, social, demographic, cultural, institutional and governance circumstances. For example, rapid and unsustainable urban development, international financial pressures, increases in socioeconomic inequality, failures in governance and environmental degradation affect vulnerability. These changes unfold in different places at different times, meaning that strategies to strengthen resilience and reduce exposure and vulnerability need to be locally or regionally specific. For example, countries that are rapidly urbanising are vulnerable to climate change if their economic development is slow. In other countries, urbanisation may present opportunities to adapt to climate change. Poverty is also a critical factor in determining vulnerability to climate change and extreme events. For example, vulnerability to drought in sub-Saharan Africa is closely linked to poverty and poor rural economies.



Regardless of future emissions, we are already committed to further warming.

Further climate change is inevitable in the coming decades

Regardless of future emissions, we are already committed to further warming, largely due to past emissions and inertia in the climate system. Globally, most greenhouse gas emissions due to human activities have come from just a few countries. Total emissions since 1970 have continued to rise, and emissions between 2000 and 2010 have been the highest yet.[32]

The IPCC warns that if global society continues to emit greenhouse gases at current rates, the average global temperature could rise by 2.6–4.8°C by 2100 (according to the IPCC's highest emissions scenario see Box 3).[33]

The figure in Box 3, below, illustrates projected warming under a low-emissions scenario, a high-emissions scenario and two mid-range scenarios, and the temperature changes associated with each.[38] Whether global society continues to emit greenhouse gases at today's rate, or cuts greenhouse gas emissions sharply now, does not make a big difference in terms of climate impacts in the next few decades.

Curbing emissions to maintain global temperatures below 2°C would need urgent action at global level. However, the benefits to the global climate – and societies and ecosystems that depend on it – will only emerge in the latter half of the century. The IPCC lists the many reasons why *mitigation* action must start now and the kinds of immediate benefits it can deliver (see page 20). In contrast, taking action on *adaptation* today delivers many immediate benefits. But, there are limits to adaptation.[39] For this reason, both adaptation and mitigation are needed; they each deliver benefits but over different timeframes.[40]

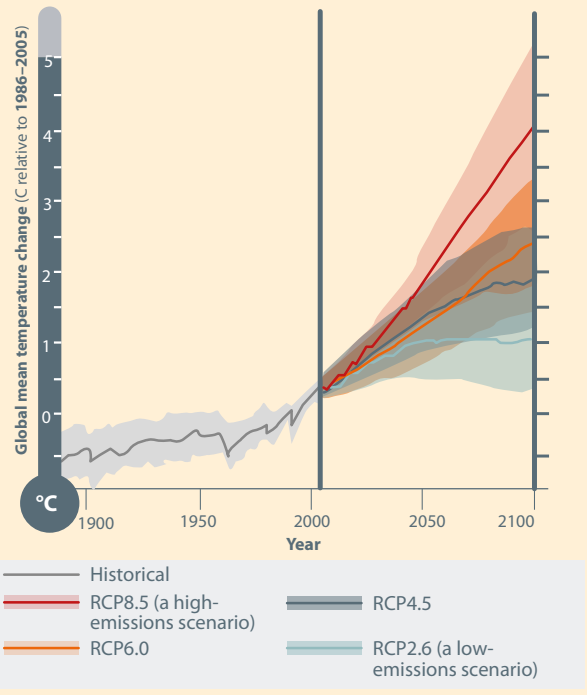
Box 3: What are the IPCC scenarios?

In assessing future climate change, the *Fifth Assessment Report* presents four scenarios, known as Representative Concentration Pathways (RCPs – see figure at right). The scenarios show the result of different levels of emissions of greenhouse gases, from the present day to 2100, on global warming. IPCC does not indicate which policy and behavioural choices society could make that would lead to the scenarios.

In all scenarios, carbon dioxide concentrations are higher in 2100 than they are today. The low-emissions scenario[34] assumes substantial and sustained reductions in greenhouse gas emissions. The high-emissions scenario[35] assumes continued high emissions. The two intermediate scenarios[36] assume some stabilisation in emissions.

In the next few decades, warming will be the same in all scenarios (see the overlap between the scenarios at right, and in Box 4). Regardless of action taken now to reduce emissions, the climate will change until around the middle of this century. In the longer term, in all except the low-emissions scenario, global warming at the end of the 21st century is likely to be at least 1.5°C.In the two higher emissions scenarios, global warming is *likely* to be 2°C. In the second lowest emissions scenario, global warming is *more likely than* not to be 2°C.[37]

Warming will continue beyond 2100 under all emissions scenarios except the lowest and will continue to vary between years and between decades.



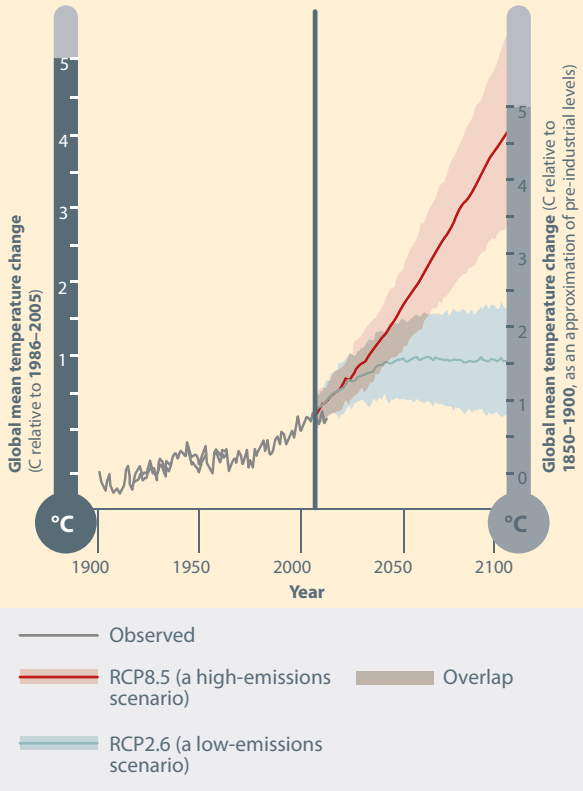
Climate change will amplify existing stress on water availability for society and the natural environment in Africa.[41]

Box 4: Impacts of global warming[42]

The diagram below shows global warming in the last century, and projected global warming to 2100 according to the IPCC's highest and lowest emissions scenarios. The IPCC identifies five main areas of concern as temperatures rise. The diagram on the right indicates the additional climate-related risks when the temperatures reach a certain level, are sustained at that level or exceeded. At even relatively low levels of warming of 1 to 2°C, many unique natural systems are threatened and food productivity, human health and water resources could be negatively impacted in some regions. The IPCC concludes that large-scale warming, of around 4°C or above, will increase the likelihood of severe, pervasive and irreversible impacts to which it will be difficult to adapt.

Climate change impacts across these areas of concern will increase risks of food insecurity and the breakdown of food systems, increase risks of loss of rural livelihoods and income due to insufficient access to drinking and irrigation water and reduced agricultural productivity, particularly for farmers and pastoralists with minimal capital in semi-arid regions. Risks due to extreme weather events leading to breakdown of infrastructure networks and critical services such as electricity, water supply, and health and emergency services are also linked to these areas of concern.

Observed and projected global annual average temperature



Global risks under increasing levels of climate change

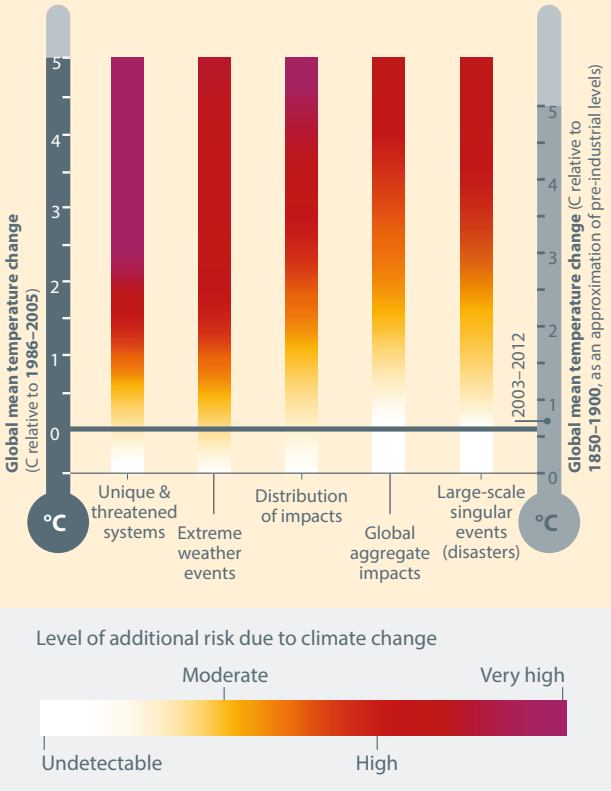


Image:
iStock | Seaweed farm at low tide, Zanzibar Island,Tanzania

Climate change threats could undermine the progress African countries have made in tackling disease, malnutrition and early deaths, and gains in agricultural productivity.

