Mapping climate change and health indicators

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Contents

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Abbreviations

ATACH	Alliance for Transformative Action on Climate and Health
ENSO	El Niño-Southern Oscillation
GGA	Global Goal on Adaptation
GHG	greenhouse gas
GPW-14	Fourteenth General Programme of Work (WHO)
HNAP	health national adaptation plan
NCDs	noncommunicable diseases
O_3	ozone
$PM_{2.5}$	fine particulate matter
UV	ultraviolet
V&A	vulnerability and adaptation assessment
WASH	water, sanitation and hygiene
WHA	World Health Assembly
WHO	World Health Organization

Executive summary

This report identifies indicators being used by countries in assessments of their current and future vulnerability to the health risks of climate change (known as vulnerability and adaptation assessments, V&As) and reports on health national adaptation plans (HNAPs), submitted to the United Nations Framework Convention on Climate Change.

The review process included evaluating reports from member countries of the Alliance for Transformative Action on Climate and Health (known as ATACH), from all six regions of the World Health Organization, that were available on the Alliance's website from January 2015 to November 2024. A total of 31 reports from 22 countries were available, of which 15 were V&As and 16 were HNAPs. This report identified common indicators used by countries as well as differences in indicators and approaches.

Overall, 3 880 indicators were extracted, although many of them were not written as indicators; however, their conversion to indicators was feasible. The summary indicator tables were developed from these data. Indicators were categorized by the main areas that emerged from evaluating the causal pathways between climate change and health, which include hazards, exposures, vulnerabilities, climate-sensitive health outcomes and their impacts on health systems and facilities, future changes in the climate and in health risks, and enabling factors.

The mapping exercise summarized the indicators identified, removed repetitions and merged similar indicators, resulting in 1 684 summary indicators.

This report found inconsistencies among countries in their understanding of the indicators, the definitions used for them, and their application. Nevertheless, countries are using their indicators to support national and local decision-making processes.

Further discussion with countries and experts is needed to decide whether a core set of common indicators would be useful to assist countries in conducting both V&As and HNAPs. The summary list of indicators identified here can be used for that purpose.

Introduction

In 2024, the World Health Assembly (WHA) approved two key initiatives that had a major impact of climate change and health globally. The first was the World Health Organization's (WHO) Fourteenth General Programme of Work (GPW-14) *(1)*. The second was WHA Resolution 77.14 addressing climate change and health *(2)*. Both introduced strong mandates to encourage the development of indicators.

The GPW-14 has six strategic objectives, one of which is to respond to climate change, an escalating health threat in the 21st century. This objective has two joint outcomes and two indicators *(1)*. The first indicator is "more climate-resilient health systems are addressing health risks and impacts", and this is to be measured as an "index of national climate change and health capacity". The second indicator is "lower-carbon health systems and societies are contributing to health and well-being", which is to be measured using "health care sector greenhouse gas emissions".

Resolution WHA 77.14 on climate change and health calls upon Member States to commit to

> "integrate climate data into existing monitoring, early warning, surveillance and data collection systems, including data disaggregated by sex, age, disability and any other relevant factor, where appropriate, to enable evidence-based decision-making and targeted interventions that respond to the impacts of climate change, including loss and damage, on health and health systems as well as health sector impacts on the environment *(2)*.

This report is a contribution to this call and it aims to identify the common indicators used by countries, as well as to support urgent action to address gaps and needs in data collection and use.

In addition to this, the Global Goal on Adaptation (GGA), established in 2015 within the Paris Agreement, is relevant to this discussion. The goal is to assess progress in enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change. There are 11 targets for which indicators are being developed, one of which focuses on health. This target aims to achieve resilience against climate change-related health impacts, promote climate-resilient health services, and significantly reduce climate-related morbidity and mortality, particularly in the most vulnerable communities.

Mapping indicators based on current country assessments

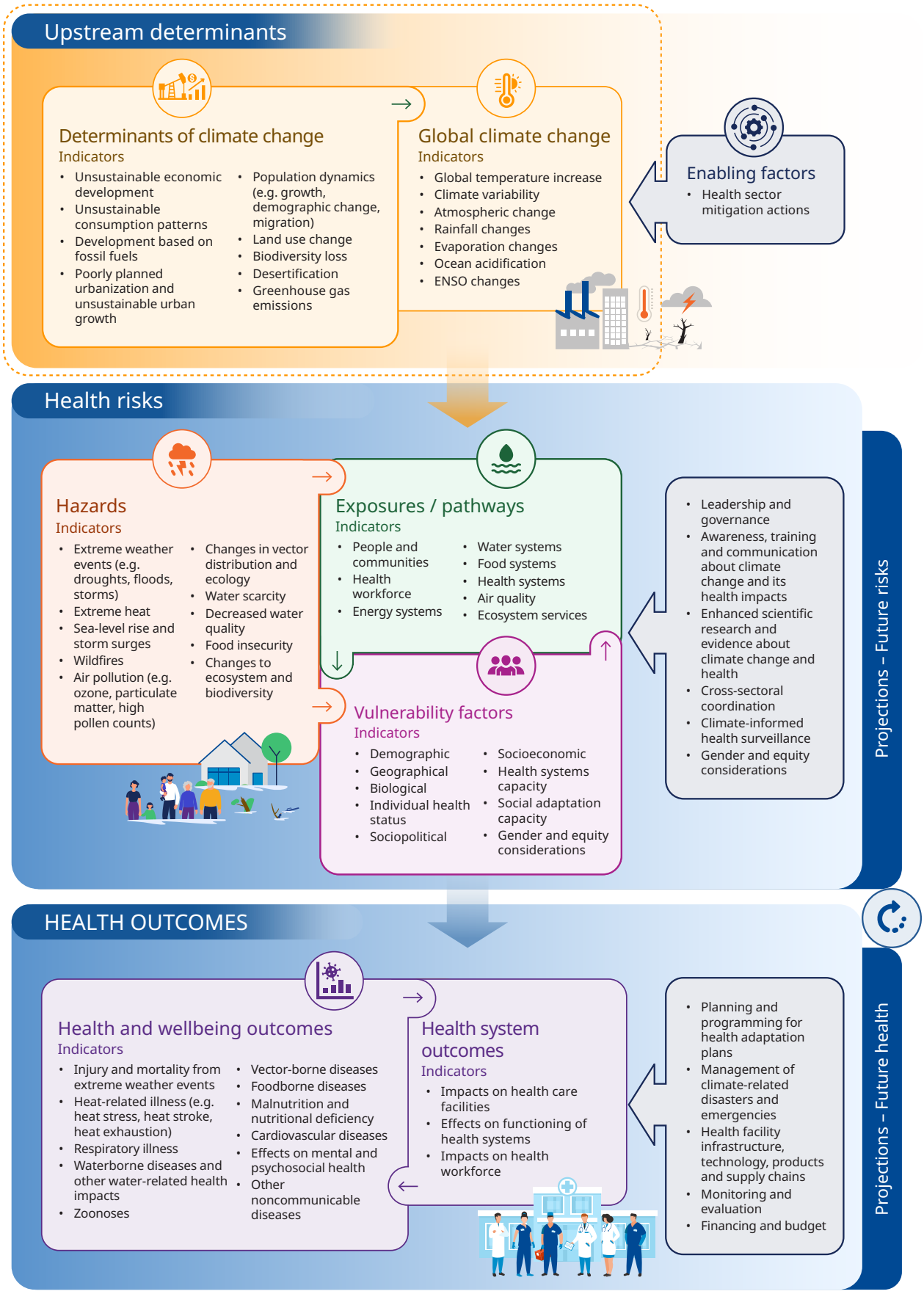
WHO has developed guidance and tools to help countries assess their vulnerabilities, adaptations and capacities, as well as to implement action to respond to the health threats from climate change. In 2013, WHO began the process of assessing vulnerabilities and adaptation actions in countries, first by developing guidance *(3)*, and then by offering direct support to countries. In 2021, the guidance was updated by incorporating a simpler tool and lessons learned from the more than 50 vulnerability and adaptation assessments (V&As) that had been conducted *(4)*.

In 2014, WHO developed guidance to support countries in their submissions to the United Nations Framework Convention on Climate Change as they related to the process of preparing their national adaptation plans *(5)*. The 2014 report guides countries on incorporating health into the national adaptation plan process, and these new plans became known as health national adaptation plans (HNAPs). This process includes assessing risks; identifying, prioritizing and implementing adaptation options; and monitoring and evaluating the adaptation process. To further support this process and assist countries in conducting their HNAPs, in 2021 WHO launched *Quality criteria for health national adaptation plans (6)*.

Both the V&A and the HNAP processes identify and use indicators, for climate-related hazards, exposures and vulnerabilities, or for health-related impacts and response actions. This report presents a collection of indicators used by countries in their V&As and HNAPs. The report summarizes the indicators that are proposed explicitly or implicitly by countries in the V&As and HNAPs reports assessed, but doesn't attempt to assess their relevance or quality, or the availability of data that would allow them to be monitored. Complete V&A and HNAP country reports are available on the website of the Alliance for Transformative Action on Climate and Health (ATACH) *(7)*. It is expected that most countries will continue to adopt both V&As and HNAPs as part of actions taken to address climate change and its health impacts. Therefore, this report may help countries by summarizing information about what other countries have done and helping to identify ways to improve and, if possible, standardize the use of indicators.

Based on several WHO reports that describe the causal pathways between climate change and heath, and following both the framework described in *Measuring the climate resilience of health systems (8)* and the overview of the pathways between climate change and health developed by ATACH *(9)*, a comprehensive template to map the indicators identified from different sources was developed. Fig. 1 shows the causal pathways and the most common indicator areas identified in V&A and HNAP reports.

Fig. 1. Causal pathways linking climate change and health, with identified areas used to map the indicators[a]



ENSO: El Niño-Southern Oscillation.

[a] Most of the upstream determinants are addressed by other sectors, and these are highlighted with a dashed border. The only upstream-level indicator included in this report is climate change mitigation actions taken by the health sector.

Review process

This report consists of a selection of V&As and HNAPs from different ATACH member countries and an in-depth assessment of all indicators collected; the reports include Members States from all six WHO regions.

V&A and HNAP reports were included if they:

- were available on the ATACH progress tracker *(7)*;
- had data from 1 January 2015 to 1 November 2024 (i.e. 10 years);
- were written in English, French, Portuguese or Spanish.

The review had two stages. The first was the extraction of indicators from the country reports. The second stage was the mapping exercise that resulted in the summarized indicators.

Extracting indicators from country reports

Based on the causal pathways for climate change and health described in Fig. 1, the following six templates were used to extract indicators from the country reports:

(i) hazards;

(ii) exposures and exposure pathways;

(iii) vulnerabilities;

(iv) climate-sensitive health outcomes and impacts on health systems and health facilities;

(v) hazards and health outcomes linked to future climate change and associated health risks;

(vi) enabling factors.

Templates used to extract indicators

The templates used to extract the indicators are shown below. For each report, the country, type of report and the year of the report were noted, followed by information about who developed the report, as shown below and in Template tables 1–6.

Country:	Report/year:	Developed by:

Template table 1. Hazards

Country:	
Climate hazards	**Hazard-related indicators identified**
Increased temperature and extreme heat	
Precipitation changes and rainfall patterns	
Floods	
Droughts	
Storms	
Sea-level rise (including storm surges)	
Wildfires	
Air pollution	
Changes in vector distribution and ecology	
Water scarcity and quality	
Food security and safety	
Changes to the ecosystem and biodiversity	
Other	

Template table 2. Exposures and exposure pathways

Country:	
Exposures	**Indicators of hazard-related exposures identified**
People and communities	
Health workforce	
Energy systems	
Water systems	
Food systems	
Health systems	
Air quality	
Ecosystem services	

Template table 3. Vulnerability factors

Country:	
Vulnerability factors	**Vulnerability indicators identified**
Demographic	
Geographical	
Biological	
Sociopolitical	
Socioeconomic	
Health systems capacity	
Social adaptation capacity	
Gender and equity considerations	
Other	

Template table 4. Climate-sensitive health outcomes and impacts on health systems and health facilities

Country:	
Climate-sensitive health outcomes and impacts on health systems and health facilities	**Health indicators identified**
Injuries and mortality from extreme weather events	
Vector-borne diseases and zoonotic diseases	
Waterborne diseases and water-related diseases	
Foodborne diseases	
Malnutrition and nutritional deficiency	
Respiratory illnesses	
Cardiovascular diseases	
Heat-related illnesses	
Mental and psychosocial health	
Other noncommunicable diseases	
Other climate-sensitive diseases or health outcomes	
Impacts on health systems, facilities and workforce	
Impacts on other systems	

Template table 5. Hazards and health outcomes linked to future climate change and associated health risks

Country:	
Future changes and health risks	
Projection of future climate change	
Projection of future climate-related health outcomes	

