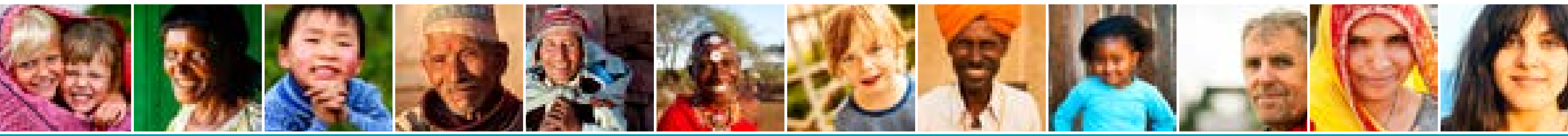
CLIMATE AND HEALTH COUNTRY PROFILE – 2015
BRAZIL

World Health Organization

United Nations Framework Convention on Climate Change



COUNTRY OVERVIEW

Brazil, with a population over 200 million[a], has experienced a period of steady economic growth which has led to a reduction in poverty and efforts to reduce inequality [World Bank, 2015]. Brazil plays an important and unique role in climate change: it has one of the largest economies in the world and has one of the largest ecosystems and forests on the planet, the Amazon. Brazil is vulnerable to climate change impacts, including reduced water availability, risk of coastal flooding, and health risks associated with heat stress and changing patterns of climate sensitive vector-borne diseases such as malaria and dengue fever. Brazil has announced that it intends to commit to reduce greenhouse gas emissions by 37% below 2005 levels by 2025 (Intended Nationally determined Contribution submitted to UNFCCC by Federative Republic of Brazil). The participation of Brazil in global efforts to mitigate climate change provides an opportunity to protect the fragile ecosystem of Brazil alongside promoting positive health outcomes.

SUMMARY OF KEY FINDINGS

- Under a high emissions scenario, mean annual temperature is projected to rise by about 5.4°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 heat-related deaths in the elderly (65+ years) are projected to increase to about 72 deaths per 100,000 by 2080 compared to the estimated baseline of about 1 death per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to approximately 13 deaths per 100,000 in 2080.
- Under a high emissions scenario, and without large investments in adaptation, an annual average of 618,000 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 3,200 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.
- By 2070, over 168 million people are projected to be at risk of malaria assuming a high emissions scenario. If emissions decrease rapidly, projections indicate this number could be limited to about 126 million.

OPPORTUNITIES FOR ACTION

Brazil has an approved national heath adaptation strategy and is taking initiatives to implement health adaptation programmes. Additionally, Brazil is implementing actions to build institutional and technical capacity to work on climate change and health. Country reported data (see section 6) indicate there are further opportunities for action in the following areas:

1) Adaptation

- Roll out activities to increase climate resilience of health infrastructure.
- Estimate costs to implement health resilience to climate change.

2) Mitigation

- Conduct valuation of co-benefits to health of climate change mitigation policies.

3) National Policy Implementation

- Develop a national strategy for climate change mitigation which considers the health implications of climate change mitigation actions.

DEMOGRAPHIC ESTIMATES	
Population (2013)[a]	204 million
Population growth rate (2013)[a]	0.9%
Population living in urban areas (2013)[b]	85.2%
Population under five (2013)[a]	7.3%
Population aged 65 or older (2013)[a]	7.3%
ECONOMIC AND DEVELOPMENT INDICATORS	
GDP per capita (current US$, 2013)[c]	11,711 USD
Total expenditure on health as % of GDP (2013)[d]	9.7%
Percentage share of income for lowest 20% of population (2012)[c]	3.4%
HDI (2013, +/- 0.01 change from 2005 is indicated with arrow)[e]	0.744 ▲
HEALTH ESTIMATES	
Life expectancy at birth (2013)[f]	75 years
Under-5 mortality per 1000 live births (2013)[g]	16

a World Population Prospects: The 2015 Revision, UNDESA (2015)
b World Urbanization Prospects: The 2014 Revision, UNDESA (2014)
c World Development Indicators, World Bank (2015)
d Global Health Expenditure Database, WHO (2014)
e United Nations Development Programme, Human Development Reports (2014)
f Global Health Observatory, WHO (2014)
g Levels & Trends in Child Mortality Report 2015, UN Inter-agency Group for Child Mortality Estimation (2015)