The emissions already in the atmosphere, together with the greenhouse gases that will be emitted in the future, mean that the climate will continue to change. These changes in climate will create new risks and will amplify existing risks for natural and human systems. The IPCC report finds that for the remainder of this century, climate change will pose further challenges to food security, livelihoods, health and wellbeing.[43]

During this century, temperatures in the African continent are likely to rise more quickly than in other land areas, particularly in more arid regions.[44] Under a high-emissions scenario,[45] average temperatures will rise more than 2°C, the threshold set in current international agreements, over most of the continent by the middle of the 21st century.[46] Average temperatures will rise by more than 4°C across most areas in the late 21st century.[47] Changes in average temperature are projected to be greater over northern and southern Africa and relatively smaller over central Africa.[48] Under a low-emissions scenario,[49] average temperature rises across Africa are projected to be less than 2°C over the course of the century.[50]

Projections for rainfall are less certain than projections for temperature.[51] Most areas of the African continent do not show changes in average yearly rainfall under low-emissions scenarios.[52] However, projections do show a very likely decrease in average yearly rainfall over areas of southern Africa beginning in the mid-21st century, and expanding substantially by the late 21st century, under a high-emissions scenario.[53] In contrast, likely increases in average yearly rainfall are projected over areas of central and eastern Africa beginning in the mid-21st century for the same high-emissions scenario.[54]

As climate change impacts become more dramatic, their effect on a range of climate extremes in Africa, including heavy rainfall, heat waves and drought, will become increasingly important[55] and will play a more significant role in disaster impacts. There will be a likely increase in the frequency of hot days across the Sahara and parts of west, east and southern Africa.[56] Eastern and southeastern Africa will likely experience more heavy rainfall, with more extreme wet days by the mid-21st century and greater potential for intense flooding, partially driven by possible changes in landfall of cyclones originating in the Indian Ocean.[57]

Global mean sea level will continue to rise during the 21st century under all emissions scenarios, by a magnitude that poses significant risks for Africa's coastal settlements, as well as for coastal economies, cultures and ecosystems.[58]

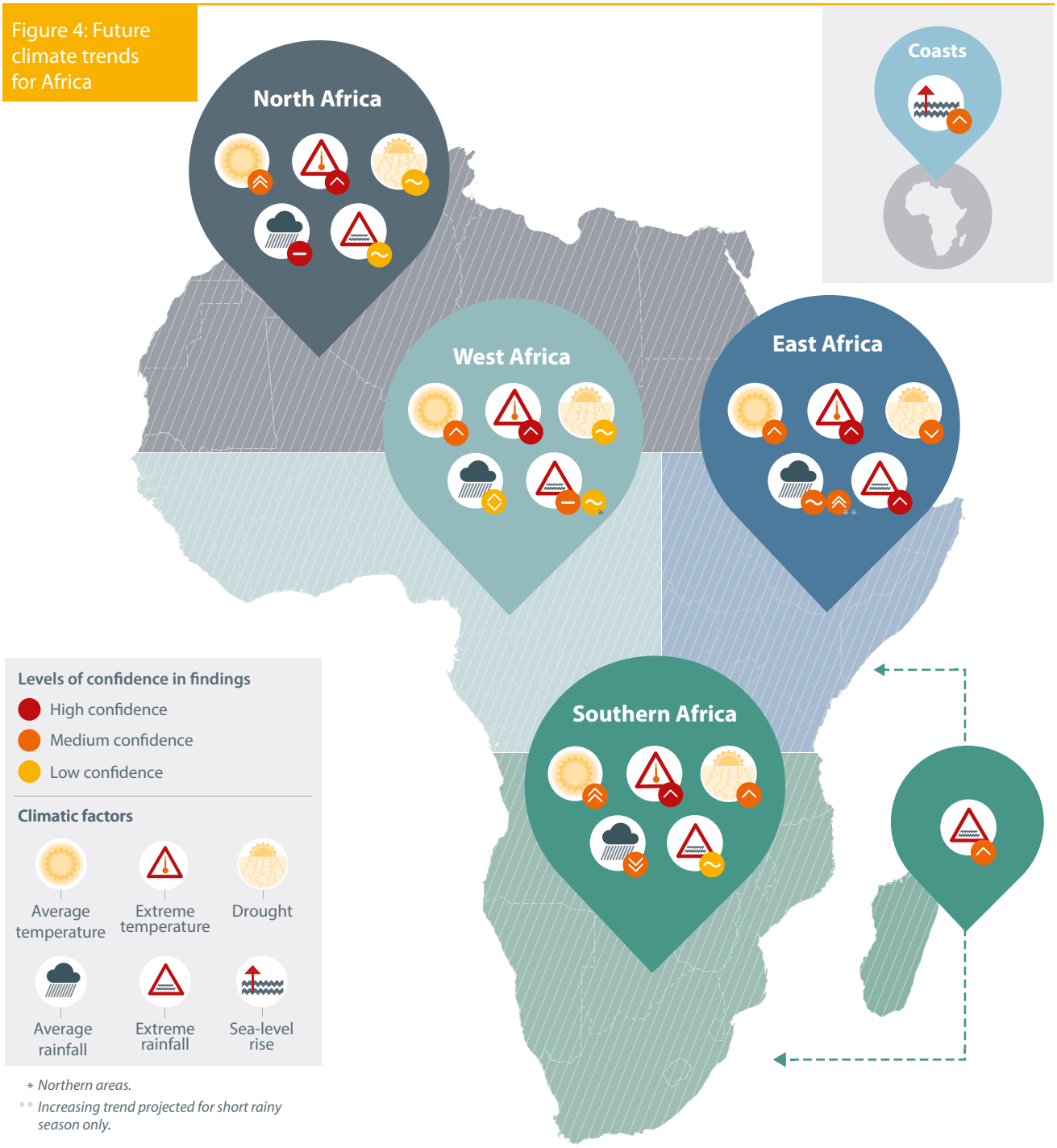
Climate change poses challenges to growth and development in Africa

Sub-Saharan Africa is a rapidly developing region with a population of about 900 million, and wide ecological, climatic and cultural diversity. At present, six of the ten fastest growing economies in the world are in Africa. Growth in these economies started from a relatively low base so the current rate of economic growth needs to be seen against a background of three decades of poor development performance, conflict and economic marginalisation. Some of these problems remain. However, there are hopeful signs that a number of countries are turning a corner – for the better.

It is critical to recognise that Africa's growth is fragile. Real economic transformation has yet to take root. Part of Africa's vulnerability lies in the fact that recent development gains have been in climate-sensitive sectors. Economically, many Africans depend for food, fibre and income on primary sectors such as agriculture and fisheries, sectors which are affected by rising temperatures, rising sea levels and erratic rainfall. Demographic and economic trends in Africa mean that climate impacts will be acute. For example, growing populations will increase the demand for water and food but prolonged droughts will put additional pressure on already scarce water resources and will reduce crop yields (see Figure 4).

