

CLIMATE AND HEALTH COUNTRY PROFILE – 2015

MOROCCO



United Nations
Framework Convention on
Climate Change



OVERVIEW

Morocco's climate is very diverse, with a warm, Mediterranean climate in the northern coastal region, continental inland areas and semi-arid areas in the south. Morocco has ambitious renewable energy targets and is making political and strategic efforts to conserve biodiversity and to mitigate and adapt to climate change.

Despite positive action, Morocco remains vulnerable to the effects of climate change. The Mediterranean coast and low-lying Moulouya River delta, with their economic and ecological importance are threatened by sea-level rise and subsequent shoreline erosion and saline intrusion.^a Agriculture, which represents 16% of Morocco's GDP,^b is endangered by decreases in annual rainfall increasing the risk of crop failures and malnutrition. Morocco could also face aggravated water scarcity; rising temperatures; severe heat waves; and increased incidence of dengue fever, malaria and schistosomiasis.^c

SUMMARY OF KEY FINDINGS

- Under a high emissions scenario, mean annual temperature is projected to rise by about 5.5°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.6°C.
- Under a high emissions scenario, and without large investments in adaptation, an annual average of 187,400 people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If emissions decrease rapidly and there is a major scale up in protection [i.e. continued construction/raising of dikes] the annual affected population could be limited to about 100 people. Adaptation

alone will not offer sufficient protection, as sea level rise is a long-term process, with high emissions scenarios bringing increasing impacts well beyond the end of the century.

- Under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to almost 50 deaths per 100,000 by 2080 compared to the estimated baseline of just under 5 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to just over 14 deaths per 100,000 in 2080.

OPPORTUNITIES FOR ACTION

Morocco has an approved national health adaptation strategy and is currently implementing projects on health adaptation to climate change. Country reported data [see section 6] indicate there are further opportunities for action in the following areas:

1) Adaptation

- Conduct an updated assessment of climate change impacts, vulnerability and adaptation for health.
- Implement actions to build institutional and technical capacities to work on climate change and health.
- Develop an integrated disease surveillance and response system with climate information included.
- Estimate the costs to implement health resilience to climate change.

2) Mitigation

- Initiate actions for greening the health sector, such as promoting the use of renewable energy.
- Conduct valuation of the co-benefits of health implications of climate mitigation policies.

DEMOGRAPHIC ESTIMATES

Population [2013] ^d	33 million
Population growth rate [2013] ^d	1.4%
Population living in urban areas [2013] ^e	59.2%
Population under five [2013] ^d	10.0%
Population aged 65 or older [2013] ^d	6.0%

ECONOMIC AND DEVELOPMENT INDICATORS

GDP per capita [current US\$, 2013] ^f	3,056 USD
Total expenditure on health as % of GDP [2013] ^g	6%
Percentage share of income for lowest 20% of population [2012] ^f	NA
HDI [2013, +/- 0.01 change from 2005 is indicated with arrow] ^h	0.617 ▲

HEALTH ESTIMATES

Life expectancy at birth [2013] ⁱ	71 years
Under-5 mortality per 1000 live births [2013] ^j	30

a Tekken, V., et al. [2009] Assessing the regional Impacts of Climate Change on Economic Sectors in the Low-Lying Coastal Zone of Mediterranean East Morocco. *Journal of Coastal research* p 272-276.

b World Bank Data. Agriculture as % of GDP. <http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS>

c EMRO 61st Session Regional Committee Meeting, Towards A Public Health Response To Climate Change And Air Pollution In The Eastern Mediterranean Region.

d World Population Prospects: The 2015 Revision, UNDESA [2015]

e World Urbanization Prospects: The 2014 Revision, UNDESA [2014]

f World Development Indicators, World Bank [2015]

g Global Health Expenditure Database, WHO [2014]

h United Nations Development Programme, Human Development Reports [2014]

i Global Health Observatory, WHO; 2014

j Levels & Trends in Child Mortality Report 2015, The UN Inter-agency Group for Child Estimation [2015]