Template table 6. Enabling factors

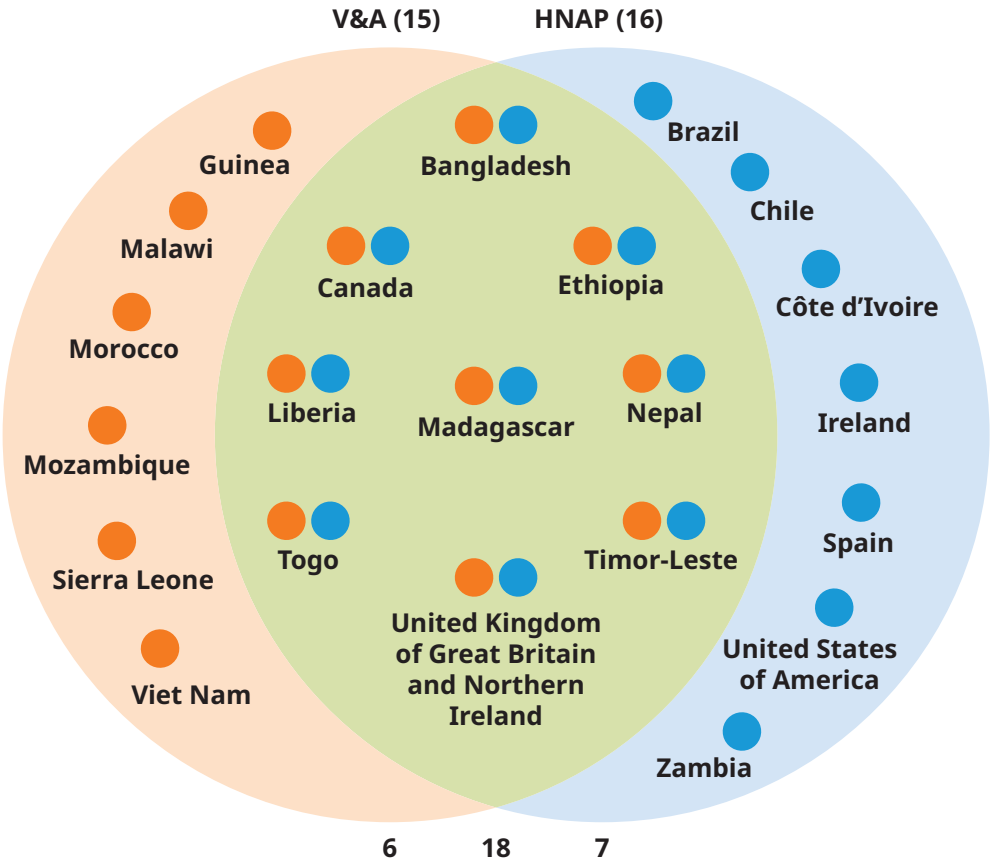
Country:	
Health sector governance policies	**Enabling factors**
Leadership and governance	
Awareness, training and communication about climate change and its health impacts	
Enhanced scientific research and evidence about climate change and health	
Cross-sectoral coordination	
Climate-informed health surveillance	
Gender and equity considerations	
Planning and programming for health adaptation plans	
Management of climate-related disasters and emergencies	
Health facility infrastructure, technology, products and supply chains	
Monitoring and evaluation	
Financing and budget	
Health sector mitigation actions	

Mapping the extracted indicators

A total of 31 reports were reviewed, of which 15 were V&As and 16 were HNAPs, from 22 countries (Bangladesh, Brazil, Canada, Chile, Côte d'Ivoire, Ethiopia, Guinea, Ireland, Liberia, Madagascar, Malawi, Morocco, Mozambique, Nepal, Sierra Leone, Spain, Timor-Leste, Togo, United Kingdom of Great Britain and Northern Ireland, United States of America, Viet Nam, and Zambia) (Fig. 2). Although thousands of indicators were extracted from the country reports reviewed, as expected there were many repetitions of common themes; many were proposed indicators that are not being used; and others were statements not written as indicators, although at least some could be converted into indicators. The indicator extraction work did not eliminate the repetitions and did not attempt to improve the wording of collected or proposed indicators in the tables. However, the mapping exercise not only

summarized the indicators identified but also removed the repetitions and categorized indicators under the main areas that emerged.

Fig. 2. Vulnerability and adaptation assessments (15 reports) and Health national adaptation plans (16 plans), by country, from the website of the Alliance for Transformative Action on Climate and Health[a]



● V&A: Vulnerability and adaptation assessment; ● HNAP: Health national adaptation plan

[a] There were 31 reports from 22 countries. Nine countries had both a vulnerability and adaptation assessment and a health national adaptation plan.

In both V&As and HNAPs, countries detail general background information about their climate, environment, socioeconomic and demographic situations, and the health situation, including providing information about health status of the population, health infrastructure and health workers; they also list policies, structures, strategies and actions to address the effects of climate on health. National and subnational indicators used by countries included climate change hazards, exposures, vulnerabilities and health outcomes. Several reports analysed the links between some climatic variables (e.g. temperature and rainfall) and vector-borne and other communicable diseases (e.g. those that are water-mediated); high temperatures and wildfires were also analysed in tandem with some noncommunicable diseases. But specifically for climate change, the analyses were often descriptions of general health statistics, environmental statistics and socioeconomic data for issues known to be affected by climate change as reported in the literature; however, explicit connections to climate change at the local level were not made.

Similarly, relevant environmental conditions affecting water, sanitation, air pollution and related environmental threats were often listed with the understanding that they are made

worse by climate change, but, again, they were not always directly linked to the country level in the assessments. Nevertheless, the identified indicators proved useful in their intention to identify vulnerabilities, capacities and adaptations, as well as for developing and monitoring action plans. Although guidance by WHO on V&As and HNAPs contains specific steps to follow, which could facilitate the mapping of indicators, that guidance was not, was not always or was only partially followed by some countries.

Overall, there are common indicators of hazards, exposures and health outcomes. When it comes to vulnerabilities, these tend to be more specific to each country's context. This is also the case for indicators for enabling factors and response actions. In many cases, there was an intention to describe indicators, but often they were formulated as statements, which could be converted into indicators. Projections of climate and health risks tended to be generic, but were complemented by country-specific projections. Attribution was a common issue in all countries: most attributions come from the literature, but at the local level, countries found it hard to assess whether a given health outcome was the result of a climate hazard.

This section summarizes the six indicator areas, based on Template tables 1 to 6, with the aim of obtaining a set of common indicators (i.e. mapping them). Note that findings may not reflect the complete reality in each country. This is because some countries chose to focus on specific hazards or specific health outcomes, and thus did not cover the spectrum of the six areas considered here. Countries that conducted both a V&A and an HNAP used similar indicators in both reports.

The indicators extracted from country reports were mapped as identical indicators, as the same issue expressed in different ways or as not being expressed as an indicator or measurable outcome but falling within a common topic (Table 1).

Table 1. Examples of how indicators were mapped

Category	As originally reported	Converted to indicator
Identical indicator	• Annual number of heatwave days	• Annual number of heatwave days (i.e. no change)
Same issue expressed in different ways	• Mental health effects on people who experienced displacement; isolation; physical, emotional and economic stress; and loss • People with less resilience are anticipated to be most at risk of negative impacts on their mental health and well-being in the face of climatic changes • Increase in mental health effects among the population due to human and material losses, injuries, trauma caused by extreme weather events (plus other similar statements)	• Mental health impacts measured as the percentage of people experiencing stress, trauma or depression after displacement or extreme weather events

Category	As originally reported	Converted to indicator
Same topic but expressed differently and not expressed as an indicator or measurable output	• Access to health care is limited due to many obstacles, including a lack of financial means necessary for treatment, the distance from a health service, the availability of providers and medications, or transport difficulties • Access to health services poses a major concern as 70% of the population lives in rural areas in small, dispersed villages isolated by mountainous terrain and poor road conditions (plus other similar statements)	• Percentage of population without access to primary health care (e.g. rural vs urban areas)

ChatGPT (OpenAI 2024) was used to organize themes and indicators after ensuring that only generic indicators were included and no confidential information was used.

Table 2 summarizes the number of indicators extracted into each of the six categories, and shows the consolidation of indicators after repetitions and similarities were removed.

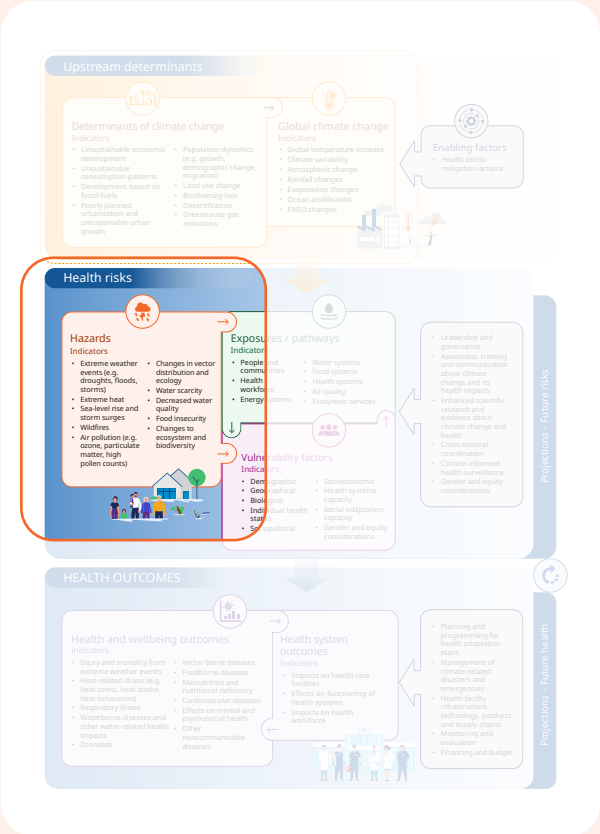
Table 2. Total number of indicators extracted, by category, and final number of mapped indicators

Category	No. of indicators extracted	Final no. of indicators
Hazards	470	317
Exposures	363	224
Vulnerabilities	710	361
Health outcomes	512	279
Projections	289	74
Enabling factors	1 536	429
Total	**3 880**	**1 684**

Common hazards across countries

Fig. 3 shows the hazards identified.

Fig. 3. Hazards identified

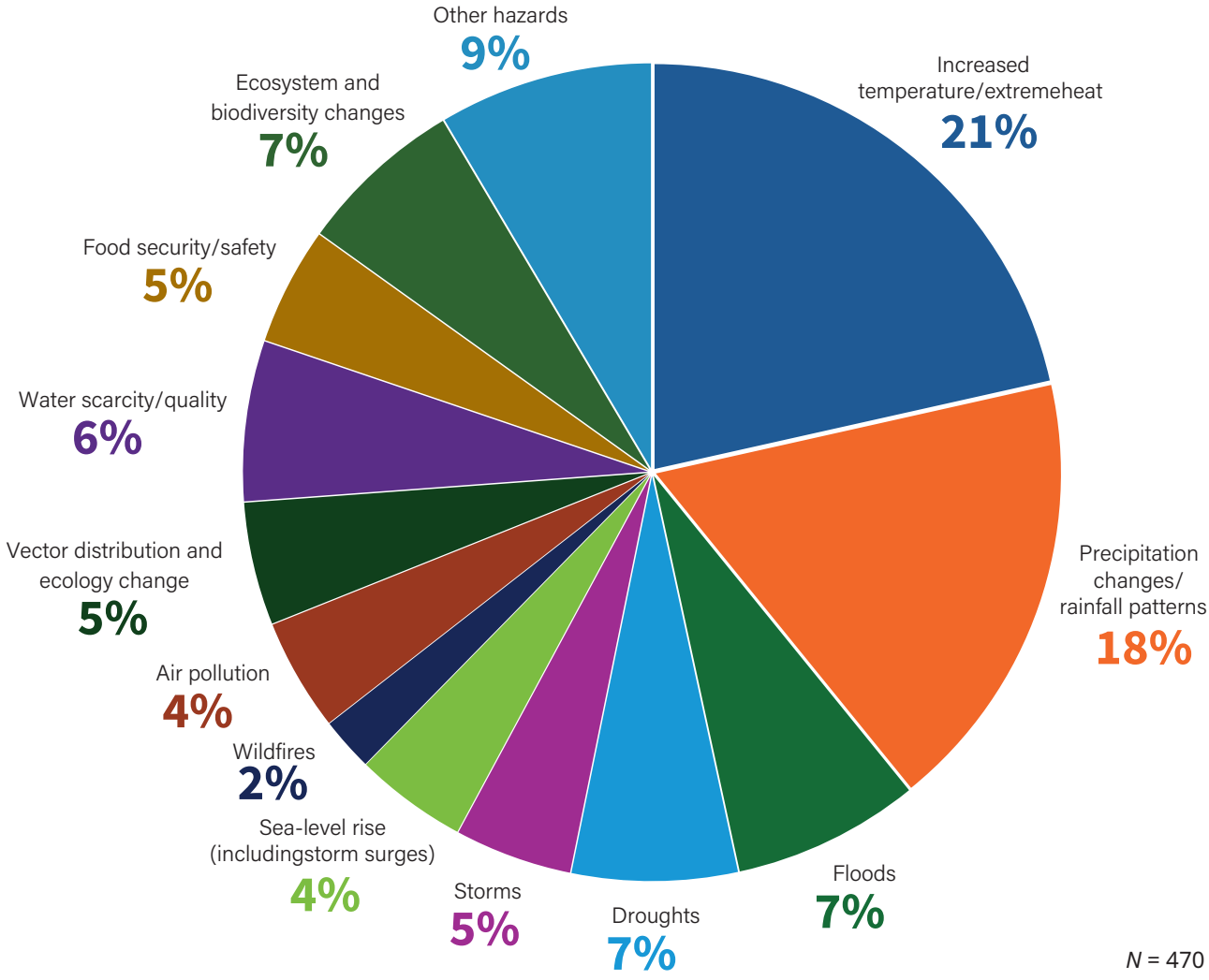


Hazards

- Increased temperature and extreme heat
- Changes in precipitation and rainfall patterns
- Floods
- Droughts
- Storms
- Sea-level rise (including storm surges)
- Wildfires
- Air pollution
- Changes in vector distribution and ecology
- Water scarcity and decreased water quality
- Food insecurity and food safety
- Changes to ecosystems and biodiversity
- Other hazards

A total of 470 hazard-related indicators and statements were identified. As expected, these were dominated by the categories increased temperature/extreme heat and changes in precipitation and rainfall patterns, which together accounted for 38% of indicators (Fig. 4). These indicators were reduced to 317 after removing repetitions. Boxes 1–13 summarizes the 317 final hazards indicators identified by countries.