Already the region suffers from widespread, recurring risks to food production. Without adequate measures to adapt, these risks could become more intense under a changing climate.[59] For scenarios approaching 4°C warming, the risk to food security in Africa could be very severe, and there would be limited potential for reducing risk through adaptation.[60] The IPCC points out that some of the major crops in Africa are highly sensitive to changes in temperature.[61] For example, climate change is very likely to have an overall negative effect on yields of major cereal crops across Africa, though with strong regional variability in the degree of loss.[62] Estimated yield losses at mid-century range from 18% for southern Africa to 22% aggregated across sub-Saharan Africa, with yield losses for South Africa and Zimbabwe in excess of 30%.[63]

Figure 4: Future climate trends for Africa



Symbol	Rainfall	Temperature	Extreme rainfall, extreme temperature, sea-level rise
⌃⌃	up to 30% increasing trend	1–6°C increasing trend	–
⌃	up to 10% increasing trend	1–4.5°C increasing trend	increasing trend
◇	both increasing and decreasing trends	–	both increasing and decreasing trends
⌄	up to 10% decreasing trend	–	decreasing trend
⌄⌄	up to 30% decreasing trend	–	–
–	inconsistent trend	inconsistent trend	inconsistent trend
~	no or only slight change	inconsistent trend	inconsistent trend

"In Africa, climate change will amplify existing stress … on agricultural systems, particularly in semi-arid environments." – IPCC[66]

In a world that is 4°C warmer, the current cropping areas of crops such as maize, millet and sorghum across Africa could become unviable.[64] The adaptation challenges of a world that is 4°C warmer are not limited to agriculture, but extend to other critical sectors such as livestock, fisheries, tourism, health, water and energy.[65]

Health is an area of particular risk in Africa's changing climate. Already, people over much of the continent have insufficient access to safe water, good sanitation and adequate healthcare. The IPCC finds that because of this, climate change will exacerbate vulnerability to vector and water-borne diseases.[67] For example, more floods in areas with poor sanitation and inadequate waste management will spread disease. Warmer nights and days will allow disease-carrying insects to spread to new latitudes.[68]

The considerable threats could undermine the progress that African countries have made in tackling disease, malnutrition and early deaths in past decades, together with gains in improving agricultural productivity. Adaptation can reduce these risks and bring immediate benefits.

Adaptation will bring immediate benefits and reduce the impacts of climate change in Africa

It is important to recognise that, even if global society ceased to emit greenhouse gases today, further warming is inevitable in the next few decades. Adaptation is the only effective option to manage the inevitable impacts of climate change that mitigation cannot reduce. The IPCC describes adaptation as "the process of adjustment to actual or expected climate and its effects".[69] Through adaptation, societies and communities can seek to moderate the harm of current and future climate risks or to take advantage of new opportunities.

Adaptation brings benefits both today and in the future. For example, Africa has much to gain from adaptation actions like disaster risk reduction and social protection that reduce the impacts of warming that are already being felt (Figure 5), and from building resilience around critical sectors such as water, energy and agriculture. The IPCC emphasises that integrating adaptation into planning and decision-making can create many synergies with development.[70]

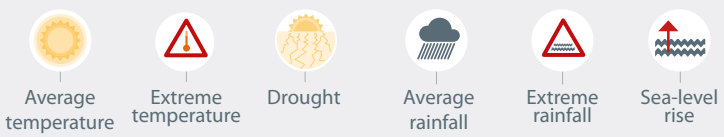
Effective adaptation strategies can, and should, strengthen livelihoods, enhance wellbeing and human security, and reduce poverty today. 'No regrets' or 'low regrets' measures such as increasing access to information and resources, improving health services, diversifying cropping systems, strengthening access to land, credit and other resources for poor and marginalised groups and making water and land management and governance more effective are good for development, irrespective of changes in climate (Table 1; Boxes 4–5).[71]

Even with significant resource and institutional investment on adaptation, for the most vulnerable there may be residual risks to food security, access to water, health and human security. In the long term, there may be limits to adaptation and the only way to reduce these risks is through global action to reduce greenhouse gas emissions.

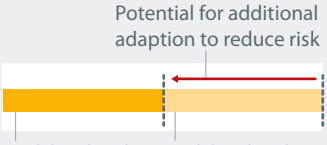
Figure 5: Adaptation can reduce risk[72]

Key risk	Adaption issues & prospects	Climate drivers	Time frame	Risk & potential for adaptation
Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future with drought stress exacerbated in drought-prone regions of Africa *(high confidence)*	• Reducing non-climate stressors on water resources • Strengthening institutional capacities for demand management, groundwater assessment, integrated water-wastewater planning, and integrated land and water governance • Sustainable urban development		Present Near-term (2030–2040) Long-term (2080–2100)	Very low / Medium / Very high 2°C 4°C
Reduced crop productivity associated with heat and drought stress, with strong adverse effects on regional, national and household livelihood and food security, also given increased pest and disease damage and flood impacts on food system infrastructure *(high confidence)*	• Technological adaptation responses (e.g., stress-tolerant crop varieties, irrigation, enhanced observation systems) • Enhancing smallholder access to credit and other critical production resources, diversifying livelihoods • Strengthening institutions at local, national and regional levels to support agriculture (including early warning systems) and gender-orientated policy • Agronomic adaptation responses (e.g., agroforestry, conservation agriculture)		Present Near-term (2030–2040) Long-term (2080–2100)	Very low / Medium / Very high 2°C 4°C
Changes in the incidence and geographic range of vector- and water-borne diseases due to changes in the mean and variability of temperature and precipitation, particularly along the edges of their distribution *(medium confidence)*	• Achieving development goals, particularly improved access to safe water and improved sanitation, and enhancement of public health functions such as surveillance • Vulnerability mapping and early warning systems • Coordination across sectors • Sustainable urban development		Present Near-term (2030–2040) Long-term (2080–2100)	Very low / Medium / Very high 2°C 4°C

Climatic factors



Level of risk and potential for adaption



"In many cases, we are not prepared for the climate-related risks that we already face. Investments in better preparation can pay dividends both in the present and for the future." Vicente Barros, Co-Chair of Working Group II

Box 5: Women, children and the elderly can be more vulnerable to climate change impacts[73]

Women often experience additional duties as labourers and caregivers as a result of extreme weather events and climate change, as well as from society's responses to climate change (e.g., male migration). They face more psychological and emotional distress, reduced food intake and adverse mental health outcomes due to displacement, and in some cases, increasing incidences of domestic violence.

Children and the elderly are often at higher risk due to narrow mobility, susceptibility to infectious diseases, reduced caloric intake and social isolation; young children are more likely to die from or be severely compromised by diarrheal diseases and floods. The elderly face disproportional physical harm and death from heat stress, droughts and wildfires.

Box 6: Action on climate change and development are inextricably linked[74]

The IPCC concludes:

- People who are socially, economically, culturally, politically, institutionally or otherwise marginalised in society are often highly vulnerable to climate change.
- Climate change impacts are projected to slow economic growth, make poverty reduction more difficult, further erode food security, and prolong existing and create new poverty traps, particularly in urban areas and emerging hotspots of hunger.
- Climate change poses an increasing threat to equitable and sustainable development. Sustainable development and equity provide a basis for assessing climate policies and addressing the risks of climate change.
- Business-as-usual development pathways can contribute to climate risk and vulnerability, and miss out on innovations and opportunities to build resilience in social and economic sectors.