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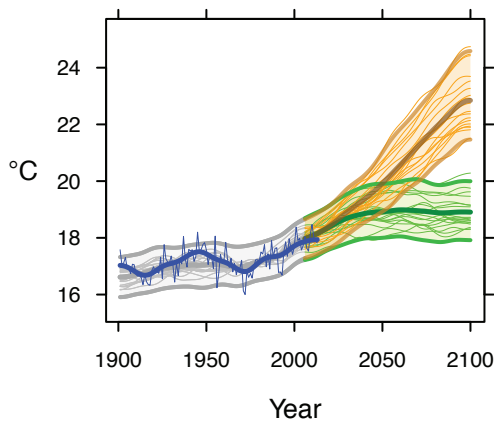
CURRENT AND FUTURE CLIMATE HAZARDS

Due to climate change, many climate hazards and extreme weather events, such as heat waves, heavy rainfall and droughts, could become more frequent and more intense in many parts of the world.

Outlined here are country-specific projections up to the year 2100 for climate hazards under a 'business as usual' high emissions scenario (in orange) compared to projections under a 'two-degree' scenario with rapidly decreasing emissions (in green).^a Most hazards caused by climate change will persist for many centuries.

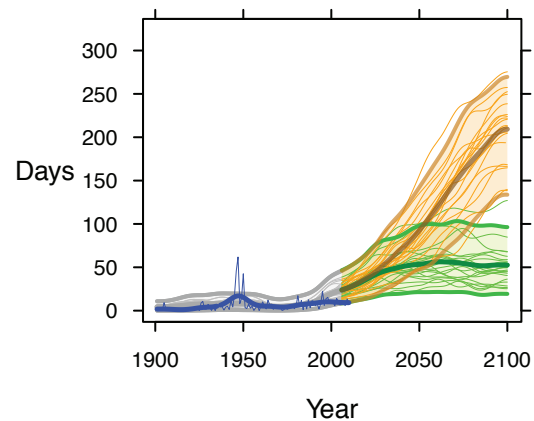
The text boxes below describe the projected changes averaged across about 20 models (thick line). The figures also show each model individually as well as the 90% model range (shaded) as a measure of uncertainty and, where available, the annual and smoothed observed record (in blue).^{b,c}

MEAN ANNUAL TEMPERATURE



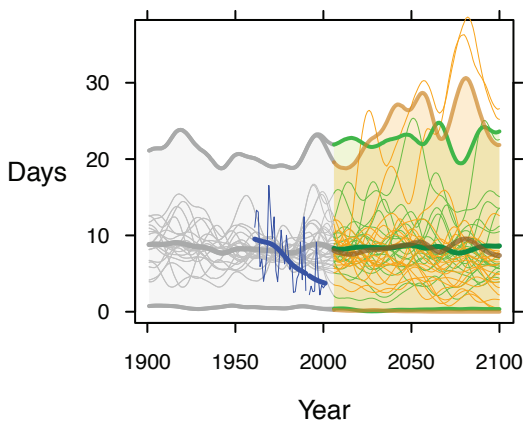
Under a high emissions scenario, mean annual temperature is projected to rise by about 5.5°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.6°C.

DAYS OF WARM SPELL ('HEAT WAVES')



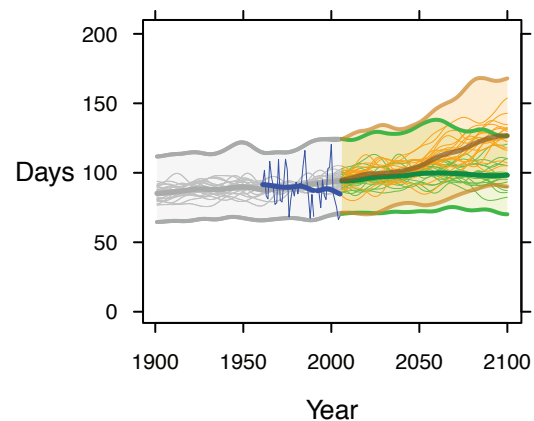
Under a high emissions scenario, the number of days of warm spell^d is projected to increase from about 10 days in 1990 to about 210 days on average in 2100. If emissions decrease rapidly, the days of warm spell are limited to about 50 on average.