1 CURRENT AND FUTURE CLIMATE HAZARDS

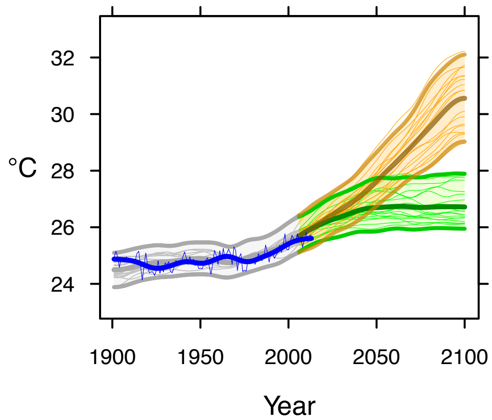
Due to climate change, many climate hazards and extreme weather events, such as heat waves, heavy rainfall and droughts, could become more frequent and more intense in many parts of the world.

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

COUNTRY-SPECIFIC CLIMATE HAZARD PROJECTIONS

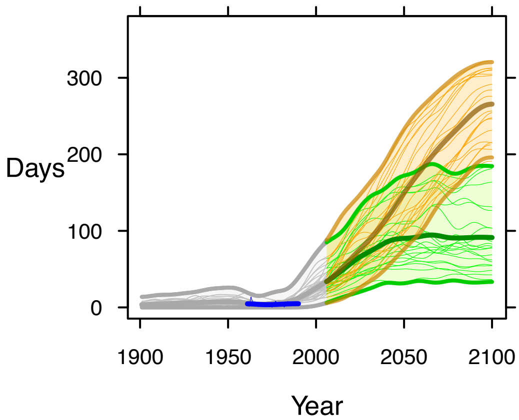
The model projections below present climate hazards under a high emissions scenario, Representative Concentration Pathway 8.5 [RCP8.5] (in orange) and a low emissions scenario, [RCP2.6] (in green).[a] The text boxes describe the projected changes averaged across about 20 models (thick line). The figures 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



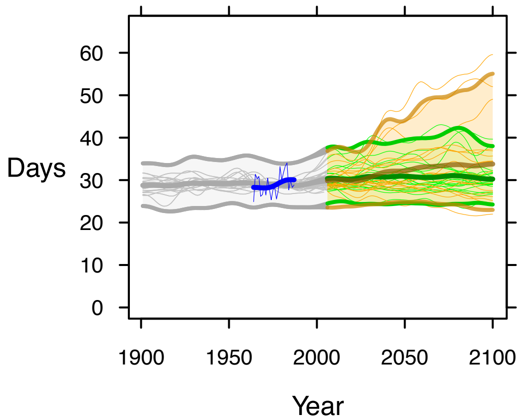
Under a high emissions scenario, mean annual temperature is projected to rise by about 5.4°C on average from 1990 to 2100. If emissions decrease rapidly, the temperature rise is limited to about 1.6°C.

DAYS OF WARM SPELL ('HEAT WAVES')



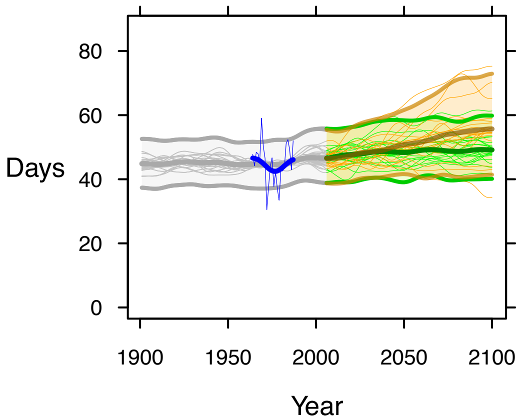
Under a high emissions scenario, the number of days of warm spell[d] is projected to increase from less than 10 days in 1990 to about 265 days on average in 2100. If emissions decrease rapidly, the days of warm spell are limited to about 90 on average.