Fig. 4. Distribution of hazard indicators among countries



Box 1. The 36 indicators for increased temperature or extreme heat

General temperature trends
Average annual temperature (°C)
Annual maximum temperature (°C)
Annual minimum temperature (°C)
Average monthly temperature (°C)
Change in average annual temperature over time (e.g. in °C/year)
Annual % increase in average temperature compared with baseline period
Extreme temperature events
No. of heatwaves occurring annually, by region (e.g. defined using national or regional criteria)
Annual no. of heatwave days (e.g. consecutive days with maximum temperature above a threshold)
Annual total no. of extreme heat events
Annual no. of torrid nights (e.g. nights with minimum temperature >25 °C)

Annual no. of hot days and nights (e.g. days and nights with temperature >90th percentile)
Annual no. of cold days and nights (e.g. days and nights with temperature <10th percentile)
Average duration of heatwaves (e.g. no. of days)
Average intensity of heatwaves (e.g. difference between maximum temperature during heatwave and average maximum temperature)
Annual no. of consecutive-day heatwave events (e.g. for a defined no. of days with a maximum temperature >90th percentile)
Temperature variation
Diurnal temperature range (e.g. difference between daily maximum and minimum temperatures)
Average seasonal variation in maximum and minimum temperatures (°C)
Current daily temperature range, by month (°C)
Regional and specific temperature trends
Annual temperature increase in coastal regions (e.g. in °C/year)
Annual temperature increase in mountain regions (e.g. in °C/year).
Annual average maximum temperature in lowlands and highlands (°C)
Increase in marine water surface temperatures (e.g. in °C/year)
Temperature extremes
% of warm days (e.g. days with maximum temperature >90th percentile)
% of warm nights (e.g. nights with minimum temperature >90th percentile)
% of cold days (e.g. days with maximum temperature <10th percentile)
% of cold nights (e.g. nights with minimum temperature <10th percentile)
High temperatures and health interactions
% of households reporting heat-related health issues (e.g. heat stroke, dehydration)
% of the population exposed to extreme heat (e.g. as measured by days with temperatures >30 °C)
% of population experiencing heat-related illnesses during extreme heat events
Annual no. of reported deaths or hospitalizations due to heatwaves
Increase in disease vectors linked to rising temperatures
Trends
Upward trend in maximum temperatures over decades (e.g. change in °C/decade)
Upward trend in minimum temperatures over decades (e.g. change in °C/decade)
Increase in the frequency of hot days and nights compared with historical baselines
Humidity and temperature variations
Average variation in relative humidity (%) during high-temperature periods
Interaction between temperature and humidity (e.g. heat index calculations)

Box 2. The 30 indicators for changes in precipitation and rainfall patterns

General precipitation trends
Annual total rainfall (mm/year) by region (e.g. coastal areas, agroecological zones)
Annual average change in precipitation (%) compared with historical baselines
Monthly average rainfall (mm/month)
Pluviometric variation from climatic norms (e.g. mm/year or % deviation)
Changes in precipitation trends (e.g. increased, decreased, erratic)
Intensity and extremes[a]
Annual no. of rainy days (e.g. days with precipitation ≥1 mm)
No. of days with extreme rainfall (e.g. days with precipitation ≥20 mm or at the 95th or 99th percentile)
Maximum daily rainfall (mm/day)
Maximum rainfall totals for 5 consecutive days (mm/5 days)
Annual total rainfall during extremely wet days (e.g. RR > 99th percentile)
Frequency of heavy rainfall events (e.g. total no. days/year with PRCP ≥ 20 mm)
Frequency of intense precipitation events (%) compared with historical trends
Wet and dry spells
Maximum no. of consecutive wet days (e.g. days with daily precipitation ≥1 mm)
Maximum no. of consecutive dry days (e.g. days with daily precipitation <1 mm)
Extension of dry spells (e.g. annual no. of prolonged periods without rainfall)
Seasonal shifts in wet and dry periods (e.g. the start, duration and end dates of rainy seasons)
Variability and distribution
Rainfall variability within and across regions (e.g. mm/year deviation from average)
Rainfall distribution by time and place (e.g. in agroecological zones)
Seasonal shifts in rainfall patterns (e.g. delayed or shortened rainy seasons)
Precipitation extremes[a]
Frequency of torrential rain events (e.g. no of days/year with heavy downpours)
Changes in extreme precipitation events (e.g. no. of days with RR > 95th percentile or PRCP > 20 mm)
Trends in patterns of consecutive wet and dry days (e.g. increased unpredictability)

Humidity trends
Annual average relative humidity (%)
Average monthly relative humidity (%)
Annual average maximum humidity (%)
Annual average minimum humidity (%)
Annual delay in the onset of rainy season (e.g. no. of days delayed compared with historical averages)
No. of shortened rainy seasons (e.g. no. of days less than average duration)
Health and ecosystem impacts
% of areas affected by reduced precipitation that impacts water availability, agriculture or health
Annual frequency of precipitation-related health events (e.g. waterborne diseases after heavy rainfall)

PRCP: precipitation; RR: rainfall rate.

[a] For definitions, see reference *(10)*.

Box 3. The 26 indicators for floods

Flood frequency and intensity
Annual no. of flood events (e.g. total no. of floods, flash floods, coastal floods or river floods)
Frequency of flash floods (e.g. no. of flash floods/year)
Historical trends in flood frequency (e.g. no. of events/year over decades)
No. of catastrophic flood events (e.g. events with significant human, economic or infrastructure loss, as defined locally)
Flood intensity index (e.g. based on water volume, flow rate and affected area)
Population and health impacts
Annual % of population affected by floods
% of households reporting diseases linked to flooding (e.g. malaria, cholera, schistosomiasis, malnutrition)
Annual incidence of waterborne diseases associated with flooding (e.g. cholera outbreaks)
Annual no. of flood-related injuries and deaths, and no. of people displaced
Flooding, by type
Annual no. of river floods (e.g. river overflows)
Frequency of coastal flooding events (e.g. no. of occurrences/year)
Frequency of urban flash floods in coastal and inland areas (e.g. no. of flash floods)

Infrastructure and economic impacts
% of infrastructure damaged by floods (e.g. roads, bridges, buildings)
Annual economic losses caused by floods (e.g. disruption to agriculture, property damage)
% of agricultural land affected by flooding (e.g. annually)
Annual no. of flood events disrupting critical infrastructure (e.g. health care facilities, drinking-water systems)
Flood risks and vulnerabilities
% of areas classified as high-risk flood zones (e.g. urban, rural and coastal areas)
Critical infrastructure at risk of flooding (e.g. no. of hospitals, schools, transportation networks)
No. of flood-prone households in high-risk areas
Frequency of landslides triggered by floods
Water and sanitation impacts
% of drinking-water systems disrupted by floodings
Annual no. of water contamination events caused by flooding
% of population without access to clean water during flood events
Monitoring and data collection
Historical data about flood frequency (e.g. no. of events during past decades)
Annual change in flood frequency or intensity (e.g. measured in % or water flow rates)
% of floods categorized as recurrent (e.g. no. of events in the same area/year)

Box 4. The 26 indicators for drought

Drought frequency and duration
Annual no. of drought events (e.g. meteorological and agricultural)
Annual no. of drought months
Average drought frequency (e.g. no. of events/decade)
Annual no. of consecutive dry days (e.g. no. of days with precipitation <1 mm)
Historical trends in drought frequency (e.g. no. of drought events during past decades)
Average duration of drought events (e.g. measured in days, months or years)
Annual no. of declared drought situations (e.g. alert or emergency declarations)
Population and health impacts
Annual % of population affected by drought
% of households reporting health issues linked to drought (e.g. malnutrition, diarrhoea, dysentery, scabies, respiratory illness)
Incidence of waterborne and drought-related diseases (e.g. no. of dysentery cases/1 000 people)
No. of deaths and hospitalizations associated with drought events

Environmental, economic and food security impacts
Annual % of agricultural land affected by drought
% decrease in crop yield due to drought episodes
No. of cases of food insecurity linked to drought (e.g. % of households affected)
% of drought-related economic losses in the agricultural sector
Desertification level (e.g. proportion of land area classified as desertified or at risk of desertification)
Annual change in soil moisture levels (e.g. % moisture reduction in affected areas)
Increase in evaporation or evapotranspiration rates (e.g. mm/year)
Drought intensity and severity
% of drought events classified as severe or extreme
Annual duration of prolonged droughts (e.g. measured in months or years)
No. of drought episodes with significant impacts (e.g. economic, social, health-related)
Drought events as % of total no. of disasters recorded annually
No. of recurrent droughts (e.g. repeated events in the same region)
% of drought episodes linked to erratic rainfall (e.g. % of events caused by unpredictable rainfall patterns)
Anticipated trends and projections
Projected increase in drought frequency (e.g. % or no. of events/decade)
% increase in the likelihood of severe or extreme drought due to climate change

Box 5. The 19 indicators for storms

Frequency
Annual no. of cyclones categorized by intensity (e.g. tropical storms, hurricanes, tornadoes)
Annual no. of strong storms (e.g. storms exceeding a defined wind speed threshold)
Annual no. of windstorm events (e.g. classified by severity)
Annual no. of tropical depressions and storms
Historical trend in cyclone frequency (e.g. no. of events/decade)
Intensity
% increase in storm intensity (e.g. based on wind speed, pressure or rainfall)
Annual no. of storms categorized as strong or severe (e.g. using the Saffir–Simpson Hurricane Scale)
Annual no. of storms causing significant damage (e.g. classified as major cyclones or hurricanes)
Health impacts
% of households reporting diseases linked to storm events (e.g. waterborne diseases)
Annual no. of injuries and deaths caused by storms
No. of hospitalizations caused by storm-related health impacts (e.g. injuries, stress-related conditions)

Population, infrastructure and economic impacts
Annual no. of people affected by storms (e.g. displaced or otherwise impacted)
% of infrastructure damaged by storms (e.g. homes, schools, hospitals)
% of coastal populations at risk from storm surges or flooding due to cyclones
Annual economic losses caused by storm events (e.g. damage to property, agriculture, infrastructure, health facilities)
No. of natural water bodies disrupted by storm events (e.g. by contamination, sedimentation)
Temporal trends and projections
Annual trend in the frequency of cyclones (e.g. % increase or decrease over time)
Projected increase in cyclone frequency or intensity (e.g. modelled as % change)
Annual no. of thunderstorms (e.g. categorized by region or intensity)

Box 6. The 22 indicators for sea-level rise

Rising sea level
Rate of sea-level rise (mm/year) measured at key coastal locations
Increase in average sea level compared with historical baselines (e.g. pre-2000 averages)
Frequency of tidal abnormalities (e.g. no. of extreme high tides/year)
Projected sea-level rise by 2050 and 2100 (e.g. based on climate models)
Coastal inundation and land loss
Annual total area inundated due to sea-level rise and storm surges (e.g. measured in km^2)
Proportion of coastal agricultural land lost due to erosion and inundation
Annual rate of coastal erosion (e.g. m/year)
No. of persons displaced due to coastal flooding and erosion
Annual change in coastal inundation patterns (e.g. frequency and extent of flooding)
Saltwater intrusion
Extent of saline intrusion into soil and groundwater sources (e.g. salinity concentration in mg/L)
% of groundwater wells contaminated by saltwater intrusion in coastal areas
Annual % of agricultural land affected by soil salinization
Historical trends in saline intrusion (e.g. area affected or salinity concentration over decades)
Vulnerability and risk
% of coastal population at risk from sea-level rise (e.g. those living <1 m above sea level)
No. of coastal communities classified as at high risk from storm surges and flooding
% of critical infrastructure in coastal zones vulnerable to sea-level rise (e.g. schools, hospitals, roads)

Water quality and availability
% of coastal areas reporting degraded water quality due to saline intrusion
% reduction in groundwater availability in coastal regions due to contamination
Incidence of waterborne diseases linked to degraded water quality in coastal areas
Economic and food security impacts
Annual economic losses due to sea-level rise and related coastal impacts (e.g. affecting agriculture, fisheries, infrastructure)
Reduction in coastal fish populations (e.g. measured as % change in catch/year)
% of coastal households reporting reduced food security linked to inundation and saline intrusion

Box 7. The 16 indicators for wildfires

Wildfire frequency
Annual no. of wildfire events (e.g. total and categorized by severity)
Annual no. of forest fires occurring in different regions
Historical trends in wildfire frequency (e.g. no. of events/decade)
Annual no. of severe wildfires (e.g. fires causing significant ecological, health or economic impacts)
Wildfire severity and extent
Annual total area burned by wildfires (e.g. measured in hectares or km^2)
% of forest area burned (e.g. % of total forest cover)
Average duration of wildfire events (e.g. measured in days)
Temporal trends
Length of the wildfire season (e.g. measured in months or weeks/year)
Increase in length of wildfire season over time (e.g. compared with a baseline)
Annual change in wildfire frequency and severity (e.g. measured as % increase over time)
Projected wildfire risk based on trends in temperature and precipitation
Health impacts
Incidence of cardiorespiratory conditions linked to exposure to wildfire smoke (e.g. no. of hospitalizations, emergency visits)
Annual no. of allergy cases exacerbated by wildfire events
Mortality associated with exposure to wildfire smoke
Economic and infrastructure impacts
Annual economic losses caused by wildfires (e.g. property damage, firefighting costs)
No. of health facilities and other infrastructure destroyed during wildfire events