The IPCC underlines Africa's need to integrate climate action with inclusive and sustainable economic development.[75]

Image:
Shutterstock | Mother and child at medical clinic, Nairobi, Kenya


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Table 1: Action on climate change adaptation can bolster development[76]

Overlapping approaches	Category	Examples
Vulnerability and exposure reduction through development, planning and practices including many low regrets measures; Adaptation including incremental and transformational adjustments; Transformation	Human development	Improved access to education, nutrition, health facilities, energy, safe housing and settlement structures, and social support structures; reduced gender inequality and marginalisation in other forms.
	Poverty alleviation	Improved access to and control of local resources; land tenure; disaster risk reduction; social safety nets and social protection; insurance schemes.
	Livelihood security	Income, asset, and livelihood diversification; improved infrastructure; access to technology and decision-making fora; increased decision-making power; changed cropping, livestock, and aquaculture practices; reliance on social networks.
	Disaster risk management	Early warning systems; hazard and vulnerability mapping; diversifying water resources; improved drainage; flood and cyclone shelters; building codes and practices; storm and wastewater management; transport and road infrastructure improvements.
	Ecosystem management	Maintaining wetlands and urban green spaces; coastal afforestation; watershed and reservoir management; reduction of other stressors on ecosystems and of habitat fragmentation; maintenance of genetic diversity; manipulation of disturbance regimes; community-based natural resource management.
	Spatial or land-use planning	Provisioning of adequate, housing, infrastructure and services; managing development in flood-prone and other high risk areas; urban planning and upgrading programmes; land zoning laws; easements; protected areas.
	Structural/physical	Engineered and built environment options: sea walls and coastal protection structures; flood levees; water storage; improved drainage; flood and cyclone shelters; building codes and practices; storm and wastewater management; transport and road infrastructure improvements; floating houses; power plant and electricity grid adjustments.
		Technological options: new crops and animal varieties; indigenous, traditional and local knowledge, technologies, and methods; efficient irrigation; water-saving technologies; desalinisation; conservation agriculture; food storage and preservation facilities; hazard and vulnerability mapping and monitoring; early warning systems; building insulation; mechanical and passive cooling; technology development, transfer and diffusion.
		Ecosystem-based options: ecological restoration; soil conservation; afforestation and reforestation; mangrove conservation and replanting; green infrastructure (e.g., shade trees, green roofs); controlling overfishing; fisheries co-management; assisted species migration and dispersal; ecological corridors; seed banks, gene banks and other ex situ conservation; community-based natural resource management.
		Services: social safety nets and social protection; food banks and distribution of food surplus; municipal services including water and sanitation; vaccination programmes; essential public services; enhanced emergency medical services.
	Institutional	Economic options: financial incentives; insurance; catastrophe bonds; payments for ecosystem services; pricing water to encourage universal provision and careful use; microfinance; disaster contingency funds; cash transfers; public-private partnerships.
		Laws and regulations: land zoning laws; building standards and practices; easements; water regulations and agreements; laws to support disaster risk reduction; laws to encourage insurance purchasing; defined property rights and land tenure security; protected areas; fishing quotas; patent pools and technology transfer.
		National and government policies and programmes: national and regional adaptation plans including mainstreaming; sub-national and local adaptation plans; economic diversification; urban upgrading programmes; municipal water management programmes; disaster planning and preparedness; integrated water resource management; integrated coastal zone management; ecosystem-based management; community-based adaptation.
	Social	Educational options: awareness raising and integration into education; gender equity in education; extension services; sharing indigenous, traditional and local knowledge; participatory action research and social learning; knowledge-sharing and learning platforms.
		Informational options: hazard and vulnerability mapping; early warning and response systems; systematic monitoring and remote sensing; climate services; use of indigenous climate observations; participatory scenario development; integrated assessments.
		Behavioural options: household preparation and evacuation planning; migration; soil and water conservation; storm drain clearance; livelihood diversification; changed cropping, livestock and aquaculture practices; reliance on social networks.
	Spheres of change	Practical: social and technical innovations, behavioural shifts, or institutional and managerial changes that produce substantial shifts in outcomes.
		Political: political, social, cultural, and ecological decision and actions consistent with reducing vulnerability and risk and supporting adaptation, mitigation and sustainable development.
		Personal: individual and collective assumptions, beliefs, values, and worldviews influencing climate change responses.

Development planning and practice must reflect the reality of the changing climate.[77]

Adaptation is fundamentally about risk management

In Africa, the primary concern is adapting to the negative impacts of climate change. This means taking both short- and long-term approaches to managing climate risks. In the short term, integrating climate adaptation and disaster risk reduction will help withstand shocks to human security and economic development from which recovery can be costly. African governments, businesses and communities can do much to anticipate and reduce risk, rather than reacting after impacts have occurred. Support for effective disaster relief and recovery needs to continue, along with proactive efforts to reduce risk, such as integrating comprehensive risk assessments and risk reduction measures into national economic and development policy.

In the longer term, governments, businesses and communities need not only to prepare for the kinds of climate impacts experienced up to now but also for different and more intense climate impacts and extreme events. Measures may include providing adequate housing, infrastructure or services, or mainstreaming climate change into urban planning processes (see Table 1).

There are good reasons to start now in the process of adapting to these longer-term risks. The IPCC cautions against overemphasising short-term outcomes or insufficiently anticipating consequences.[78] Given that climate change cuts across sectoral boundaries, poorly conceived development programmes or sector-specific adaptation strategies could lower resilience in other sectors or ecosystems. Some development pathways, like rapid urbanisation of coastal zones, can increase the vulnerability of certain groups to future climate change – known as 'maladaptation'. This is a particular challenge for Africa where economies are growing rapidly and societies are undergoing significant demographic shifts.[79]

More 'transformational' changes may be needed in situations where there are high levels of vulnerability and low capacity to adapt, as is often the case in Africa.[80] Such adaptations entail major economic, social, technological and political decisions and actions, rather than incremental changes to existing structures and processes. They involve, for example, changing agricultural practices, integrating climate change into education, providing useful climate services, diversifying livelihoods or introducing social and technical innovations (see Table 1). Recent success stories from smallholder systems in Africa illustrate the potential for transforming degraded agricultural landscapes into more productive and sustainable systems by integrating trees into annual cropping systems.[81] However, it should be noted that transformational adaptation can result in either positive or negative outcomes, as the greater level of investment and or shift in fundamental values and expectations required for transformational change may create greater resistance.[82]

There is no one-size-fits-all approach to adaptation. The IPCC stresses that no single adaptation strategy will meet the needs of all communities and contexts in Africa.[83] Moreover, the characteristics of a community or society's capacity to adapt to climate change will differ from place to place, and depend largely on specific contexts. A range of actions that address underlying vulnerabilities, implement specific adaptation measures and instigate transformations may be necessary to reduce climate risks.[84]

There are challenges to adaptation. First, African countries lack climate data and information, which creates difficulties in assessing the overall risks and vulnerabilities triggered by climatic and non-climatic factors.[85] Data and information are vital for countries to develop robust climate-resilient strategies and policies, and national and sectoral development plans. In some cases, adaptation may require additional resources in terms of funding, skills and capacity beyond 'business as usual' development.

Second, development planning tends to take place at a national scale and so may not take account of the impacts of climate change and variability in particular localities.[86] National policies can inadvertently disregard or undermine cultural, traditional and context-specific practices that support local adaptation to climate change.[87]

Third, interventions need to cross sectors. The cross-sectoral approach requires institutional integration and collaboration. The practice of working across sectors in Africa, and indeed in many parts of the world, does not come naturally, as it challenges entrenched institutional and sectoral behaviours. Overall, African countries' adaptive capacity and institutional framework to manage complex social and ecological change, especially at local government level, needs strengthening.[88]

Risk assessment must be comprehensive so that development programmes and adaptation strategies in one sector do not lower climate resilience in another.[89]

Adaptation experience in Africa is growing[90]

Over the past decade, countries across Africa have shown increasing interest in comprehensive development plans that set ambitious social and economic development objectives. These plans move beyond the narrow objective of poverty reduction to encompass the wider objectives of accelerating growth, creating employment, and providing safe water, sanitation, health care and education within a framework of sustainable development. Moving forward, development planning and practice also needs to reflect the reality of the changing climate, and to ensure that investments consider future climate conditions.

Many African countries have a long-term vision to guide their steps towards ambitious development goals. In many cases, countries are making concerted attempts to mainstream climate adaptation into development planning. Although efforts to date have tended to be isolated, initiatives in disaster risk management, adjustments in technologies and infrastructure, ecosystem-based approaches, basic public health measures and livelihood diversification are reducing vulnerability to climate impacts.

More specifically, a number of African governments have developed National Climate Change Response Strategies or, in least developed countries, National Adaptation Programmes of Action (NAPAs). As yet, implementation and integration of these and other strategies and programmes with economic and development planning is limited but growing. The development of NAPAs and early experience with National Climate Change Response Strategies, show that adaptation planning is evolving and becoming more integrated, multi-level and multi-sector. Ethiopia's Programme of Adaptation to Climate Change, for example, covers sectoral, regional, national and local community issues. Mali integrates adaptation into many sectors. National climate-resilient development strategies include Rwanda's National Strategy on Climate Change and Low-Carbon Development.