DAYS WITH EXTREME RAINFALL ('FLOOD RISK')



Under a high emissions scenario, the number of days with very heavy precipitation (20 mm or more) could increase by about 5 days on average from 1990 to 2100, increasing the risk of floods. Some models indicate increases well outside the range of historical variability, implying even greater risk. If emissions decrease rapidly, the increase in risk is much reduced.

CONSECUTIVE DRY DAYS ('DROUGHT')



Under a high emissions scenario, the longest dry spell is indicated to increase from an average of about 45 days to about 55 days, with continuing large year-to-year variability. If emissions decrease rapidly, the anticipated changes in the length of dry spells are considerably reduced.

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.

2 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

Severity of climate change scenario	Without Adaptation	With Adaptation
RCP2.6	156,400	3,200
RCP8.5	618,000	6,200

* Medium ice melting scenario ** Values rounded to nearest '00

Under a high emissions scenario, and without large investments in adaptation, an annual average of 618,000 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 3,200 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.

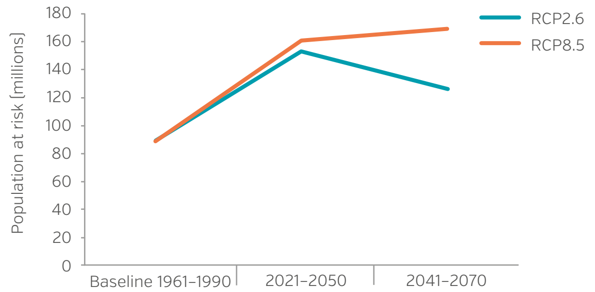
KEY IMPLICATIONS FOR HEALTH

Brazil also faces inland river flood risk due to climate change. Under a high emissions scenario, it is projected that by 2030, 78,600 additional people may be at risk of river floods annually due to climate change and 82,600 due to socio-economic change above the estimated 505,000 annual 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

Population at risk of malaria in Brazil (in millions)



By 2070, over 168 million people are projected to be at risk of malaria assuming a high emissions scenario. If emissions decrease rapidly, projections indicate this number could be limited to about 126 million.

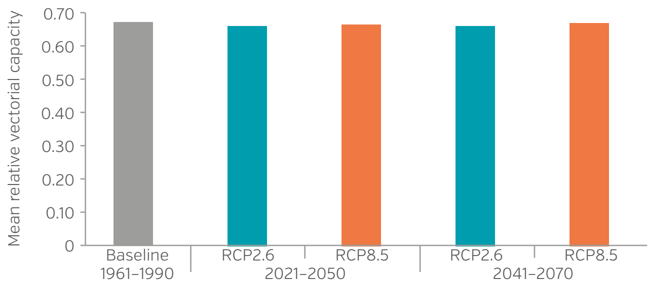
Source: Rocklöv, J., Quam, M. et al. 2015.[d]

KEY IMPLICATIONS FOR HEALTH

Some of the worlds 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]

Mean relative vectorial capacity for dengue fever transmission in Brazil



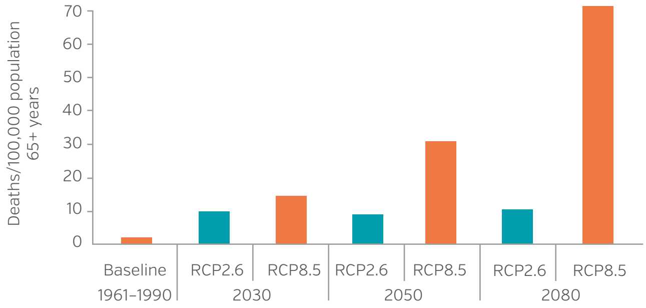
The mean relative vectorial capacity for dengue fever transmission is projected to remain at almost the same level from the baseline period towards 2070. This level, about 0.67, is a relatively high endemic transmission level. Co-factors such as urbanization, development and population movements may modify the disease burdens associated with dengue, and make the disease cross new sub-national borders.