DAYS WITH EXTREME RAINFALL ('FLOOD RISK')



Under both high and low emissions scenarios, the number of days with very heavy precipitation [20 mm or more] is not projected to change much on average, though year-to-year variability is large and a few models indicate increases outside the range of historical variability. This contrasts with the observed decrease in such days.

CONSECUTIVE DRY DAYS ('DROUGHT')



Under a high emissions scenario, the longest dry spell is indicated to increase from an average of about 90 days to just over 125 days, with continuing large year-to-year variability. If emissions decrease rapidly, the anticipated changes in the length of dry spells are somewhat less.

^a Model projections are from CMIP5 for RCP8.5 [high emissions] and RCP2.6 [low emissions]. Model anomalies are added to the historical mean and smoothed.

^b Observed historical record of mean temperature is from CRU-TSv.3.22; observed historical records of extremes are from HadEX2.

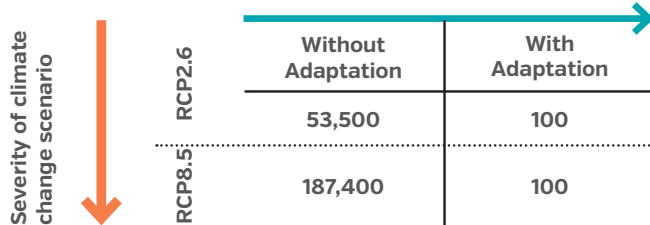
^c Analysis by the Climatic Research Unit and Tyndall Centre for Climate Change Research, University of East Anglia, 2015.

^d A "warm spell" day is a day when maximum temperature, together with that of at least the 6 consecutive previous days, exceeds the 90th percentile threshold for that time of the year.

CURRENT AND FUTURE HEALTH RISKS DUE TO CLIMATE CHANGE

Human health is profoundly affected by weather and climate. Climate change threatens to exacerbate today's health problems – deaths from extreme weather events, cardiovascular and respiratory diseases, infectious diseases and malnutrition – whilst undermining water and food supplies, infrastructure, health systems and social protection systems.

EXPOSURE TO FLOODING DUE TO SEA LEVEL RISE



* Medium ice melting scenario

** Values rounded to nearest '00

Under a high emissions scenario, and without large investments in adaptation, an annual average of 187,400 people are projected to be affected by flooding due to sea level rise between 2070 and 2100. If emissions decrease rapidly and there is a major scale up in protection (i.e. continued construction/raising of dikes) the annual affected population could be limited to about 100 people. Adaptation alone will not offer sufficient protection, as sea level rise is a long-term process, with high emissions scenarios bringing increasing impacts well beyond the end of the century.

Source: Human dynamics of climate change, technical report, Met Office, HM Government, UK, 2014.



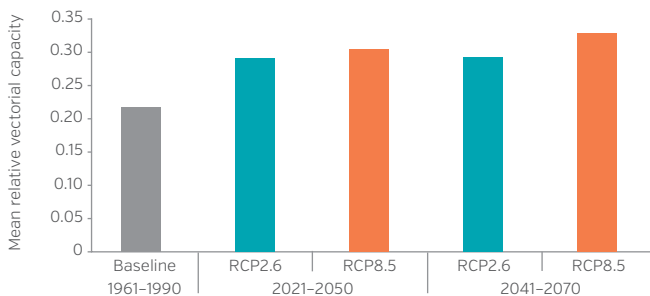
KEY IMPLICATIONS FOR HEALTH

Morocco also faces inland river flood risk. It is projected, that by 2030, an additional 133,500 people may be at risk of river floods annually as a result of climate change above the estimated 155,700 annually affected population in 2010.^a

In addition to deaths from drowning, flooding causes extensive indirect health effects, including impacts on food production, water provision, ecosystem disruption, infectious disease outbreak and vector distribution. Longer term effects of flooding may include post-traumatic stress and population displacement.