Niger, Zambia and Mozambique are involved in the African Development Bank Pilot Program for Climate Resilience. Zambia's Sixth National Development Plan 2011–2015 and Niger's new Economic and Social Investment Plan are examples of integration of climate resilience measures in national development plans.

Inter-sectoral climate risk management approaches are emerging in integrated water resources management, integrated coastal zone management, disaster risk reduction and land-use planning. Biodiversity planning to guide land use in South Africa incorporates design principles for climate change.

In some African countries, broader policy frameworks, such as Namibia's National Policy on Climate Change, Zambia's National Climate Change Response Strategy and Policy, and South Africa's National Climate Change Response Policy White Paper reflect a commitment to climate adaptation. Gabon has proposed a National Coastal Adaptation Law. Lesotho's coordinated policy framework involves all ministries and stakeholders. Ten countries were developing new climate-change laws or formal policies in 2012.

Managing for climate-related risks may involve experimenting with larger scale, new or more transformational adaptation measures than those already tried, and additional planning and investment. Adaptation measures that also deliver development benefits, now and in the future, offer significant opportunities. Moreover, people and societies may come to perceive or rank risks and potential benefits differently, thus decision-making processes should also allow for debates around diverse values and goals.

The IPCC reports a growing understanding of potential limits to adaptation in Africa.[91] Climate change, combined with other stressors, may overwhelm the ability of people to cope and adapt, especially if there is a failure to address the root causes of poverty and vulnerability[92] (Box 5–6). Evidence is growing of the need to design new development trajectories that will reduce vulnerability, spread risk and build capacity to adapt.[93]

African governments can help to promote ambitious global action on climate change mitigation

Ambitious climate mitigation at the global level must start now in order to limit the magnitude of long-term climate change and reduce the risks. Delaying action on mitigation will not only mean that adaptation costs will rise, but will substantially increase the difficulty of transitioning, globally, towards a low-emissions development pathway as countries invest in low-cost but potentially carbon-intensive infrastructure.[94] Between 15% and 40% of emitted carbon dioxide will remain in the atmosphere for more than 1,000 years. This creates a major intergenerational challenge in terms of rights and responsibilities to act on climate change. The *Fifth Assessment Report* provides a global carbon budget: it says that for the world to limit average global warming to less than 2°C, total emissions from human activity should not exceed 800–1,000 gigatonnes of carbon dioxide equivalent. To date, human activity has released 500 gigatonnes.[95]

The world's governments have pledged to limit warming to 2°C above pre-industrial levels. Above the 2°C warming threshold, climate-change impacts become severe and unmanageable. Deep cuts in greenhouse gas emissions would limit warming to 2°C relative to pre-industrial levels and avoid dangerous climate change. The IPCC states that under this ambitious scenario, emissions would peak in Africa by 2030 then decline.[96] The need for deep cuts in emissions to limit warming to the 2°C threshold is a central theme of the section of the *Fifth Assessment Report* on climate mitigation. Warming of 2°C alone would pose a significant threat to economic growth and human development in Africa (see page 10). The African Common Position on Climate Change promotes a 1.5°C warming threshold as more appropriate for Africa.

In 2010, governmental Parties to the United Nations Framework Convention on Climate Change (UNFCCC) meeting in Cancun[97] pledged to reduce emissions to achieve the long-term goal of limiting global warming to 2°C above pre-industrial temperatures. The *Fifth Assessment Report* finds that the actual governmental pledges made at and since Cancun fall short of what is needed to achieve the long-term goal.

Here lies an uncomfortable paradox. Africa's historic contribution to the build-up of greenhouse gas emissions has been relatively small but the cost of climate change it will face in terms of human wellbeing and ecosystems is, and will continue to be, large. Over large parts of Africa, warming could exceed 2°C by 2050 and rise by as much as 2.6–4.8°C by the end of the century (under the medium and high emissions scenarios).[98]

To be cost-effective on a global scale, most mitigation needs to take place in countries projected to have the highest emissions in the future. But it is important to recognise that, although deep cuts in greenhouse gas emissions are technically possible, making such cuts will entail substantial technological, economic, institutional and behavioural changes.

The IPCC also finds that mitigation efforts and the costs of mitigation vary between countries; developing countries have a significant proportion of the opportunities for low-cost mitigation.[99] As such, African countries can play a role in global climate stabilisation efforts by taking advantage of low-carbon options where it is advantageous to do so, thereby avoiding future emissions. For example, there are opportunities to reduce deforestation by adopting sustainable practices, plan innovative low-carbon towns and cities, and develop land-use schemes that intensify agricultural practices and sustainably manage livestock. Such actions can bring large co-benefits beyond reducing the impacts of climate change.

Ethiopia's Climate-Resilient Green Economy strategy is a good example of a vision for meeting multiple development goals while contributing to the global effort to mitigate climate change.

Nevertheless, it is also important to recognise that Africa will need substantial financial support for mitigation and that it will have to be a shared effort.

The *Fifth Assessment Report* explicitly states that, because the atmosphere is a global commons, we will not achieve effective mitigation if individual countries advance their interests independently. International cooperation is essential to limit greenhouse gas emissions effectively and to address other climate change issues such as building resilience and capacity in regions such as Africa.[100]

Renewable energy technologies have demonstrated substantial performance improvements and cost reductions.[113]

Some low-carbon development options may be less costly in the long run and could offer new economic opportunities for Africa

The IPCC recognises that Africa (particularly sub-Saharan Africa but excluding South Africa) has low levels of emissions and that over time these emissions will increase moderately to meet pressing development needs.[101] In expanding economically and meeting their development needs, African countries have abundant opportunities to adopt clean, efficient low-carbon technologies and practices. They can side step the inefficient, fossil fuel-dependent infrastructure that more developed countries are 'locked into'.[102]

The *Fifth Assessment Report* identifies many low-carbon opportunities and co-benefits.[103] Many of the measures to avoid greenhouse gas emissions provide generous gains in economic productivity, human development and quality of life. For example, the development of low-carbon mass transit systems can boost economic productivity, by reducing traffic congestion, and can improve air quality, thus benefiting public health.[104] This is a major opportunity.