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

a World Resources Institute, Aqueduct Flood Analyser; Assumes continued current socio-economic development trends (SSP2) and a 25-year flood plan.
b Atlas of Health and Climate, WHO & WMO 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, Brazil (deaths / 100,000 population 65+ years)



Under a high emissions scenario heat-related deaths in the elderly (65+ years) are projected to increase to about 72 deaths per 100,000 by 2080 compared to the estimated baseline of about 1 death per 100,000 annually between 1961 and 1990. A rapid reduction in emissions could limit heat-related deaths in the elderly to approximately 13 deaths per 100,000 in 2080.

Source: Honda et al., 2015.[a]

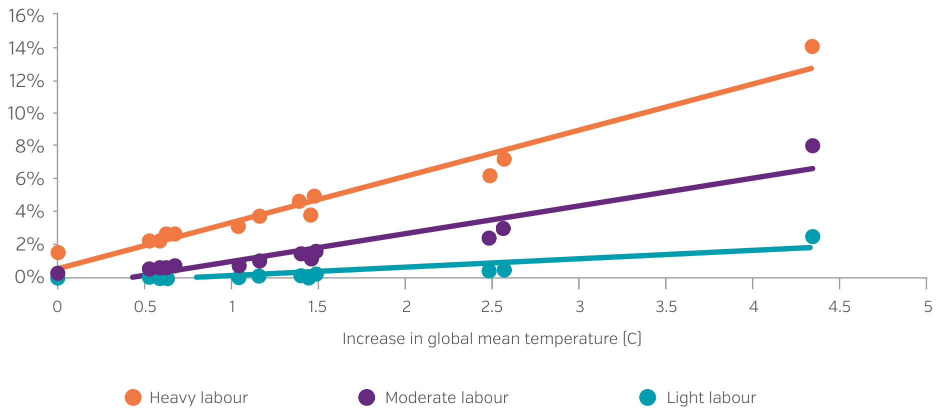
KEY IMPLICATIONS FOR HEALTH

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.

HEAT STRESS AND LABOUR PRODUCTIVITY

Annual daily work hours lost in relation to change in global mean temperature, Brazil (%)



Labour productivity is projected to decline siginifcantly under a high emissions scenario. If global mean temperature rises 4 degrees, approximately 12% of annual daily work hours is projected to be lost by workers carrying out heavy labour (e.g. agricultural, construction and some industrial workers).

Source: Kjellstrom, T. et al., 2015 http://www.climatechip.org/

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 disproportionally 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 Brazil, the prevalence of child malnutrition in children under age 5 is 2.2% (2007).[c]

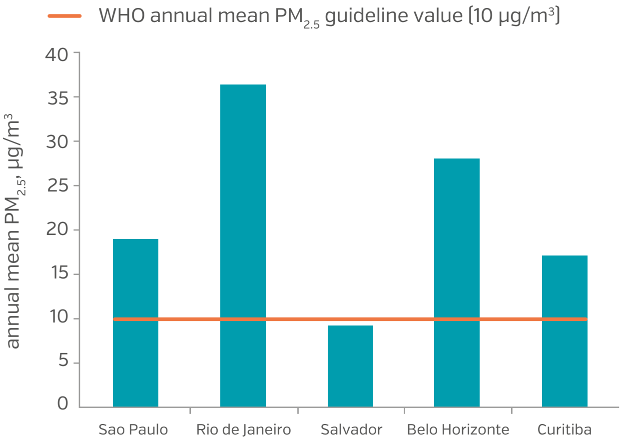
a Country-level analysis, completed in 2015, was based on health models outlined in the Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014.
b World Food Project 2015 https://www.wfp.org/content/two-minutes-climate-change-and-hunger
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.

3 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 EXPOSURE

Outdoor air pollution in cities in Brazil annual mean $PM_{2.5}$ (µg/m³) 2010 - 2012*



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.