INFECTIOUS AND VECTOR-BORNE DISEASES

Mean relative vectorial capacity for dengue fever transmission in Morocco



Under a high emissions scenario, the mean relative vectorial capacity for dengue fever transmission is projected to increase to 0.33 by 2070 compared to the baseline value of 0.22. If emissions decrease rapidly, the mean relative vectorial capacity could be limited to about 0.29 by 2070.

Source: Rocklöv, J., Quam, M. et al., 2015.^d

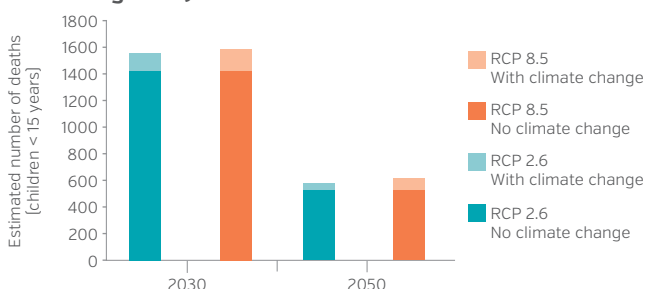


KEY IMPLICATIONS FOR HEALTH

Some of the world's most virulent infections are also highly sensitive to climate: temperature, precipitation and humidity have a strong influence on the life-cycles of the vectors and the infectious agents they carry and influence the transmission of water and food-borne diseases.^b

Socioeconomic development and health interventions are driving down burdens of several infectious diseases, and these projections assume that this will continue. However, climate conditions are projected to become significantly more favourable for transmission, slowing progress in reducing burdens, and increasing the populations at risk if control measures are not maintained or strengthened.^c

Estimated number of deaths due to diarrhoeal disease in children under 15 years in Morocco (base case scenario for economic growth)



In the baseline year of 2008 there were an estimated 4,200 diarrhoeal deaths in children under 15 years old. Under a high emissions scenario, diarrhoeal deaths attributable to climate change in children under 15 years old are projected to be about 10.5% of approximately 1600 diarrhoeal deaths projected in 2030. Although diarrhoeal deaths are projected to decline to just over 600 by 2050 the proportion of deaths attributable to climate change could rise to approximately 14.7%.

Source: Lloyd, S., 2015.^d

a World Resources Institute, Aqueduct Flood Analyser; Assumes continued current socio-economic development trends [SSP2] and a 10-year flood plan.

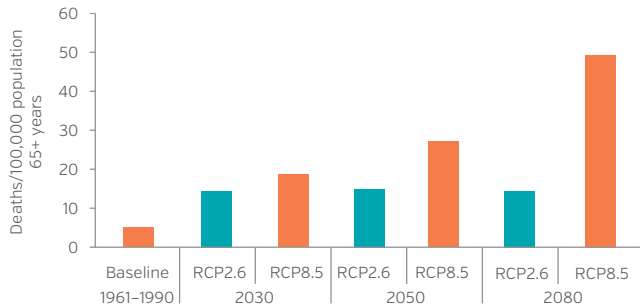
b Atlas of Health and Climate, World Health Organization and World Meteorological Organization, 2012

c Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014.

d Country-level analysis, completed in 2015, was based on health models outlined in the Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014.