Box 8. The 22 indicators for air pollution

Air quality metrics
Annual average concentration (μg/m^3) of $PM_{2.5}$ in urban and rural areas
No. of days/year with $PM_{2.5}$ levels exceeding WHO guidelines (e.g. 25 μg/m^3)
Annual concentration of tropospheric O_3 (e.g. measured in parts per billion or μg/m^3)
Annual no. of acute air pollution episodes caused by forest fires or other extreme events
Airborne allergens and seasonal variability
Seasonal concentration (μg/m^3) of airborne allergens (e.g. pollen, dust)
No. of high allergen days/year (e.g. days exceeding established allergen thresholds)
Frequency of dust wind events during dry seasons (e.g. measured in days/year)
Air pollution sources
Annual proportion of air pollution attributed to wildfires
Annual increase in air pollutants from specific sources (e.g. proportional increase from fossil fuel combustion, industrial emissions)
Frequency of heatwaves associated with increased air pollution levels (e.g. no. of spikes in $PM_{2.5}$ and O_3)
Population exposure
% of urban or rural population exposed to unhealthy air quality (e.g. air quality index >100)
% of outdoor workers exposed to high pollution levels (e.g. $PM_{2.5}$ or O_3 exceeding WHO guidelines)
% of population reporting health issues linked to poor air quality (e.g. respiratory or cardiovascular conditions)
Temporal trends
Annual trend in $PM_{2.5}$ concentrations (e.g. % change over time)
Annual variation in ambient air pollution levels (e.g. by season or region)
Risk to health and well-being
No. of hospitalizations linked to exposure to air pollution (e.g. for respiratory or cardiovascular diseases)
Annual mortality rate attributable to air pollution (e.g. measured as deaths/100 000 people)
Incidence of health issues related to worsening air quality (e.g. asthma exacerbations)
Interaction between air quality and climate
% of events of decreased air quality linked to extreme weather (e.g. forest fires, heatwaves)
No. of days with worse air pollution during heatwaves (e.g. spikes in O_3 and $PM_{2.5}$)
Monitoring and reporting
% of areas with active air quality monitoring stations
Annual no. of regions reporting ambient air pollution levels

O_3: ozone; $PM_{2.5}$: fine particulate matter.

Box 9. The 22 indicators for changes in vector distribution and ecology

Incidence and prevalence of diseases
Annual incidence of dengue fever (e.g. cases/100 000 population)
Annual incidence of malaria (e.g. cases/100 000 population)
Annual incidence of Lyme disease (e.g. cases/100 000 population)
Annual no. of outbreaks of vector-borne diseases (e.g. dengue, malaria, yellow fever)
Peak incidence of vector-borne diseases (e.g. dengue, malaria) during high-transmission seasons
Vector and host dynamics
Geographical expansion of vector species (e.g. mosquitoes, ticks) from lower altitudes to higher altitudes
Changes in the geographical distribution of vectors (e.g. species spreading into new regions)
Length of mosquito transmission season (e.g. measured in months)
Annual change in vector density (e.g. no. of *Aedes* mosquitoes/km^2)
Annual increase in indigenous vector populations (e.g. *Anopheles* mosquitoes)
No. of new vector species introduced to previously unaffected regions
Environmental and climatic factors
Correlation between precipitation patterns and mosquito breeding-site density (e.g. occurrence of stagnant water)
Impact of seasonal temperature variations on vector survival rates
Changes in humidity levels affecting vector development and disease transmission rates
Annual increase in no. of areas classified as suitable for vector survival due to climate change
Transmission and risk patterns
Length of transmission season for vector-borne diseases (e.g. malaria, dengue)
% of population at risk of vector-borne diseases (e.g. based on geographical and climatic factors)
No. of new habitats created for vector species due to climate change (e.g. areas with altered rainfall or temperature patterns)
No. of regions reporting new vector-borne diseases previously considered non-endemic
Climate impact on vector life cycle
Impact of changing temperature ranges on vector development cycles (e.g. time to maturity)
Impact of warmer winters on tick populations and activity levels (e.g. lifespan, biting rates)
Correlation between extreme rainfall events and density of mosquito larvae (e.g. in post-flood areas)

Box 10. The 23 indicators for water scarcity and water quality

Water storage and availability
% change in water storage capacity (e.g. volume in local reservoirs, aquifers)
Annual reduction in water levels in reservoirs (e.g. measured in % or m^3)
Annual reduction in availability of freshwater (e.g. m^3 per capita).
% of population experiencing water scarcity (e.g. those living in water-stressed regions)
Annual no. of days with disrupted water supplies in affected areas
% of regions reporting drying-up of natural water sources
Annual % of agricultural regions reporting shortages of irrigation water
% of glacier-fed water sources reduced due to temperature increases and rapid melting
Water quality
% of potable water sources with decreased quality (e.g. exceeding contamination thresholds)
Annual % of drinking-water sources contaminated (e.g. by pollutants, saline intrusion)
Levels of waterborne pollutants (e.g. nitrates, heavy metals or microbial contamination)
Frequency of saline intrusion into groundwater and coastal water supplies
% of water sources impacted by temperature-induced contamination (e.g. microbial growth, chemical changes)
% of regions experiencing reduced water quality due to climate-related factors
Vulnerable populations
% of Indigenous communities reporting water scarcity (e.g. lack of access to clean water)
% of households unable to perform basic hygiene activities due to water scarcity
No. of cases of food- and waterborne diseases (e.g. cholera, diarrhoea, dysentery) linked to poor water quality and sanitation
Health impacts
Incidence of waterborne diseases/100 000 people (e.g. hepatitis A, typhoid, diarrhoea)
Annual % increase in diseases linked to contaminated water (e.g. cholera outbreaks)
Annual health burden (e.g. in hospitalizations or deaths) associated with water scarcity in vulnerable populations
Monitoring and projections
Annual trend in water scarcity by region (e.g. proportion of regions with <500 m^3/capita per year)
Projected decline in potable water sources by 2030 or 2050 (e.g. % reduction compared with a baseline year)
Annual variation in natural water cycle metrics (e.g. precipitation and evapotranspiration rates)

Box 11. The 23 indicators for food security and safety

Food access and availability
% of population experiencing food insecurity
% of households reporting limited food access (e.g. rural vs urban)
Annual no. of people affected by food shortages
No. of people affected by food insecurity linked to climate-related events (e.g. cyclones, droughts, flooding)
% of regions experiencing reduced food availability (e.g. by geographical region)
Food quality and safety
% of food contaminated by mycotoxins (e.g. aflatoxins in cereal grains)
Annual no. of cases of foodborne disease (e.g. linked to mould, insects, moisture or pathogens)
% of food storage facilities with inadequate conditions (e.g. mould, pests or lack of ventilation)
Annual decrease in the nutritional quality of staple crops (e.g. protein, micronutrient content)
Agricultural production
Annual reduction in agricultural production (e.g. tonnes of cereal grains, vegetables or fruits)
% of agricultural land affected by climate stressors (e.g. drought, flooding, sea-level rise)
Annual rate of crop failure events (e.g. % of planted crops that fail)
% decrease in livestock production
% decrease in fish catch volume
Climate impacts on food systems
% of agricultural land affected by sea-level rise and salinity intrusion
No. of food supply disruptions due to extreme weather events
No. of extreme weather events affecting food production (e.g. cyclones, droughts, flooding, sea-level rise, high temperatures)
% of agricultural regions reporting reduced productivity due to soil degradation or climate impacts
Annual increase in disease prevalence in agricultural livestock (e.g. number of outbreaks, mortality)
% of livestock lost annually due to disease, flooding, drought or extreme heat
Annual economic losses in livestock farming caused by disease or climate events
Health impacts related to food insecurity
No. of adverse health outcomes linked to food insecurity (e.g. undernutrition related diseases)
Prevalence (%) of diseases related to food insecurity (e.g. micronutrient deficiencies, gastrointestinal conditions)

Box 12. The 30 indicators for changes to the ecosystem and biodiversity

Water and land impacts
Annual rate of water intrusion into coastal and inland areas (e.g. measured in km^2 or salinity levels)
Annual % of riverbanks and coastal areas affected by erosion
% of land area experiencing salinization (e.g. land, rivers and aquifers)
Rate of land degradation (e.g. desertification, loss of soil fertility, erosion)
Annual % of land affected by deforestation annually (e.g. measured in hectares or % of forest cover lost)
% of agricultural land degraded due to pests, droughts or fires
% of swampland affected by rising sea levels or salinization
Ecosystem and biodiversity impacts
Annual loss of biodiversity (e.g. no. of species endangered, extinct or with declining populations)
Rate of ecosystem change (e.g. shifts in dominant species, habitat loss or loss of ecosystem function)
No. of invasive alien species expanding their range (e.g. new habitats colonized/year)
Behavioural changes observed in key wild species (e.g. migration, breeding or feeding patterns)
Annual rate of coastal erosion (e.g. measured in km^2 lost)
Change in species distribution in marine ecosystems (e.g. fish migration patterns)
Risk of climate-sensitive diseases
Annual incidence of zoonotic diseases linked to ecosystem changes (e.g. Lyme disease, hantavirus, avian influenza)
% of diseases with expanded vector ranges due to environmental changes (e.g. malaria, dengue)
Incidence of enteric diseases linked to multiplication of environmental pathogens (e.g. cholera outbreaks)
% of cases of water-related disease associated with environmental degradation (e.g. schistosomiasis, leptospirosis)
Annual incidence of waterborne diseases (e.g. no. of outbreaks or cases)
Rate of proliferation of disease vectors (e.g. mosquitoes, ticks, waterborne pathogens)
Ecosystem services and productivity
Annual loss of crop areas due to drought, pests or land degradation (e.g. measured in hectares)
Annual change in energy production and consumption patterns linked to climate factors (e.g. use of renewable energy, reductions in hydropower)
% reduction in swampland or irrigated agricultural areas providing breeding sites for disease vectors (e.g. *Anopheles* mosquitoes)

Climate and seasonal changes
Annual no. of arid days or no. of days of prolonged dry seasons (e.g. days with precipitation <1 mm)
% change in length of the growing seasons for major crops due to increased temperatures
Annual rate of desertification (e.g. measured as land area affected)
Annual rate of biodiversity reduction in arid or semi-arid regions
Pathogen and vector dynamics
Annual change in vector population density (e.g. *Anopheles* vectors in specific regions)
% of ecosystems with altered pathogen dynamics due to climate change (e.g. spread of enteric diseases)
Monitoring and temporal trends
Historical trends in desertification, deforestation and land degradation (e.g. annual changes over decades)
Annual no. of ecosystem disturbances (e.g. fire, drought, invasive species outbreaks)

Box 13. The 22 indicators for other hazards

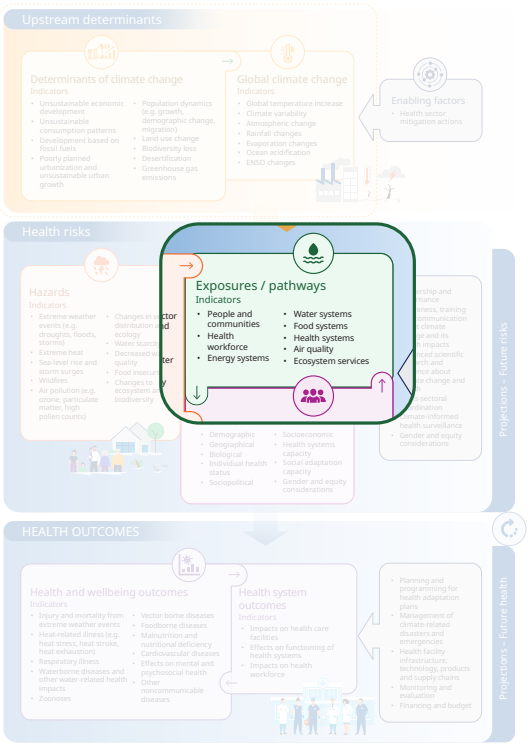
Cold weather events and impacts
Annual no. of cold waves (e.g. events/year)
No. of extreme cold-episode days (e.g. days with minimum temperature below a defined threshold)
% of households reporting diseases linked to extreme cold (e.g. frostbite, hypothermia)
Annual incidence of cold wave–related health impacts (e.g. hospitalizations, deaths)
Annual no. of frost days (e.g. days with temperature below 0 °C)
Reduction in cold episodes (e.g. % change compared with historical averages)
Annual no. of winter storms (e.g. events/year)
Lightning, thunderstorms and hailstorms
Annual no. of lightning and thunder strike events (e.g. measured by region)
Annual no. of hailstorms
Economic damage caused by lightning and hailstorms (e.g. property damage)
Landslides and avalanches
Annual no. of landslide events (e.g. categorized by severity)
Annual no. of structures affected by landslides (e.g. no. of homes or specific types of infrastructure affected)
Annual total no. of avalanches (e.g. recorded in mountainous regions)
% of population in high-susceptibility zones at risk of landslides

Environmental changes
Annual rate of permafrost melting (e.g. measured in km^2 or by depth)
Annual no. of glacial lake outburst flood events
Area of glaciers lost annually (e.g. measured in km^2)
Change in average river flow (e.g. m^3/s, measured seasonally)
Annual % of land transitioning to semi-arid climate
Water and soil impacts
Annual rate of marine water acidification (e.g. change in pH/year)
% of water sources affected by saline intrusion (e.g. groundwater salinity levels)
Annual rate of increase in soil pollution (e.g. contamination levels in parts per million)

Common exposures and exposure pathways across countries

Fig. 5 shows common exposures and pathways.