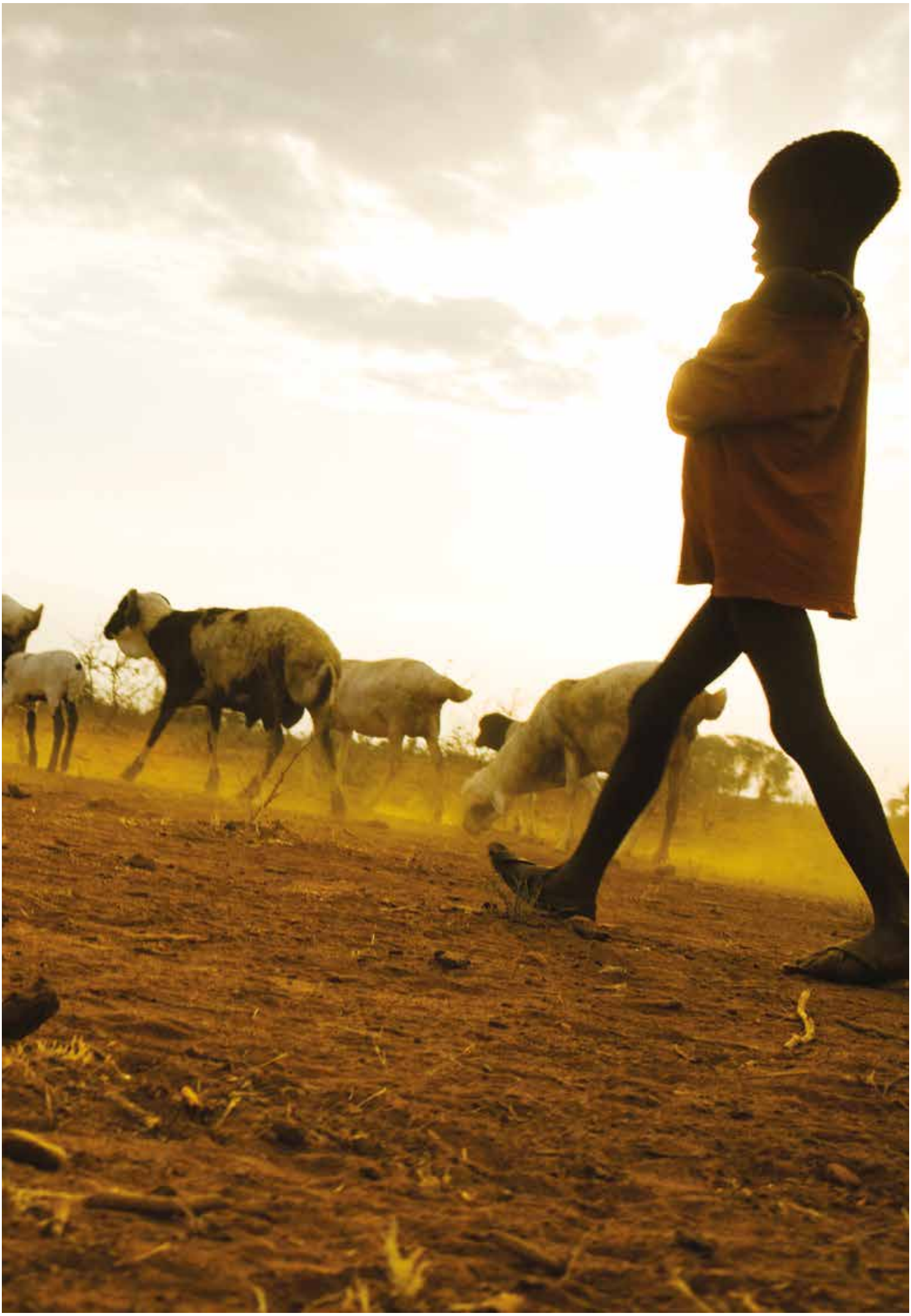
The IPCC states, "…in rapidly growing and urbanising regions, mitigation strategies based on spatial planning and efficient infrastructure supply can avoid lock-in of high emission patterns".[105] Because much of the urban space in Africa is yet to be developed, urban adaptation provides opportunities for incremental and transformational adjustments towards resilient and sustainable systems.[106] Reducing energy and water consumption through greening cities and recycling water, and developing resilient infrastructure systems can reduce the vulnerability of urban settlements in many parts of Africa.[107]

Other co-benefits of proactive climate policies include meeting the need to expand access to energy in Africa, for example by scaling-up renewable energy.[108] The *Fifth Assessment Report* and the IPCC's *Special Report on Renewable Energy Sources and Climate Change Mitigation*[109] show that renewable energy technologies have demonstrated substantial performance improvements and cost reductions, and a growing number of renewable energy technologies have matured enough to enable deployment at significant scale.[110]

Improvements in the performance and cost of renewable energy technologies are significant for Africa, given the huge renewable energy resource endowment across the region and the need to scale up energy services to meet demand. Encouraged by developments, many countries across Africa are investing heavily in new energy infrastructure as well as putting in place regulatory and policy measures to persuade the private sector to invest in energy.[111] In addition, decentralised, renewable energy technologies, such as improved cookstoves, can markedly alleviate the workload and enhance the personal security of women and girls. The cookstoves, while reducing greenhouse gas emissions, lessen the need for women and girls to walk long distances to collect firewood, and vastly reduce illness and death from indoor air pollution.[112]

Certain low-carbon development options cost more than 'conventional' options. However, taking the long view, the cost of adopting low-carbon options now is less than the cost of waiting for the development of improvements in renewable technologies or locking infrastructure into high-emissions pathways and then cutting emissions more precipitously, later. Globally, estimates indicate that the growth in *consumption* is 1.6–3% a year. Adopting ambitious climate mitigation measures would reduce this consumption growth by around 0.06 (0.04–0.14) percentage points per year over the 21st century.[114]

Image:
Panos | Goat herder, Nakapelimen, Uganda



Climate mitigation activities, managed carefully so that they do not introduce new risks to development, can provide multiple benefits.[117]

Africa stands to benefit from integrated climate adaptation, mitigation and development approaches

The IPCC points out that there are many complementarities among climate adaptation, mitigation and development.[115]

Many sustainable development pathways combine adaptation, mitigation and development approaches. For example, decentralised solar photovoltaic systems provide energy to people not connected to electricity grids in a way that avoids the damaging greenhouse gas emissions of fossil fuel-based alternatives (kerosene stoves, diesel generators or fossil fuel-based power stations).[116] Such decentralised, renewable systems can prove more resilient to climate extremes such as storms, droughts and very high temperatures, which may affect the performance of conventional sources of power such as large hydropower dams or large power stations reliant on water for cooling. The damage to energy supplies every year caused by cyclones in Mozambique is a case in point.

Another African example of multiple benefits from sustainable development pathways is community-based carbon offset and agroforestry schemes. These programmes provide development benefits, help communities adapt and mitigate climate change. An important feature of African agriculture is the predominance of smallholder farmers, whose priorities are food security and generating income to improve their livelihoods. Agroforestry schemes allow farmers to generate income and accumulate assets from carbon capture, wood-based energy and improving soil fertility, as well as potentially promoting sustainable wood production. Integrated agroforestry schemes across Africa can have direct benefits for local adaptation, as they enhance agro-ecosystem diversity and resilience, as well as contributing to the global goal of limiting greenhouse gas concentrations in the atmosphere.

The *Fifth Assessment Report* provides policy-makers with a wealth of evidence from climate change adaptation and mitigation efforts around the world on what works and what does not work (see opposite page).

Case studies : Achieving adaptation, mitigation and development

As well as the many benefits integrating adaptation, mitigation and development can achieve, decision-makers also need to consider the trade-offs.

Urban planning: Cities in Africa are expanding rapidly. Projections indicate that the region's urban population will double to 760 million by 2030. Many city planners advocate for more compact city structures that would accommodate Africa's growing urban population while curbing greenhouse gas emissions by reducing the need for transport. However, compact urban development may conflict with adaptation strategies, such as providing urban green spaces to counter urban heat island effects and moderate storm water run-off by increasing water filtration into the soil. Typical adaptation responses in urban heat islands involve installing air conditioning to maintain tolerable indoor comfort levels, but air conditioning contributes to greenhouse gas emissions. Displacement, especially of the urban poor, destruction of property and loss of livelihoods are common impacts of storm surges. Protection against storm surges requires heavy investment in flood defences, sea walls or drainage channels – adaptation measures that many African countries can ill afford.

More than half of the population in Africa's low lying coastal zones is urban, accounting for about 12% of the total urban population. The IPCC report indicates that rising sea levels, storm surges, heat stress, extreme precipitation, flooding, drought, water scarcity and air pollution pose widespread negative risks to people, health, livelihoods, assets, local and national economies, and ecosystems in low lying coastal zones (very high confidence). The risks are greater for those who lack essential infrastructure and services or who live in exposed areas.[118]

Planners need to consider the higher temperatures and changing rainfall patterns that climate change will bring when designing urban infrastructure, in order to prevent damage from extremes, and lessen disruption to businesses and inhabitants. Smart adaptation to current and future climate stresses affecting African cities is an imperative. Plans for low-carbon infrastructure and land use need to harmonise with needs for adaptation.

Land use: The expansion of agriculture to bolster national food security and export revenues – for geopolitical as well as economic reasons – often leads to deforestation. Loss of forest cover reduces carbon sinks (and releases carbon into the atmosphere), leads to soil erosion and increases run-off. Erosion and run-off can harm freshwater supplies and threaten local, forest-dependent livelihoods. Policies to achieve Reduced Emissions from Deforestation and forest Degradation (REDD+) are flexible. REDD+ models that integrate agriculture and adaptation promise to lessen poverty, address food security and negotiate trade-offs between reducing emissions and building the adaptive capacities of communities, ecosystems and nations.