HEAT-RELATED MORTALITY

Heat-related mortality in population 65 years or over, Morocco (deaths / 100,000 population 65+ years)



Under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to almost 50 deaths per 100,000 by 2080 compared to the estimated baseline of just under 5 deaths per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to just over 14 deaths per 100,000 in 2080.

Source: Honda et al., 2015.^a



KEY IMPLICATIONS FOR HEALTH

Climate change is expected to increase mean annual temperature and the intensity and frequency of heat waves resulting in a greater number of people at risk of heat-related medical conditions.

The elderly, children, the chronically ill, the socially isolated and at-risk occupational groups are particularly vulnerable to heat-related conditions.

UNDERNUTRITION

Climate change, through higher temperatures, land and water scarcity, flooding, drought and displacement, negatively impacts agricultural production and causes breakdown in food systems. These disproportionately affect those most vulnerable to hunger and can lead to food insecurity. Vulnerable groups risk further deterioration into food and nutrition crises if exposed to extreme weather events.^b

Without considerable efforts made to improve climate resilience, it has been estimated that the risk of hunger and malnutrition globally could increase by up to 20 percent by 2050.^b

In Morocco, the prevalence of child malnutrition in children under age 5 was 3.1% in 2011.^c

a Country-level analysis, completed in 2015, was based on health models outlined in the Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014.

b World Food Project 2015 <https://www.wfp.org/content/two-minutes-climate-change-and-hunger>

c World Health Organization, Global Database on Child Growth and Malnutrition [2015 edition]. Child malnutrition estimates are for % underweight, defined as: Percentage of children aged 0–59 months who are below minus two standard deviations from median weight-for-age of the World Health Organization (WHO) Child Growth Standards.

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CURRENT EXPOSURES AND HEALTH RISKS DUE TO AIR POLLUTION

Many of the drivers of climate change, such as inefficient and polluting forms of energy and transport systems, also contribute to air pollution. Air pollution is now one of the largest global health risks, causing approximately seven million deaths every year. There is an important opportunity to promote policies that both protect the climate at a global level, and also have large and immediate health benefits at a local level.

OUTDOOR AIR POLLUTION AND SHORT LIVED CLIMATE POLLUTANTS



KEY IMPLICATIONS FOR HEALTH

Outdoor air pollution can have direct and sometimes severe consequences for health. Fine particles which penetrate deep into the respiratory tract subsequently increase mortality from respiratory infections, lung cancer and cardiovascular disease.

Short-lived climate pollutants (SLCPs) such as black carbon, methane and tropospheric ozone are released through inefficient use and burning of biomass and fossil fuels for transport, housing, power production, industry, waste disposal (municipal and agricultural) and forest fires. SLCPs are responsible for a substantial fraction of global warming as well as air-pollution related deaths and diseases.

Since short lived climate pollutants persist in the atmosphere for weeks or months while CO₂ emissions persist for years, significant reductions of SLCP emissions could result in immediate health benefits and health cost savings,^a and generate very rapid climate benefits – helping to reduce near-term climate change by as much as 0.5°C before 2050.^a

In Morocco, it is projected that a reduction in SLCPs* could prevent almost 2,000 premature deaths per year from outdoor air pollution, from 2030 onwards [Source: Shindell, D., Science, 2012].

*Through implementation of 14 reduction measures: 7 targeting methane emissions and the rest, emissions from incomplete combustion. See source for further detail.

HOUSEHOLD AIR POLLUTION

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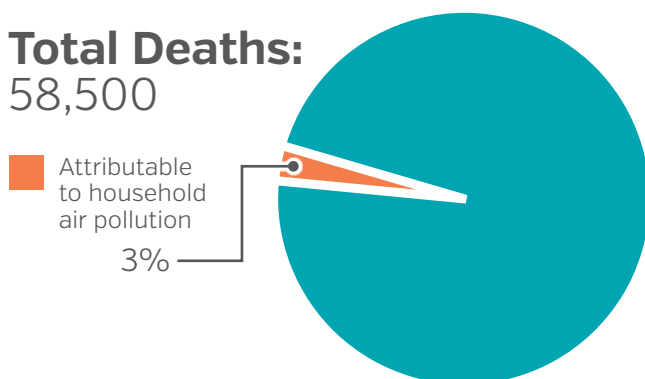
Percentage of population primarily using solid fuels for cooking [%], 2013