Fig. 5. Common exposures and exposure pathways identified

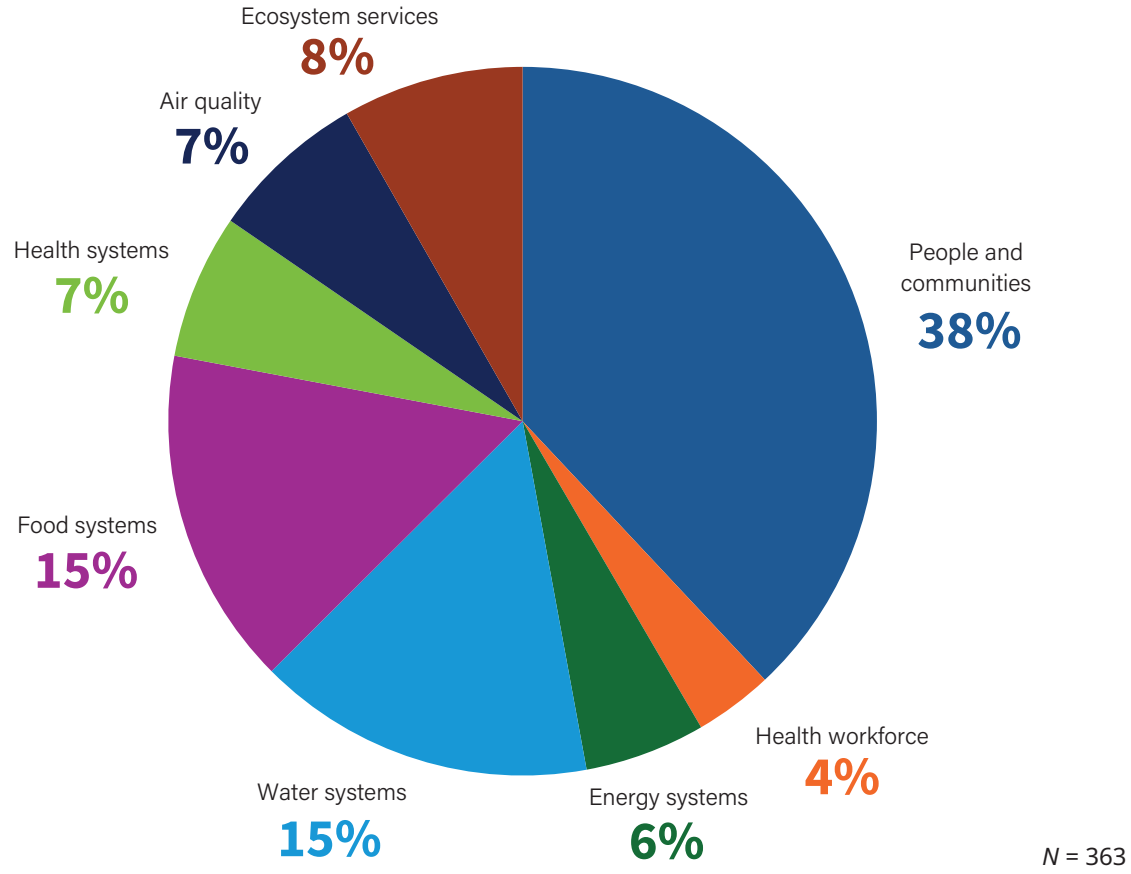


Exposures and exposure pathways

- People and communities
- Health workforce
- Energy systems
- Water systems
- Food systems
- Health systems
- Air quality
- Ecosystem services

A total of 363 indicators and statements about exposures and exposure-related pathways were identified. The category people and communities was the most prominent, accounting for 38% of all indicators and statements (Fig. 6). These indicators were reduced to 224 after removing repetitions. Boxes 14–21 summarize the 224 final indicators identified by countries for exposures and exposure pathways.

Fig. 6. Distribution of indicators for exposures and exposure pathways among countries



Box 14. The 39 indicators for people and communities

Population vulnerabilities in areas prone to climate hazards
No. of people living in areas at high risk for climate hazards (e.g. areas prone to cyclones, floods or droughts, or coastal regions vulnerable to sea-level rise and saline intrusion)
Population density in coastal regions exposed to flooding and erosion
Population density in drought-prone areas exposed to water shortages
% of populations displaced due to climate-induced extreme weather events (e.g. floods, droughts, sea-level rise)
% of population displaced due to housing loss caused by floods, landslides, or coastal erosion
Frequency of population relocation from climate-prone or hazard-exposed areas
% of population living on deforested hillsides prone to landslides or erosion
No. of Indigenous communities impacted by the effects of climate change on traditional food systems
% of households living in an area prone to climate-sensitive diseases
No. of people affected by extreme weather events (e.g. floods, windstorms, fires, landslides)

Livelihoods and resources
% of people relying on natural resources (e.g. fishing, farming) in climate-sensitive areas
% of income lost due to crop failure, livestock mortality or reduced fish stocks resulting from climate impacts
No. of farmers affected by shifts in climate variability (e.g. rainfall patterns, droughts)
Economic losses due to floods, droughts or extreme temperatures (e.g., measured in terms of homes, crops, infrastructure)
% of households experiencing food insecurity due to reduced agricultural yields
% of population dependent on biodiversity and related ecosystem services
% of communities experiencing reduced ecosystem productivity (e.g. fisheries, forests)
Housing and infrastructure
No. of houses destroyed or damaged by floods, cyclones or strong winds
No. of bridges, schools, roads and other infrastructure destroyed or rendered unusable during extreme weather events
No. of precarious housing units in climate-sensitive areas (e.g. per community or region)
% of households without access to safe drinking-water after a climate-related disaster (e.g. by region)
No. of people relying on unsafe water sources during climate-related water shortages
% of rural and urban populations in poor neighbourhoods living in an area at risk from climate change and affected by inadequate infrastructure (e.g. water, sewage, energy, housing, income)
Health risks
Incidence of heat-related illnesses among vulnerable exposed persons (e.g. children, elderly people, persons with comorbidities, outdoor workers, agricultural labourers).
Frequency of heat-related hospitalizations or deaths during extreme heat events (e.g. particularly among elderly people, pregnant women and children)
% of population exposed to thermal extremes (e.g. heatwaves, extreme cold)
Prevalence (%) of waterborne diseases (e.g. cholera, diarrhoea, dysentery, typhoid fever) following an extreme weather event
Incidence of disease outbreaks linked to inadequate water quality after a climate-related disaster (e.g. diarrhoea, cholera, amoebiasis)
Incidence of vector-borne diseases (e.g. malaria, dengue, yellow fever) in the population exposed to climate-related habitat changes due to impacts on water systems or after flooding or storms
Mental health impacts after displacement, forced migration, isolation, emotional stress, human and material losses from extreme weather events (e.g. measured as the % of people experiencing stress, trauma, or depression after an event)
% of the population suffering from mental health impacts in drought-prone areas
% of households or outdoor workers exposed to poor air quality linked to climate conditions (e.g. urban heat islands, dust storms, high temperature amplitudes and arid periods)

Rates of mortality and morbidity from extreme weather events (e.g. floods, fires, heatwaves, cyclones; measured per 1 000 population)
% of population that is malnourished due to food insecurity linked to extreme weather events (e.g. children, elderly people)
Prevalence (%) of malnutrition and famine in regions affected by droughts, floods or crop failures
% of population without access to health services due to extreme heat events or torrential rainfall
No. of health facilities without capacity to accommodate a large population exposed to climate risks (e.g. lack of health workers or infrastructure)
Climate-related migration
% of population migrating to urban areas due to long-term drought or resource scarcity
% of rural population lost to urban migration caused by non-climatic and climatic stressors

Box 15. The 17 indicators for the health workforce

Health workforce capacity and distribution
No. of health staff/10 000 inhabitants
% of health care facilities reporting insufficient staffing to meet increasing demand
% of health workers allocated to areas at high risk for climate events (e.g. flood-prone zones, heatwave regions, arid and semiarid zones)
No. of health facilities reporting uneven workforce distribution across urban and rural areas
Workforce training and knowledge
Annual % of health workforce trained in climate impacts and health interventions
No. of climate and health training programmes conducted for health care workers (e.g. in a given period)
Ratio of trained personnel to untrained personnel in climate-affected regions
Workforce readiness and support
% of health workers equipped with resources to respond to climate-related events (e.g. protective gear, emergency protocols)
Availability of support mechanisms for workers during and after climate events (e.g. counselling, logistical support)
% of health care workers trained in crisis communication related to climate change and health
No. of formal partnerships between health systems and external agencies addressing coordinated climate resilience actions

Health system disruptions
No. of outpatient services, procedures or hospital discharges disrupted due to climate hazards
Average duration of service interruptions during extreme weather events
% of health care facilities with backup power systems to maintain services during outages
Worker productivity and safety
% of health workers absent during climate events, such as heatwaves, flooding
No. of occupational health incidents linked to climate hazards (e.g. heat stress cases among health care workers)
% of work capacity reduced among health care workers during heatwaves or extreme weather events

Box 16. The 18 indicators for energy systems

Energy sources and usage patterns
% of energy generated, by source (e.g. biomass, fossil fuels, solar, wind, hydropower)
% of households using clean energy sources for cooking (e.g. liquefied petroleum gas, biogas, electricity)
% of households relying on polluting energy sources (e.g. charcoal, firewood, animal dung)
Ratio of use of clean energy to polluting energy in urban versus rural areas
Energy system impacts from climate events
No. of health facilities with disruptions to their energy supply caused by extreme weather events (e.g. windstorms, cold snaps, heatwaves)
Frequency of electricity outages in each settlement category (e.g. urban, semiurban, concentrated rural, dispersed rural)
No. of energy facilities damaged by flooding, sea-level rise or intense precipitation
Annual % of power lines and poles dropped due to windstorms
% reduction in cooling capacity of power generators due to water scarcity
Energy consumption patterns
Annual changes in energy consumption due to climate variability (e.g. increased cooling demand, reduced heating demand)
% of residential and nonresidential buildings, by energy efficiency rating
% of communities experiencing insufficient energy generation due to decreased precipitation or extreme weather
Risks to energy infrastructure
% of electricity networks at risk from heatwaves or strong winds
Annual no. of energy infrastructure components damaged by sea-level rise or precipitation
Frequency of failures in energy transport, distribution or storage systems due to extreme weather (e.g. per month or year)

Hydropower and water-dependent energy systems
Volume of hydropower capacity reduced due to dryness of river basins or decreased precipitation
Annual % change in availability of water to cool power plants
No. of hydropower facilities reporting disruptions due to climate-related variability in water resources

Box 17. The 34 indicators for water systems

Water supply access and availability
% of the population with access to safe drinking-water, disaggregated by source
No. of households experiencing water shortages (e.g. measured monthly or seasonally)
% of water supply coverage (e.g. urban vs rural).
Frequency of water supply interruptions (e.g. measured in days/year per region)
Volume of water available per capita (e.g. L/person per day)
% reduction in availability of potable water due to drought or extreme rainfall events, evaporation or contamination
Water contamination and quality
% of water sources contaminated by harmful bacteria, pathogens or pollutants
Frequency of harmful algal blooms caused by extreme weather events (e.g. temperature increases, drought, floods) or eutrophication leading to water contamination (e.g. per year)
Annual no. of drinking-water contamination events associated with floods, drought, heavy rainfall, temperature increases or saline intrusion
% of coastal aquifers affected by saltwater intrusion due to sea-level rise
Annual volume of surface water and groundwater degraded by chemical and biological pollution
Volume of potable water affected by sediment and pollutant entrainment during torrential rains
Sanitation and WASH services
% of households with access to both safe water and sanitation services
No. of sanitation system disruptions caused by floods or water shortages
No. of regions reporting inadequate water supply to sewage systems, causing sanitation challenges
Frequency of open defecation and poor hygiene practices due to lack of water or sanitation (e.g. no. of people practising open defecation)

Climate impacts on water systems
No. of drinking-water supply systems exposed to risks from floods (e.g. due to rising sea levels)
Annual reduction in water availability caused by changes in precipitation or increased temperatures
% of water storage systems damaged during floods or other extreme weather events leading to impacts on health facility services
No. of shallow wells and springs drying up during droughts
No. of eutrophication processes in water sources due to high temperatures and reduced flow
Annual volume of stagnant water after flood events that increases disease risks
% of water transport or storage systems impaired due to flooding or heavy rainfall
Waterborne and vector-borne diseases
No. of outbreaks of waterborne or vector-borne disease (e.g. diarrhoea, cholera, malaria) following flooding or water contamination events
Incidence of waterborne diseases (e.g. diarrhoea, cholera, dysentery) linked to contaminated water sources
No. of malaria cases linked to stagnant water resulting from flooding and poor sewage disposal
Incidence of waterborne diseases caused by harmful algal blooms or bacterial growth in contaminated water during or after drought and flood events
Vulnerable populations and water risks
% of rural areas experiencing drying up of water sources (e.g. boreholes, rivers, streams) during dry seasons
No. of coastal communities affected by saltwater intrusion into aquifers or wells
% of regions experiencing severe drinking-water shortages (e.g. in drought-prone areas)
% of population at risk of unsafe water consumption due to contamination and inadequate access to clean water
Urban and agricultural water challenges
Annual volume of water insufficient for the agricultural, fishing and energy sectors
% of urban areas reporting water stress caused by climate variability
No. of urban water systems impacted by increased temperatures, precipitation and sea-level rise

WASH: water, sanitation and hygiene.