Energy: The energy sector illustrates some of the choices that African decision-makers face in balancing adaptation, mitigation and development. Many Africans are energy poor: demand for power often outstrips supply, and the lack of energy hinders economic and social progress. Meeting the continent's energy needs requires large-scale investment; low-carbon technologies offer opportunities to invest in energy systems that are cleaner and more efficient than conventional alternatives. Low-carbon technologies can also be advantageous for national security, by reducing dependence on imported fossil fuels.

Greenhouse gas emissions from the energy supply sector in Africa increased by 3.38 times between 1970 and 2010.[119] Emissions from producing electricity and heat, and from petroleum refining grew the most quickly, although emissions from fuel production and transmission were also important. Limiting greenhouse gas emissions from Africa's energy sector will require investment in renewable energies such as hydropower, bioenergy and ocean energy. Opportunities to limit greenhouse gas emissions also include preventing methane emissions and improving energy efficiency.[120]

There is a choice between pursuing widespread, small-scale (decentralised) solutions, and larger, centralised ones: in general, large energy projects emit more over a life cycle than small projects because of the emissions produced in construction. For example, in the hydropower sector, large projects have more lifecycle emissions than small run-of-the-river projects.[121]

Kenya already exploits geothermal and solar energy for both large-scale and decentralised

Image: Panos | Dr. Sidiki Toe is pictured with a new solar panel, Kaara Village, Mali

electricity production. However, the distribution of renewable resources, competition for resources and capacity to invest, together with public acceptability, may limit the extent to which Kenya, or other African countries, can deploy renewable energy technologies.[122]

Social attitudes matter. Energy use in the transport sector is growing rapidly in Africa. Social expectations will need to change quickly if the region is to follow a low-carbon pathway. Rising incomes as a result of development have, in the past, increased the consumption of energy in the transport sector and allowed more people to own cars. Rising energy consumption in the transport sector and car ownership lead to an increase in greenhouse gas emissions and high levels of air pollution.[123]

African investment in energy will need to consider the resilience of new infrastructure to changes in climate. Gradual changes in temperature, rainfall, windiness and cloudiness, and changes in the frequency and intensity of extreme weather events, will progressively affect infrastructure. The vulnerability and exposure of different energy systems will depend on the resource (e.g., water, wind, solar radiation), the technology (e.g. cooling) and the location (e.g., coastal, floodplain). For instance, if climate change leads to variable rainfall, improving communities' access to energy by developing hydropower, which depends on reliable water supplies, could become more costly. Climate impacts may also affect the integrity and reliability of pipelines and electricity grids.

Without safeguards, development of low-emissions energy can also create risks to environmental sustainability. Decision-makers need to develop low-emissions energy technologies in ways that conserve and enhance ecosystems, support biodiversity and livelihoods, and sustain wider resilience.

Box 7: Gaining development benefits from climate mitigation and avoiding adverse effects

The IPCC highlights many of the substantial development benefits that low-carbon development can achieve. The *Fifth Assessment Report* also warns that mitigation action can pose risks to development if not managed carefully.[124]

For example, new techniques to deliver climate-smart agriculture – especially if they involve changes in land tenure and land-use rights – bear the risk of marginalising smallholder farmers and forest users. However, given appropriate arrangements and incentives to manage these risks, such measures could provide social benefits and promote equity.[125]

Identifying the downside risks of mitigation action and ensuring that low-carbon choices support inclusive, sustainable development requires robust institutions and decision-making processes.

International cooperation is vital to avert dangerous climate change

Since the IPCC's formation in 1992, its work has given us a better understanding of climate science and has provided us with a better picture of vulnerabilities in different parts of the world. The IPCC has reviewed the range of potential policy options and their implementation in a range of country contexts. The *Fifth Assessment Report* provides the strongest scientific evidence of climate change yet. The report also indicates that waiting or doing nothing is no longer an option and makes a compelling case for immediate global action on climate change.

Political processes need to reflect this. Ensuring the right choices now requires every government to participate in global climate negotiations towards a collective solution. African leaders have an important part to play – with all other international leaders – in forging this solution. Cooperating, recognising that everyone must share the effort, and making financial resources available for investment in adaptation programmes and low-emissions infrastructure are important in reaching global agreement.

To this end, developed countries have committed to jointly mobilising US$100 billion a year from various sources by 2020 for adaptation and mitigation in developing countries. As yet, there is no agreed understanding on how to allocate funds between mitigation and adaptation, or between developing countries and regions. What is clear is that Africa needs resources to build viable adaptation frameworks and capabilities, and critical infrastructure for development. Provision of climate finance through the Global Climate Fund or other schemes is one way of mobilising resources to support adaptation and mitigation action in Africa.

The IPCC's key messages provide crystal clear implications for the global climate negotiations process. As mentioned above, the IPCC states categorically that the Cancun pledges for emissions reduction by 2020 are insufficient,[126] but could be the basis for something more ambitious. This is what the international process must deliver.

African leaders have an important part to play – with all other international leaders – in forging this commitment to ambitious, collective action. An important part of reaching a global agreement is ensuring that the cooperative spirit is in place, effort-sharing is recognised and financial resources are made available to invest in adaptation programmes and low-emissions development paths.

About the IPCC's Fifth Assessment Report

The Intergovernmental Panel on Climate Change (IPCC) has produced the most comprehensive assessment of climate change ever. The *Fifth Assessment Report* (http://www.ipcc.ch), which IPCC is releasing in four parts between September 2013 and November 2014, is the work of 830 expert authors, from 85 countries. The report reviews the scientific evidence on the trends and causes of climate change, the risks to human and natural systems, and options for adaptation and mitigation. The IPCC aims to be – in its own words – "policy relevant but not policy prescriptive". Its findings further our understanding of humankind's interaction with our environment: how we are affecting the global climate and what we can do about it.

The IPCC Working Groups publish the reports comprising the *Fifth Assessment Report* (see figure: How the IPCC works). These groups are: Working Group I (Physical Science of Climate Change), Working Group II (Impacts, Adaptation and Vulnerability) and Working Group III (Climate Change Mitigation). The final report is a synthesis of findings. Although the collected reports total many thousands of pages, each Working Group produces a *Summary for Policy-Makers,* which presents key findings in a more succinct form. Representatives of more than 190 governments review and negotiate the summaries in detail during a week-long event. Once governments have signed off on each *Summary*, the IPCC publishes it, together with the full scientific report.

The component parts of the *Fifth Assessment Report* may be accessed on the following websites:

Working Group I: The Physical Science
www.climatechange2013.org

Working Group II: Impacts, Adaptation, and Vulnerability
www.ipcc.ch/report/ar5/wg2/