Source: Global Health Observatory, data repository, World Health Organization, 2013

Percent of total deaths from ischaemic heart disease, stroke, lung cancer, chronic obstructive pulmonary disease (18 years +) and acute lower respiratory infections (under 5 years) attributable to household air pollution, 2012

Total Deaths:
58,500



Source: Global Health Observatory, data repository, World Health Organization, 2012



KEY IMPLICATIONS FOR HEALTH

Air pollution in and around the home is largely a result of the burning of solid fuels (biomass or coal) for cooking.

Women and children are at a greater risk for disease from household air pollution. Consequently, household air pollution is responsible for a larger proportion of the total number of deaths from ischaemic heart disease, stroke, lung cancer and COPD in women compared to men.^b

In Morocco, 5% percent of an estimated 2,900 child deaths due to acute lower respiratory infections is attributable to household air pollution [WHO, 2012].

a United Nations Environment Programme. Reducing Climate-related Air Pollution and Improving Health: Countries can act now and reap immediate benefits. <http://www.unep.org/ccac/Media/PressReleases/ReducingClimate-relatedAirPollution/tabid/131802/language/en-US/Default.aspx>

b Annu. Rev. Public. Health. 2014.35:185-206. http://www.who.int/phe/health_topics/outdoorair/databases/HAP_BoD_results_March2014.pdf?ua=1

CO-BENEFITS TO HEALTH FROM CLIMATE CHANGE MITIGATION

Health co-benefits are local, national and international measures with the potential to simultaneously yield large, immediate public health benefits and reduce the upward trajectory of greenhouse gas emissions. Lower carbon strategies can also be cost-effective investments for individuals and societies.

Presented here are examples of opportunities for health co-benefits that could be realised by action in important greenhouse gas emitting sectors.^a



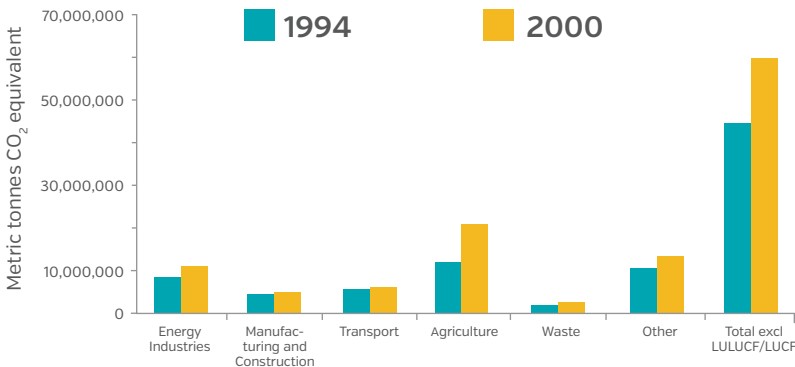
^a For a complete list of references used in the health co-benefits text please see the Climate and Health Country Profile Reference Document, at: <http://www.who.int/globalchange/en/>

5

EMISSIONS AND COMMITMENTS

Global carbon emissions increased by 80% from 1970 to 2010, and continue to rise.^{a,b} Collective action is necessary, but the need and opportunity to reduce greenhouse gas emissions varies between countries. Information on the contribution of different sectors, such as energy, manufacturing, transport and agriculture, can help decision-makers to identify the largest opportunities to work across sectors to protect health, and address climate change.