Box 18. The 27 indicators for food systems

Food availability and production
% of hectares of agricultural land and crops destroyed by floods, droughts or sea-level rise
Annual crop yields affected (e.g., wheat, maize, millet, barley), by region and climate-related event
% reduction in crop yields due to poor distribution of rainfall and to extreme weather events
% reduction in aquaculture productivity (e.g. fish stocks) due to harmful algal blooms and warming waters
% of farmland lost due to flood events or coastal flooding
Average length of growing season (e.g. measured in days) and reduction due to extreme rainfall or heat stress
Volume of fresh water available for agriculture (e.g. measured in m^3/hectare)
Food safety and quality
Annual frequency of food contamination events (e.g. by cyanobacteria, algal toxins, chemical substances)
% of foodstuffs contaminated due to higher temperatures and higher precipitation
% of food crops affected by pests and diseases (e.g. grasshoppers, black pod disease, coffee rust) due to temperature increases
Annual frequency of algal bloom events negatively affecting the safety of food produced by aquaculture
Frequency of cases of antimicrobial resistance related to veterinary practices in food animals
Food insecurity and undernutrition
% of children younger than 5 years consuming a diet that meets minimum dietary diversity standards
Prevalence (%) of malnutrition in rural and marginalized populations during drought or flood events
% of households experiencing food insecurity due to extreme weather events
% of population at risk of hunger and malnutrition due to loss of crops and income
Prevalence (%) of malnutrition and undernutrition linked to food security challenges arising from climate events
Frequency of food security crises caused by some combination of heat stress, drought, floods and displacement
Climate impacts on agriculture and livestock
% of livestock deaths caused by extreme heat, flooding or drought
% of pastureland with lost productivity due to heat stress and poor rainfall distribution
% reduction in agricultural productivity caused by extreme weather events (e.g. drought, heavy rainfall)
Area of rice fields destroyed due to river overflow or poor rainfall distribution (e.g. km^2)
% of agricultural output lost due to topsoil erosion from increased rainfall intensity

Economic and livelihood impacts
% increase in food prices linked to climate-induced lower crop yields
Income loss among agricultural households due to reduced land productivity and extreme weather (e.g. % of income)
% of rural population relying on agriculture that is affected by natural disasters (e.g. floods, cyclones)
% of food systems in Indigenous communities impacted by extreme weather events

Box 19. The 26 indicators for health systems

Damage and disruption to health care infrastructure
% of health facilities damaged by extreme weather events (e.g. floods, cyclones, storm surges)
% of health facilities with disrupted communications during extreme weather events
No. of health facilities without functioning power supplies during extreme weather events
No. of outreach clinics assessed as operational after extreme weather events
% of public health facilities affected by flooding, extreme cold snaps or windstorms
% of health facilities with damaged infrastructure (e.g. buildings, water points)
Service disruption
No. of interruptions to health care services due to climate impacts (e.g. outpatient care, routine health services)
Frequency of disruptions to health care supply chains (e.g. medication, equipment, vaccines) during a climate-related event
Average length of time needed to restore disrupted health care services after extreme weather events
% of health facilities reporting discontinuity in routine health care services
% of operational health care capacity lost during climate events
Demand on health care services
% increase in patient load at health facilities during extreme weather events (e.g. hospitalizations, outpatient visits)
% increase in deaths associated with climate-related health emergencies
No. of patients requiring care for emerging or re-emerging diseases during or after climate events
Climate-related diseases
Prevalence (%) of vector-borne diseases (e.g. malaria, dengue, yellow fever) in areas affected by warming temperatures and changing precipitation patterns
Incidence of waterborne and foodborne diseases (e.g. diarrhoea, cholera) following flooding or intense precipitation
Incidence of exacerbations of respiratory diseases (e.g. asthma) caused by increased precipitation and humidity

Health workforce challenges
% of health facilities without trained WASH staff
% of health workforce affected by urban–rural maldistribution, insufficient skills or poor retention
No. of health workers migrating internationally or leaving rural areas
Frequency of delayed or irregular salary payments for health workers resulting from a climate-related event
Cost of restoring health care operations after disruptions caused by extreme weather
Health system preparedness and resilience
% of health facilities with backup power systems (e.g. generators) for critical operations
Amount of funding allocated to health system adaptation (e.g. for WASH, upgrades to infrastructure, training)
No. of climate-related training sessions conducted for health professionals
% of health facilities meeting hygiene standards despite extreme weather challenges

WASH: water, sanitation and hygiene.

Box 20. The 28 indicators for air quality

Air pollution
Annual mean concentration of $PM_{2.5}$ (μg/m^3), by region
Annual no. of districts with unhealthy $PM_{2.5}$ concentrations (e.g. above WHO's guideline values)
No. of days/year with air quality classified as unhealthy (e.g. based on Air Quality Index standards)
Frequency of acute air pollution episodes (e.g. from forest fires, bushfires, measured per year)
Annual mean concentration of ground-level O_3 in urban and rural areas
No. of heatwave days associated with increased levels of air pollutants (e.g. $PM_{2.5}$, O_3)
% of households using solid fuels for cooking or heating (e.g. wood, charcoal)
% of buildings with reported indoor air quality issues (e.g. wildfire smoke infiltration, mould after floods)

Air pollution and health outcomes
All-cause mortality rate/100 000 population linked to air pollution exposure (e.g. outdoor and indoor)
Incidence of respiratory diseases (e.g., asthma, chronic obstructive pulmonary disease) linked to $PM_{2.5}$, O_3 and allergens
Incidence of cardiovascular diseases associated with increased $PM_{2.5}$ and O_3 levels
Incidence of health conditions linked to exposure to wildfire smoke (e.g. emergency visits, mortality)
% of older adults disproportionately affected by outdoor air pollution (e.g. O_3, $PM_{2.5}$)
% of population experiencing worsened respiratory or cardiovascular conditions during air pollution episodes
Annual no. of hospital admissions linked to indoor air pollution (e.g. respiratory diseases, cardiovascular conditions)
Climate and air quality interactions
No. of air pollution episodes caused by decreased rainfall or persistent, stable atmospheric conditions (i.e. inversion)
No. of days with tropospheric O_3 levels exceeding health thresholds that are linked to temperature increases
No. of high-temperature days associated with worsened outdoor air quality
Wildfire and extreme weather impacts
Annual area burned by wildfires contributing to air pollution (e.g. measured in hectares)
Annual % of population exposed to wildfire smoke
Duration of wildfire smoke events affecting air quality (e.g. measured in days)
Sources of air pollution
% of air pollution attributable to fossil fuel use during drought episodes or energy shortages
% of ambient pollutants originating from the burning of health care waste
% of total pollutants from bushfires or forest fires carried by winds over long distances
No. of high-allergen days caused by increased temperatures and prolonged growing seasons
Annual change in concentrations of airborne allergens and their health impacts
Monitoring and estimates
Annual estimates of concentrations of $PM_{2.5}$ and O_3 in urban, semiurban and rural areas
No. of years with $PM_{2.5}$ concentrations above health standards

O_3: ozone; $PM_{2.5}$: fine particulate matter.

Box 21. The 35 indicators for ecosystem services

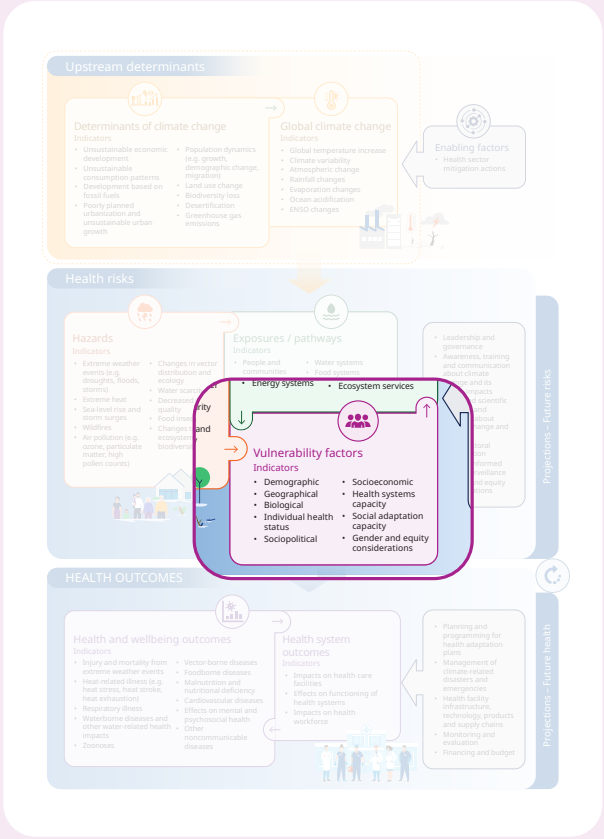
Disruption to agriculture and fisheries
Annual change in agricultural production (e.g. crop yield declines due to drought, floods or salinization)
Annual change in fisheries production (e.g. fish stocks affected by warming waters or ecosystem changes)
No. and type of crop and fish species losses due to altered harvesting periods or ecosystem disruptions
Freshwater availability
Annual % of rivers, lakes and canals drying up, particularly in mountainous or drought-prone regions
Volume of water reduction in freshwater sources (e.g. rivers, lakes) due to changing rainfall patterns or drought (e.g. m^3)
Frequency of water shortages in regions with high dependence on freshwater ecosystems
Soil and land quality
Area of land affected by soil salinization due to excessive heat and drier conditions (e.g. km^2)
Change in soil quality due to extreme weather events (e.g. flooding, drought)
Rate of soil degradation linked to climate change and pollution (e.g. chemical pollutants, measured in km^2/year)
Area of land at risk of desertification due to recurrent drought (e.g. km^2)
Area of agricultural land degraded due to environmental changes and poor land management practices
Loss of ecosystem habitats and biodiversity
% of species facing habitat loss due to climate-induced changes (e.g. altered ecosystems, decline in species reproduction)
No. of species at risk of extinction or migration due to ecosystem changes caused by climate stressors
Loss of biodiversity in key ecosystems (e.g. forests, wetlands, coastal areas, measured as the reduction in species richness)
Area of mangroves or wetlands destroyed by rising sea level, storms or intense precipitation
Area of coastal resources lost due to sea-level rise and coastal storms (e.g. sand flats, estuaries)
% of reforested areas affected by climate change (e.g. changes in temperature, occurrence of drought and climate-induced pests)

Climate-driven ecological changes
Changes in the timing of seasonal events (e.g. flowering, harvest) due to temperature shifts affecting agriculture and ecosystems
% of ecosystem services affected by climate change and floods (e.g. food production, water quality)
Duration and intensity of seasonal transmission of vector-borne diseases, linked to changing temperature and precipitation patterns
No. of people affected by the migration of species that disrupt local ecosystems or food systems
Water quality and pollution
% of freshwater ecosystems polluted by industrial, agricultural or domestic waste
Annual no. of water pollution events in marine and lagoon ecosystems (e.g. from domestic, industrial, agricultural or mining sources)
Concentration of pollutants in surface water (e.g. pharmaceuticals, chemicals from wastewater effluents)
Frequency of salinity intrusion into freshwater sources or agricultural lands
Coastal and marine ecosystem changes
Rate of coastal erosion due to rising sea levels affecting settlements, infrastructure and economic activities
Area of mangrove forests lost annually due to rising sea temperatures, flooding and storm damage (e.g. km^2)
Loss of critical ecosystem services from coastal habitats (e.g. sand dunes and flats, deltas and estuaries) due to rising sea levels
Change in the health of marine ecosystems (e.g. coral reefs, fish stocks) linked to increases in temperature and pollution
Extent of damage to infrastructure and settlements due to beach erosion and sea-level rise.
Human and ecosystem health interactions
Incidence of climate-sensitive diseases (e.g. malaria, respiratory infections) linked to changes in temperature, precipitation and ecosystem disruptions
Increase in prevalence (%) of crop and livestock diseases (e.g. pests due to climate warming)
Rate of crop failure linked to high temperatures, extreme precipitation or pests, leading to food insecurity
% of population at risk of water scarcity due to prolonged drought affecting agriculture and food production
% of communities adopting sustainable and collaborative community-driven practices that integrate science and Indigenous knowledge to mitigate climate impacts

Common vulnerabilities across countries

Fig. 7 shows common vulnerabilities identified by countries.