Working Group III: Mitigation of Climate Change
www.ipcc.ch/report/ar5/wg3/

About this report

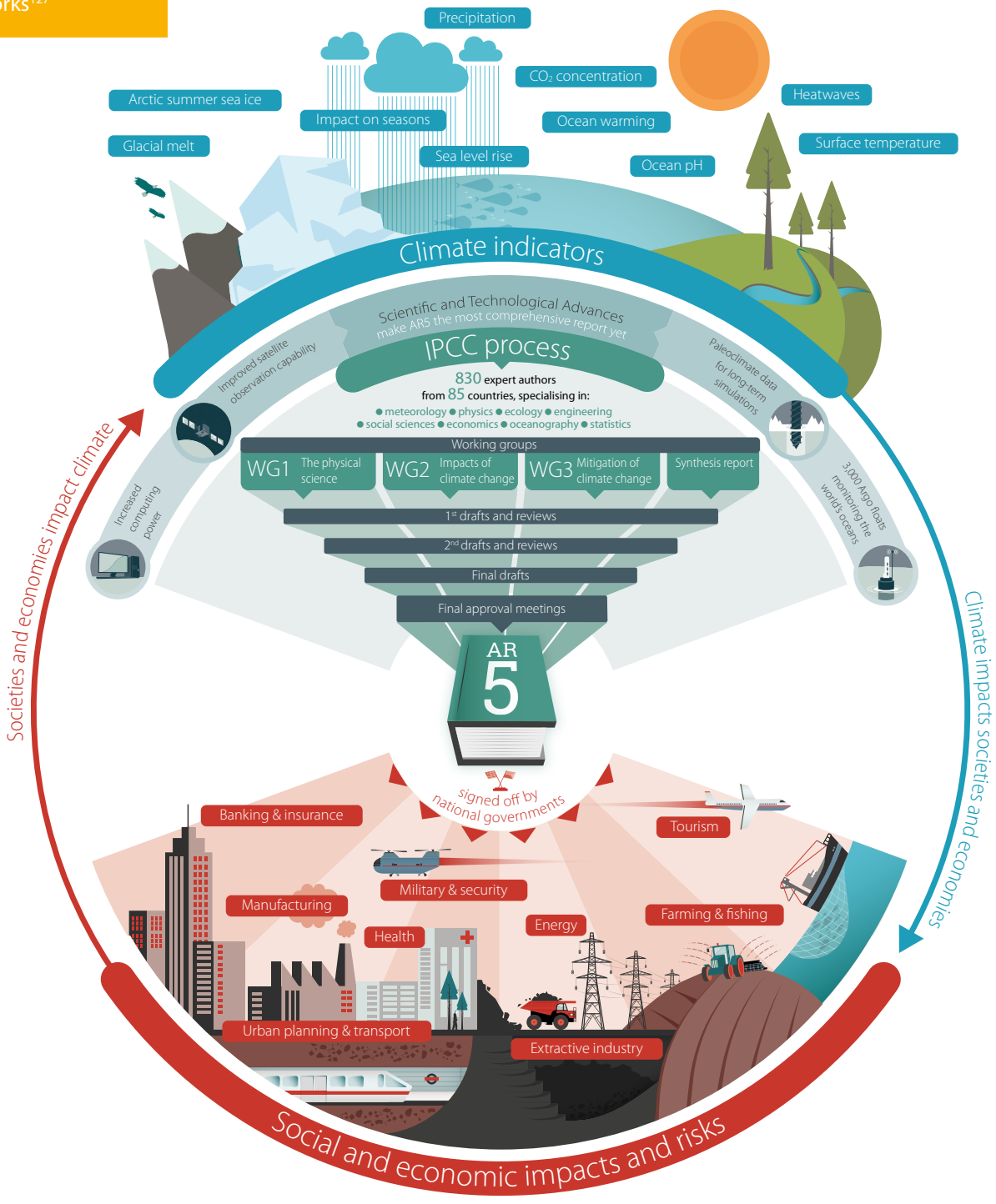
This report is a guide to the IPCC's *Fifth Assessment Report* prepared for decision-makers in Africa by the Climate and Development Knowledge Network (CDKN) and Overseas Development Institute (ODI). The IPCC 's *Summaries for Policy-Makers* focus principally on global issues and trends. This report distils the richest material on what climate change means for Africa, and African experiences in adaptation and mitigation, from the thousands of pages of the *Fifth Assessment Report*. The publication has not been through the comprehensive governmental approval process that IPCC endorsement requires. However, the expert research team has worked under the guidance of IPCC Coordinating Lead Authors and Reviewers to ensure fidelity to the original (see *Acknowledgements*).

The research team has extracted the Africa-specific data, trends and analysis directly and solely from the *Fifth Assessment Report* for this short volume. In so doing, we hope to make the IPCC's important material more accessible and usable to African audiences. This report responds to wide demand among CDKN's Africa partner networks, for region-specific information.

Our publication is part of a suite of materials to aid understanding of the IPCC's *Fifth Assessment Report*. Companion volumes provide a digest of IPCC findings for: South Asia; Latin America; and Small Island Developing States.

Please visit www.cdkn.org/ar5-toolkit

How the IPCC works[127]



Acknowledgements

The principal authors of this report are Elizabeth Carabine and Alberto Lemma, Overseas Development Institute (ODI). Mairi Dupar and Lindsey Jones of ODI/Climate and Development Knowledge Network (CDKN), Yacob Mulugetta of the University of Surrey, Nicola Ranger of the UK's Department for International Development and Maarten van Aalst of the Red Cross Red Crescent Climate Centre made substantive contributions.

Dr Mulugetta is a Coordinating Lead Author of the *Fifth Assessment's* Working Group III report (chapter on energy systems) and member of the core writing team of the *Synthesis Report*. Dr van Aalst is a Lead Author of the Fifth Assessment's Working Group II report (chapter on regional context) and *Technical Summary*. He was also a Coordinating Lead Author of the IPCC's *Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (SREX, chapter on determinants of risk), and member of the core writing team of the SREX *Summary for Policymakers*.

The report benefited from the insightful review comments of Ari Huhtala and Tom Mitchell, ODI/CDKN, together with Maliza van Eeden, Shehnaaz Moussa and Simbisai Zhanje of SouthSouthNorth/CDKN and Andrew Scott, ODI. Thanks to Sandra Child of Scriptoria for editorial support and Paulien Hosang of Soapbox for design and layout.

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Glossary

Adaptation: The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Greenhouse gas: Greenhouse gases are those gaseous constituents of the atmosphere, both natural and caused by human activity. Greenhouse gases trap energy from the sun in the atmosphere causing it to warm. Water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere; while hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs) are also of concern. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as halocarbons and other chlorine- and bromine-containing substances.

Maladaptive actions (or maladaptation): Actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future.

Mitigation (of climate change): A human intervention to reduce the sources of greenhouse gases or enhance the sinks (those processes, activities, or mechanisms that remove a greenhouse gas from the atmosphere).

Representative concentration pathways (RCPs): Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use and land cover. The word 'representative' signifies that each RCP provides only one of many possible scenarios that would lead to the specific radiative forcing characteristics (i.e., greenhouse gas-related warming). The term 'pathway' emphasises that not only the long-term concentration levels are of interest, but also the trajectory taken over time to reach that outcome.

Resilience: The capacity of a social-ecological system to cope with a hazardous event or disturbance, responding or reorganising in ways that maintain its essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Scenario: A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are useful to provide a view of the implications of developments and actions.

Social protection: In the context of development aid and climate policy, social protection usually describes public and private initiatives that provide income or consumption transfers to the poor, protect the vulnerable against livelihood risks, and enhance the social status and rights of the marginalised, with the overall objective of reducing the economic and social vulnerability of poor, vulnerable, and marginalised groups.

Transformation: A change in the fundamental attributes of a system, often based on altered paradigms, goals, or values. Transformations can occur in technological or biological systems, financial structures, and regulatory, legislative, or administrative regimes.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Source: IPCC Working Group II, Fifth Assessment Report (http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Glossary_FGD.pdf). The definition for 'greenhouse gas', above, has been shortened from the IPCC's much longer version. Readers are encouraged to reference the IPCC's original source document for a full technical definition of 'radiative forcing' and other scientific terms.

Endnotes

1 IPCC (2013). *Climate Change 2013: The Physical Science Basis. Headline Statements from the Summary for Policymakers.*
2 Ibid.
3 IPCC (2013). *Climate Change 2013: The Physical Science Basis. Summary for Policymakers* (p4).
4 The range shown is 0.65–1.06°C. IPCC (2013). *Climate Change 2013: The Physical Science. Summary for Policymakers* (p5).
5 The rate of sea level rise has been greater than the mean rate during the previous two millennia. *IPCC (2013). Climate Change 2013: The Physical Science. Summary for Policymakers* (p. 11).
6 IPCC (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Summary for Policymakers* (p4).
7 IPCC (2013). *Climate Change 2013: The Physical Science Basis. Headline Statements from the Summary for Policymakers.*
8 Ibid.
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127 *Information is Beautiful.* Graphic adapted from Information is Beautiful graphic, from a project developed and released by the European Climate Foundation and the Cambridge Institute for Sustainability Leadership.

The full citations for the component parts of the *Fifth Assessment Report* are:

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CDKN is a project funded by the UK Department for International Development (DFID) and the Netherlands Directorate-General for International Cooperation (DGIS) for the benefit of developing countries. However, the views expressed and the information contained in the document are those of the author(s) and do not necessarily represent the views of ODI or CDKN. Neither are they necessarily endorsed by DFID, DGIS or the entities managing the delivery of the CDKN project, which can accept no responsibility or liability for such views, for the completeness or accuracy of the information or for any reliance placed on them.

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