MOROCCO ANNUAL GREENHOUSE GAS EMISSIONS [metric tonnes CO₂ equivalent]



A 2°C upper limit of temperature increase relative to pre-industrial levels has been internationally agreed in order to prevent severe and potentially catastrophic impacts from climate change. Reductions are necessary across countries and sectors. In order to stay below the 2°C upper limit it is estimated that global annual CO₂-energy emissions, currently at 5.2 tons per capita, need to be reduced to 1.6 tons per capita.^c

The most recent greenhouse gas emissions data for Morocco is from 2000. At that time, carbon emissions were increasing across sectors, with the largest contributions from the agriculture, energy industries sectors and 'other' sectors. Through intersectoral collaboration, the health community can help to identify the best policy options not only to eventually stabilize greenhouse gas emissions, but also to provide the largest direct benefits to health.

Source: UNFCCC Greenhouse Gas Data Inventory, UNFCCC [2015].

NATIONAL RESPONSE^d

1995	MOROCCO RATIFIES THE UNFCCC
2002	MOROCCO RATIFIES KYOTO PROTOCOL
2009	MOROCCO'S NATIONAL PLAN AGAINST GLOBAL WARMING
2010	LAW ON THE NATIONAL AGENCY FOR THE DEVELOPMENT OF RENEWABLE ENERGY AND ENERGY EFFICIENCY
2030	MOROCCO'S COMMITMENT TO REDUCE GHG EMISSIONS 32% BY 2030 COMPARED TO THE "BUSINESS AS USUAL" PROJECTED EMISSIONS

a Boden, T.A., G. Marland, and R.J. Andres [2010]. Global, Regional, and National Fossil-Fuel CO₂ Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001_V2010.

b IPCC [2014] Blanco G., R. Gerlagh, S. Suh, J. Barrett, H.C. de Coninck, C.F. Diaz Morejon, R. Mathur, N. Nakicenovic, A. Ofosu Ahenkora, J. Pan, H. Pathak, J. Rice, R. Richels, S.J. Smith, D.I. Stern, F.L. Toth, and P. Zhou, 2014: Drivers, Trends and Mitigation. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeyer, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx [eds.]]. Cambridge University Press, Cambridge, United Kingdom

c Pathways to deep decarbonization, Sustainable development Solutions Network, 2014 report.

d Columbia Law School, 'Climate Change Laws Of The World'. N.p., 2015.

The following table outlines the status of development or implementation of climate resilient measures, plans or strategies for health adaptation and mitigation of climate change [reported by countries].^a

GOVERNANCE AND POLICY	
Country has identified a national focal point for climate change in the Ministry of Health	✓
Country has a national health adaptation strategy approved by relevant government body	✓
The National Communication submitted to UNFCCC includes health implications of climate change mitigation policies	✓
HEALTH ADAPTATION IMPLEMENTATION	
Country is currently implementing projects or programmes on health adaptation to climate change	✓
Country has implemented actions to build institutional and technical capacities to work on climate change and health	✗
Country has conducted a national assessment of climate change impacts, vulnerability and adaptation for health	✓
Country has climate information included in Integrated Disease Surveillance and Response (IDSR) system, including development of early warning and response systems for climate-sensitive health risks	✗
Country has implemented activities to increase climate resilience of health infrastructure	✓
FINANCING AND COSTING MECHANISMS	
Estimated costs to implement health resilience to climate change included in planned allocations from domestic funds in the last financial biennium	✗
Estimated costs to implement health resilience to climate change included in planned allocations from international funds in the last financial biennium	✗
HEALTH BENEFITS FROM CLIMATE CHANGE MITIGATION	
The national strategy for climate change mitigation includes consideration of the health implications (health risks or co-benefits) of climate change mitigation actions	✓
Country has conducted valuation of co-benefits of health implications of climate mitigation policies	✗

a Supporting monitoring efforts on health adaptation and mitigation of climate change: a systematic approach for tracking progress at the global level. WHO survey, 2015.

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To ensure readability, health estimates and projections have been presented without the margins of uncertainty which are available upon request.