Fig. 7. Common vulnerabilities identified

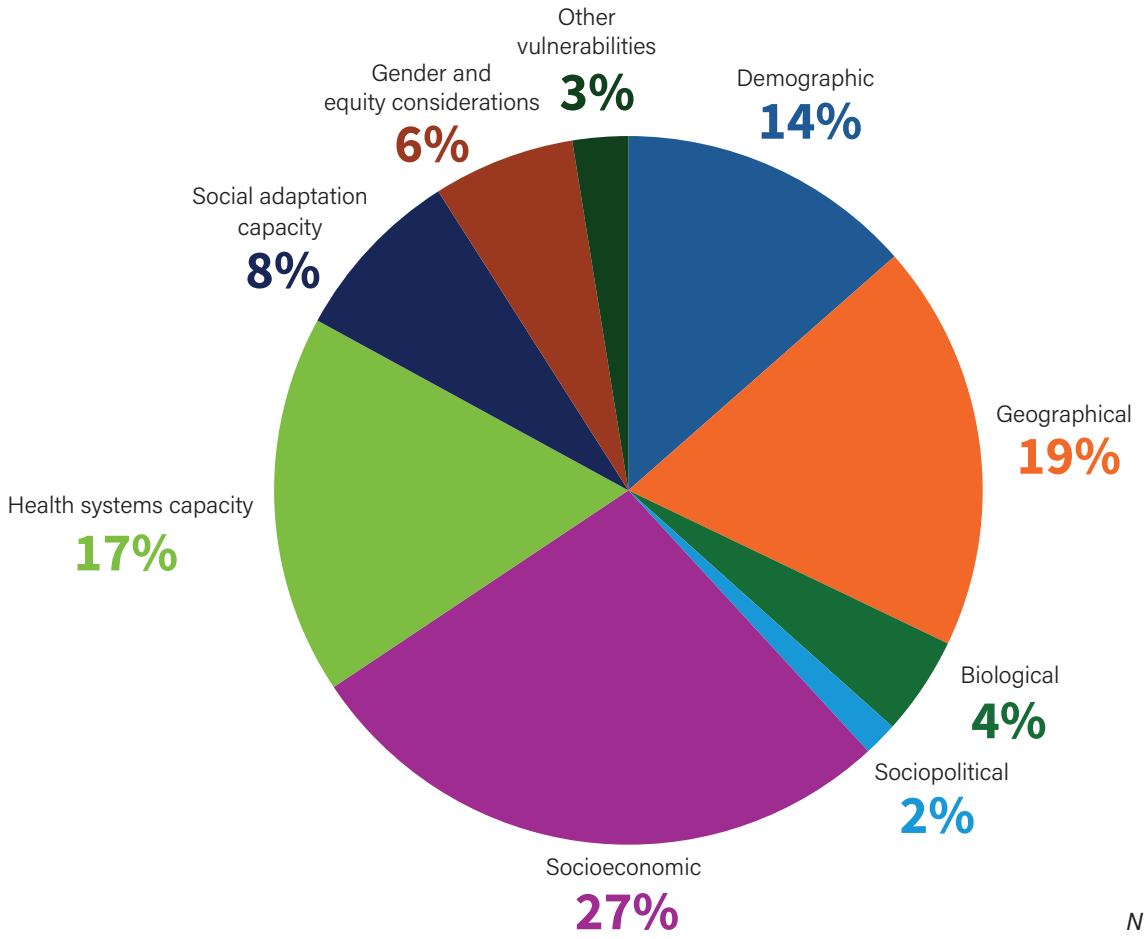


Vulnerability factors

- Demographic
- Geographical
- Biological
- Sociopolitical
- Socioeconomic
- Health systems capacity
- Social adaptation capacity
- Gender and equity considerations
- Other vulnerabilities

A total of 710 indicators and statements about vulnerabilities were identified. The category socioeconomic was the most prominent, accounting for 27% of all indicators and statements (Fig. 8). Other vulnerabilities often mentioned were geographical (19%) and health system capacity (17%). These indicators were reduced to 361 after removing repetitions. Boxes 22–30 summarize the 361 final indicators of vulnerabilities identified by countries.

Fig. 8. Distribution of indicators for vulnerability factors among countries



Box 22. The 46 demographic indicators

Age-based vulnerabilities
% of children younger than 5 years in the population
% of people aged 60 years and older
Incidence of diseases in children younger than 5 years during extreme weather events (e.g. respiratory diseases, malnutrition, vector-borne and waterborne diseases)
Mortality rate from malnutrition in children younger than 5 years (e.g. deaths/1 000 live births)
% of elderly population affected by cardiovascular diseases
Incidences of heat stress and related illnesses in children and elderly people
No. of infant deaths due to malnutrition

Gender and vulnerabilities
% of pregnant or lactating women in the population
% of women in rural areas engaged in climate-relevant activities (e.g. agriculture, water collection)
% of pregnant women with heat stress, or water-, food- or vector-borne diseases during extreme weather events
Gender-specific incidence of diseases (e.g. dengue in women, chronic obstructive pulmonary disease in women)
Prevalence (%) of malnutrition among women during climate-related events (e.g. % of women undernourished during droughts)
Rate of maternal deaths/100 000 live births
Socioeconomic and population characteristics
Population density (e.g. people/km^2), by region (e.g. urban, rural, coastal)
% of population living below the poverty line
Rate of population growth (e.g. % annual increase used to determine high population growth rate)
% of urban population living in high-density area
% of population displaced due to climate-related events (e.g. flood, sea-level rise, drought)
% of the population migrating from rural to urban areas
% of the population that is Indigenous or member of an ethnic minority
Density of urban population in climate-sensitive areas
Density of rural population in climate-sensitive areas
Vulnerabilities by health condition
Incidence of respiratory illnesses in children younger than 5 years and in elderly populations (e.g. as measured by hospital admissions, deaths)
% of population with a chronic condition (e.g. cardiovascular disease, chronic lung disease) that is vulnerable to climate events and impacts
% of children with severe acute malnutrition
% of elderly people with a chronic condition
% of children younger than 5 years with a vector-borne disease (e.g. malaria, dengue)
Prevalence (%) of protein-energy malnutrition in children and women
Vulnerabilities by climate-relevant risk
% of population exposed to heatwaves and extremely hot days (e.g. among elderly people, young children, outdoor workers, pregnant women)
% of population affected by vector-borne diseases (e.g. malaria, dengue) linked to demographic characteristics (e.g. children, pregnant women)
Incidence of diseases related to water and sanitation in children younger than 5 years and in pregnant women
%of children living in households without access to safe drinking-water and sanitation

Migration and displacement
Annual no. of people displaced due to floods, droughts, sea-level rise or coastal erosion
% of migrants and displaced populations in urban or border regions
Rate of rural-to-urban migration (e.g. % change/year)
Educational and socioeconomic indicators
Literacy rate (%) among adults
% of children aged 5–15 years attending school
% of population with access to health care services (e.g. urban vs rural)
Poverty and access to resources
% of population with access to improved drinking-water
% of population with access to improved sanitation facilities at home
% of households lacking resources for basic hygiene
% of population with limited or no access to health care
Urban and rural vulnerabilities
% of rural population involved in subsistence agricultural production
Incidence of climate-related displacement in coastal or high-density urban areas
% of urban districts with inadequate health and social services
% of rural districts with inadequate health and social services

Box 23. The 49 geographical indicators

Vulnerability to coastal and sea-level rise
Annual % of coastal land inundated (e.g. measured in km^2)
Annual % of coastal regions experiencing flooding (e.g. no. of flood events/year)
% of population in coastal areas vulnerable to sea-level rise
No. of instances of saltwater contamination of drinking-water (e.g. salinity levels in mg/L)
Flood and storm risks
Annual no. of flood events by region (e.g. urban, rural, riverine and coastal)
Proportion of households in flood-prone zones
Annual no. of people displaced due to flooding
Proportion of urban areas affected by storm surges and heavy rainfall
Heat and temperature risks
No. of heatwave days/year, by region
Proportion of urban areas classified as urban heat islands, by region
Annual % of population exposed to extreme heat events
Proportion of rural and urban areas experiencing heat-related crop failure

Drought and desertification risks
Annual % of land classified as drought-prone or desertified
Annual no. of drought events (e.g. by severity and region)
% of agricultural land experiencing crop failure due to drought
Proportion of population living in drought-affected area
% of food insecurity linked to drought
Landslides and mountain risks
Annual no. of landslide events (e.g. total and by region)
Proportion of mountain regions affected by glacial lake outburst floods
Annual % of hillsides deforested (e.g. measured in hectares)
Proportion of population living in zones at high risk of landslide
Forest fires and burned areas
Annual area burned by forest fires (e.g. measured in hectares)
Proportion of forested areas classified as fire-prone zones
% of land experiencing recurrent bushfires
Population vulnerability to diseases
Prevalence (%) of climate-sensitive diseases (e.g. malaria, acute respiratory infections, diarrhoea, malnutrition), by region
Proportion of households in areas prone to vector-borne diseases (e.g. malaria, dengue)
Prevalence (%) of severe anaemia in rural versus urban populations (e.g. % of affected individuals)
% of children younger than 5 years affected by diarrhoeal diseases, by region and by extreme weather event
Annual incidence of meningitis in high-risk regions (e.g. in the meningitis belt)
Annual incidence of respiratory diseases linked to smoke exposure
Prevalence (%) of heat-related illnesses (e.g. heat stress, heat exhaustion), by urban and rural area
% of rural population living in risk-prone area (e.g. at risk from drought, flood, cyclone)
% of urban population living in risk-prone areas (e.g. at risk from drought, flood, cyclone, sea-level rise)
Proportion of urban population exposed to extreme weather events
Proportion of rural population exposed to extreme weather events
Population density in high-risk zones (e.g. people/km^2 in floodplains, coastal regions)
Annual rate of displacement due to climate hazards (e.g. flood, drought, sea-level rise)
% of households affected by saline intrusion into aquifers and wells due to sea-level rise

Regional and resource vulnerabilities
Annual proportion of regions experiencing poor rainfall distribution
Decline in average river flow, by region (e.g. measured in m^3/s)
% of agricultural areas affected by soil salinization
Annual decrease in glacier size or coverage (e.g. measured in km^2)
Socioeconomic and infrastructure vulnerabilities
Proportion of population in rural or remote area with limited access to health services
Annual economic cost of climate-related disasters (e.g. damage to infrastructure and material, loss of agricultural output)
Proportion of rural and urban populations vulnerable to food insecurity
% of settlements in zones at high risk from extreme weather events (e.g. flood, landslide, cyclone)
Multi-hazard zones
No. of regions classified as multi-hazard zones (e.g. areas prone to drought, flood or cyclones)
Proportion of regions experiencing overlapping climate hazards (e.g. flooding and landslides during rainy seasons)
Annual rate of desertification in drier zones (e.g. measured as % of total land)

Box 24. The 29 biological indicators

Chronic and noncommunicable diseases
% of population with chronic diseases (e.g. diabetes, hypertension)
Prevalence (%) of NCDs (e.g. cardiovascular diseases, chronic respiratory conditions)
Proportion of individuals with comorbidities (e.g. combination of NCDs with infectious diseases)
Asthma prevalence (%) in the population
Proportion of population with a disability
Infectious and communicable diseases
Prevalence of malaria in children younger than 5 years and in adults (e.g. no. of cases/1 000 population).
Annual incidence of diarrhoeal diseases among children younger than 5 years
Prevalence of acute respiratory infections among children younger than 5 years (e.g. no. of cases/1 000 children)
% of population with infectious diseases (e.g. malaria, tuberculosis)

Malnutrition and nutritional deficiencies
Prevalence of chronic malnutrition (i.e. stunting) among children younger than 5 years (e.g. % of population affected)
Prevalence of severe acute malnutrition (i.e. wasting) among children younger than 5 years (e.g. % of population affected)
Prevalence of anaemia among children younger than 5 years and among women (e.g. % with low haemoglobin levels)
Vitamin A coverage (%) in severely malnourished children younger than 5 years
Prevalence (%) of protein-energy malnutrition among the population
Vulnerability to climate-related health impacts
Proportion of people with chronic illnesses vulnerable to heatwaves and extreme heat events
Rate of hospital admissions for individuals with chronic diseases during extreme heat events (e.g. no. of cases/1 000 population)
Incidence of foodborne diseases in malnourished children during extreme weather events
No. of worsening clinical outcomes among populations with comorbidities and among immunocompromised populations due to vector-borne diseases
Proportion of people with immune deficiencies or who are chronically ill and exposed to malaria
No. of cases of respiratory diseases linked to air pollutants/100 000 population (e.g. O_3, $PM_{2.5}$, aeroallergens) among people with chronic conditions
Proportion of asthma patients at risk of worsening respiratory conditions due to air pollution
General health burden
% of population with high disease burden (e.g. disability adjusted life-years for infectious diseases and NCDs)
Proportion of population with poor health status (e.g. self-reported or based on clinical assessment)
% of people with a disability associated with an increase in climate-sensitive health conditions (e.g. heat stress, vector-borne diseases)
Mental health and psychological vulnerability
% of population lacking access to psychological or psychiatric services
Incidence of mental health disorders in populations exposed to climate hazards
Child health vulnerabilities
Proportion of children younger than 5 years affected by diarrhoea, malnutrition or respiratory infections
Incidence of malnutrition-related diarrhoea in children during extreme events (e.g. flood, drought)
Mortality rate/100 000 population among malnourished children younger than 5 years

NCDs: noncommunicable diseases; O_3: ozone; $PM_{2.5}$: fine particulate matter.