Four out of five of the most populated cities for which there was air pollution data available had annual mean $PM_{2.5}$ levels that were above the WHO guideline value of 10 µg/m³.

Source: Ambient Air Pollution Database, WHO, May 2014.

* A standard conversion has been used for all cities presented except Sao Paulo. Please see source for information.

HOUSEHOLD AIR POLLUTION

BRAZIL

Percentage of population primarily using solid fuels for cooking (%), 2013

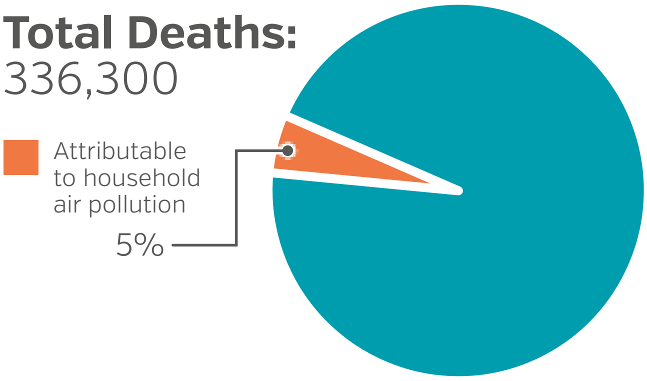
RURAL AREAS
28

URBAN AREAS
<5

NATIONAL TOTAL
5

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



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.[a]

In Brazil, 10% percent of an estimated 2,900 child deaths due to acute lower respiratory infections is due to household air pollution (WHO, 2012).

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

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

4 CO-BENEFITS TO HEALTH FROM CLIMATE CHANGE MITIGATION: A GLOBAL PERSPECTIVE

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, from a global perspective, of opportunities for health co-benefits that could be realised by action in important greenhouse gas emitting sectors.[a]

Transport

Transport injuries lead to 1.2 million deaths every year, and land use and transport planning contribute to the 2–3 million deaths from physical inactivity. The transport sector is also responsible for some 14% (7.0 $GtCO_2e$) of global carbon emissions. The IPCC has noted significant opportunities to reduce energy demand in the sector, potentially resulting in a 15%–40% reduction in CO_2 emissions, and bringing substantial opportunities for health: A modal shift towards walking and cycling could see reductions in illnesses related to physical inactivity and reduced outdoor air pollution and noise exposure; increased use of public transport is likely to result in reduced GHG emissions; compact urban planning fosters walkable residential neighborhoods, improves accessibility to jobs, schools and services and can encourage physical activity and improve health equity by making urban services more accessible to the elderly and poor.

Electricity Generation

Current patterns of electricity generation in many parts of the world, particularly the reliance on coal combustion in highly polluting power plants, contribute heavily to poor local air quality, causing cancer, cardiovascular and respiratory disease. Outdoor air pollution is responsible for 3.7 million premature deaths annually. High-income countries still have work to do in transitioning to cleaner and healthier energy sources.

The health benefits of transitioning from fuels such as coal to lower carbon sources, including ultimately to renewable energy, are clear: Reduced rates of cardiovascular and respiratory disease such as stroke, lung cancer, coronary artery disease, and COPD; cost-savings for health systems; improved economic productivity from a healthier and more productive workforce.

Food and Agriculture

Agricultural emissions account for some 5.0–5.8 $GtCO_2eq$ annually, with food and nutrition constituting an important determinant of health. Many high-income countries are feeling the burden of poor diet and obesity-related diseases, with some 1.9 billion adults overweight globally.

A wide range of interventions designed to reduce emissions from agriculture and land-use will also yield positive benefits for public health. For example, policy

Healthcare Systems

Health care activities are an important source of greenhouse gas emissions. In the US and in EU countries, for example, health care activities account for between 3–8% of greenhouse gas (CO_2-eq) emissions. Major sources include procurement and inefficient energy consumption. Modern, on-site, low-carbon energy solutions (e.g. solar, wind, or hybrid solutions) and the development of combined heat and power generation capacity in larger facilities offer significant potential to lower the health sector's carbon

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