Box 25. The 23 sociopolitical indicators

Conflict and health system impacts
No. of conflict-affected regions or areas with disrupted health services
% of health facilities damaged or destroyed due to conflict or civil unrest
Proportion of health professionals displaced or lost due to conflict
Reduction in the no. of qualified health workers/10 000 population in conflict zones
Vulnerable populations
% of Indigenous peoples in climate-affected areas (e.g. % of total population)
% of minorities or marginalized groups living in risk-prone or underserved areas
Proportion of migrants or displaced populations without access to adequate health care
Rate of migration attributed to climate-related hazards (e.g. floods, droughts, deforestation)
Health infrastructure and systems
% of neighbourhoods with inadequate health infrastructure (e.g. no clinics, poor roads or no electricity)
Proportion of population in poorer neighbourhoods lacking access to essential health services
% of health institutions implementing accountability measures in areas with minority populations or marginalized groups (e.g. audits, reports)
% of health service systems with information and awareness programmes addressing climate-related health risks in conflict areas
Governance and institutional capacity
Proportion of climate change action plans implemented (e.g. no. of actions completed vs planned)
% of health ministry budget allocated to climate-related health actions
Proportion of climate adaptation programmes with effective coordination mechanisms
% of weak or underperforming institutions identified through governance or capacity assessments
Proportion of identified climate actions successfully implemented in conflict areas or areas with minority populations or marginalized groups (e.g. programmes, infrastructure improvements)
Environmental and resource management
Annual rate of deforestation (e.g. hectares/year)
% of areas affected by deforestation or burning (e.g. as % of total land area)
Proportion of resource-constrained regions unable to implement climate-related health actions
% of climate-related programmes delayed or underfunded due to resource constraints

Monitoring and accountability
No. of accountability indicators tracked by health systems (e.g. service delivery, programme outcomes)
Proportion of health programmes in areas affected by conflict or with minority or marginalized populations that have measurable outcomes linked to climate change adaptation approaches

Box 26. The 60 socioeconomic indicators

Agriculture, fisheries and income
Annual decline in agricultural production (e.g. measured in metric tonnes)
Annual decline in fisheries production (e.g. measured in metric tonnes)
% of households dependent on subsistence farming
% of households reporting income loss from agriculture
% of income derived from agriculture and fisheries (e.g. % of total household income)
% increase in food prices linked to climate-related lower crop yields
Poverty and economic challenges
Poverty rate (e.g. % of population living below the poverty line)
% of low-income households (e.g. with household income below minimum wage)
Urban poverty rate vs rural poverty rate
% of population that is unemployed
Distribution of wealth quintiles
Access to water, sanitation and hygiene
% of households without access to improved drinking-water
% of households without access to improved sanitation and hygiene facilities
Proportion of households with only intermittent water supply
% of rural households without access to safe water and sanitation facilities
Proportion of urban households without access to safe water and sanitation facilities
Annual rate of open defecation (e.g. % of population)
Proportion of water sources deemed unsafe (e.g. by contamination levels)
Average amount of water available daily per capita (e.g. L/person)
No. of households reporting poor hygiene practices

Housing and living conditions
% of households with inadequate housing (e.g. non-solid walls and foundation, dirt floors)
% of households without proper drainage or sewage systems
Proportion of households with overcrowding (e.g. average no. people/room)
% of households using firewood and charcoal to cook and exposed to indoor air pollution
% of households without access to decent housing
Proportion of houses with walls made of mud and sticks
Health
% of population without access to health care (e.g. urban vs rural)
Incidence of diseases linked to poor sanitation and hygiene (e.g. cholera, diarrhoea)
% of children younger than 5 years with malnutrition (e.g. stunting, wasting)
Proportion of population in malaria-prone areas without mosquito nets
Rate of undernutrition and food-related diseases among vulnerable groups
Incidence of air pollution-related illnesses (e.g. respiratory diseases)
Food security
% of food-insecure households (e.g. by region or demographic group)
Annual rate of crop failure due to climate-related events
Prevalence of food poverty (e.g. % of population unable to meet basic caloric needs)
Proportion of households reliant on food-assistance programmes
% of income spent on food (e.g. by low-income households)
Waste and pollution
% of households with inadequate solid waste disposal
Annual rate of open burning of waste (e.g. % of total waste)
% of unsanitary water bodies (e.g. polluted rivers or lakes)
Education and knowledge
Literacy rate (e.g. among % of population older than 15 years)
% of households with head of household with low education level
Proportion of children not attending school (e.g. primary or secondary level)
Proportion of the population with access to vocational or technical training
Proportion of individuals with knowledge of safe water and sanitation practices
% of population that is illiterate
No. of households without any type of communication device to receive climate-related early warnings (e.g. radio, TV, cell phone)

Occupational exposure
% of outdoor workers exposed to intense solar radiation, extreme heat, cold wave, lack of access to water
Incidence of work-related illnesses (e.g. heat stress, chemical exposure)
Proportion of people working in unsafe work environments (e.g. due to air pollution, extreme conditions)
Other vulnerabilities
% of population in areas at high-risk of climate-related events (e.g. flood-prone zone, drought-prone area, area with high ambient air pollution)
% of population reliant on poorly maintained water transport and storage systems
Proportion of rural households in marginal areas (e.g. inaccessible by roads)
% of population living near an industrial zone
% of population dependent on rain-fed agriculture
Rate of annual migration or displacement due to extreme weather events
% of population displaced due to sea-level rise or drought
Annual proportion of agricultural land abandoned due to desertification or flooding
Proportion of population living in deprived community vulnerable to air pollution
Distribution of health personnel per region

Box 27. The 48 indicators for health system capacity

Health workforce and human resources
Rate of doctors per 10 000 population (e.g. for urban and rural areas)
Rate of nurses and midwives per 10 000 population
% of health facilities with insufficient staff
Proportion of qualified health personnel in rural areas versus urban areas
Annual rate of health personnel turnover
% of health personnel trained in climate change and public health issues
Ratio of medical workers to patients
Health infrastructure and access
% of population within the coverage radius of a health facility (e.g. 5 km or 10 km)
Rate of health facilities per 10 000 population
No. of hospital beds/10 000 population
% of health facilities with access to electricity and running water
Proportion of health facilities inoperable during extreme weather events

WASH in health facilities
% of health facilities with year-round access to safe drinking-water
% of health facilities without basic sanitation services
Proportion of health facilities lacking proper waste disposal systems (e.g. for solid, liquid and hazardous wastes)
% of health facilities with non-functional waste management systems
Health service delivery
Annual % of outpatient services disrupted due to extreme weather events
Proportion of emergency health services disrupted during disasters
No. of patients seeking care for climate-sensitive diseases (e.g. vector-borne, heat-related)
Annual no. of hospital admissions linked to extreme weather events (e.g. heatwaves, floods)
Proportion of health facilities reporting frequent shortages of medicines
% of facilities without essential equipment and supplies
Health system preparedness
No. of health facilities with climate-specific emergency preparedness and response plans
Proportion of health facilities with integrated early warning and surveillance systems for climate-sensitive diseases
Annual % of health facilities participating in disaster response training
Proportion of health care facilities reporting vulnerabilities in medicine supply chains
% of health sector budget allocated to climate-related health risks
Surveillance and monitoring systems
Proportion of health facilities with functional disease surveillance systems
No. of climate-sensitive diseases monitored through surveillance systems
% of health information systems integrating climate and weather data
Frequency of data collection about climate-related health risks
Proportion of regions with functional early warning systems for climate-related health threats
Health outcomes
% of population covered by government health insurance
Proportion of health outcomes linked to climate-sensitive diseases (e.g. malaria, heat stress)
Annual no. of deaths, hospitalizations and outpatient visits linked to extreme weather events
Incidences of communicable and noncommunicable diseases in high-risk regions
Rate of malnutrition and illnesses related to food insecurity/100 000 population

Funding and resources
% of health sector funding allocated to addressing impacts of climate change
Annual budget for improvements to health infrastructure in vulnerable regions
Proportion of health facilities with adequate funding for operations
Accessibility and equity
% of population without access to primary health care (e.g. rural vs urban areas)
Proportion of population in underserved regions lacking access to health care
Equity ratio for health infrastructure and resource allocation between urban and rural areas
Proportion of facilities in remote areas lacking basic services
Environmental sustainability in health facilities
% of facilities with energy derived from fossil fuels
Proportion of facilities using open burning or unsafe waste incineration methods
% of health facilities using renewable energy sources
Annual carbon emissions from health facilities (e.g. kg or tonnes of carbon dioxide equivalent)

WASH: water, sanitation and hygiene.

Box 28. The 36 indicators for social adaptation capacity

Population displacement and migration
Overall no. of populations accessing health care services
General rates of adverse health outcomes among displaced populations (e.g. malnutrition, infectious disease, mental health issues)
Proportion of migrants lacking access to essential health services
Incidence of climate-sensitive diseases among populations that have migrated or been displaced
WASH services
% of population with access to safe drinking-water
Proportion of households using improved sanitation facilities
Incidence of waterborne diseases (e.g. cholera, diarrhoea) in populations with poor access to WASH services
No. of operational water treatment plants relative to population needs
Rate of hospital admissions for WASH-related diseases in vulnerable areas

Accessibility of health services
% of poor households living more than 5 km or 10 km from a health facility
Rate of health staff/10 000 persons in rural versus urban areas
Proportion of households reporting delays in or barriers to accessing health care due to infrastructure limitations
Incidence of untreated diseases due to health facility inaccessibility
Public awareness and community participation
% of population aware of climate-sensitive health risks
Participation rate of individuals in community health and environmental campaigns
Incidence of environment-related diseases in areas with low public awareness
Proportion of community members with knowledge about climate-sensitive diseases
Proportion of community members participating in prevention programmes for climate-sensitive diseases
Infrastructure fragility
% of health facilities reporting inadequate equipment and staffing
No. of functional health care facilities in climate-sensitive zones
Annual proportion of health facilities affected by extreme weather events
No. of health care service disruption due to failures of transport infrastructure
Poverty and socioeconomic vulnerabilities
Poverty rate in communities with high exposure to climate events
% of households with insufficient income to access health care
Proportion of agricultural households vulnerable to market volatility
Prevalence (%) of health outcomes linked to poverty (e.g. communicable and noncommunicable diseases)
Institutional and operational capacities
% of health systems with strategies to adapt to climate change
Funding gap for health sector climate action plans (e.g. as a % of total need)
Proportion of health workers trained in climate-sensitive health issues
Proportion of health care providers trained in the impacts of climate change on health
% of health workers trained in climate risk communication
Annual no. of studies conducted and reports about climate change and health
No. of early warning systems for climate-related health risks implemented
Disease prevention and monitoring
Proportion of at-risk population vaccinated against climate-sensitive diseases (e.g. cholera, yellow fever)
Incidence of environment-related diseases (e.g. respiratory infections, waterborne diseases)
No. of functional disease surveillance systems integrating climate data

WASH: water, sanitation and hygiene.

Box 29. The 40 indicators for gender and equity

Gender roles and responsibilities
% of women heads of household (e.g. in rural and urban areas)
Proportion of women with agricultural holdings
Average no. of daily hours spent by women on unpaid domestic work compared with hours spent by men
Proportion of women reporting increased workload due to lack of access to water
% of women relying on biomass fuel for cooking
Health outcomes and access to services
Maternal mortality rate (e.g. per 100 000 live births)
Neonatal mortality rate (e.g. per 1 000 live births)
% of pregnant women with access to antenatal clinic check-ups
% of women reporting anaemia
Incidence of undernutrition among pregnant and lactating women
% of women unable to access maternal health services
Average distance to nearest health care facility for pregnant women (e.g. average no. of km)
Proportion of women receiving family planning and reproductive health services
Mortality and morbidity rates among women and children due to extreme weather events (e.g. per 100 000)
% of women reporting climate-sensitive diseases (e.g. malaria, heat stress)
Literacy and education
Adult literacy rate for females compared with adult literacy rate for males
% of women with primary education
% of women with secondary education
Female literacy rate in rural areas compared with urban areas
% of women who have access to climate-related health education programmes
Indigenous and marginalized communities
Total no. of male and total no. of female Indigenous population
% of Indigenous populations with access to safe drinking-water
Proportion of Indigenous population relying on store-bought food compared with proportion relying on traditional food
Proportion of Indigenous women affected by food insecurity
Economic inequalities
% of female-headed households living below the poverty line
Unemployment rate for females compared with rate for males
Income disparity between men and women (e.g. average income)

Environmental and climate vulnerabilities
Proportion of households in which women are responsible for water collection
Average distance travelled by women to fetch drinking-water, by region
% of women displaced due to climate events (e.g. droughts, floods, storms)
Health equity and systemic inequalities
Proportion of health care facilities providing maternal and child health services
% of women unable to afford health care services
Proportion of women in rural areas with no access to mental health services
Incidence of climate-related health inequalities among marginalized populations (e.g. women, Indigenous peoples; compared with the rest of the population)
Policy and representation
% of climate-related policies with explicit gender considerations
Proportion of women in leadership roles in policy and planning
% of women included in community-based climate adaptation programmes (e.g. % of participants who are women)
Representation of women in local and national government (e.g. % of women)
Proportion of women in decision-making roles at community and policy levels
% of women with access to financial resources for climate adaptation

Box 30. The 30 indicators for other vulnerabilities

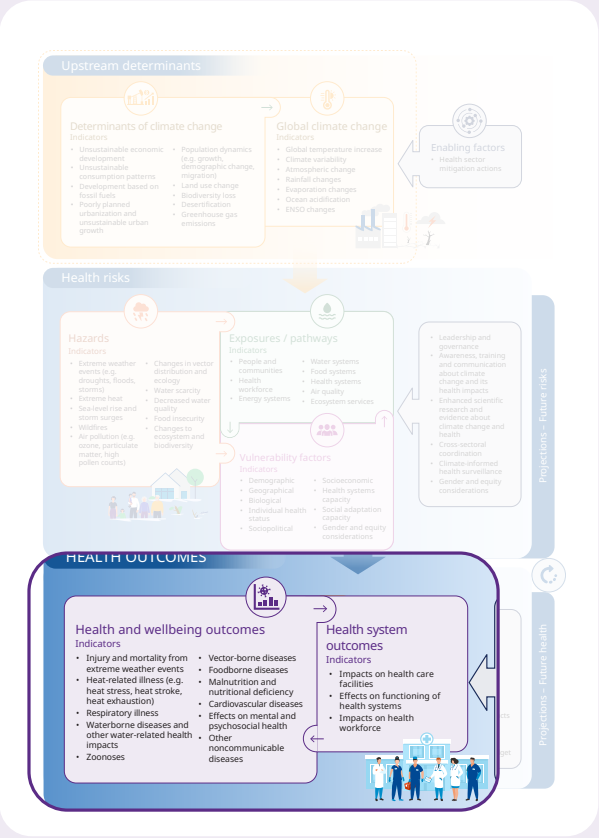
Agriculture and ecosystems
% of agricultural land affected by changing rainfall patterns and high temperatures
% of climate-sensitive species affected by sea-level rise and increased temperatures
Rate of loss of forest cover due to cyclone intensity and higher temperatures (e.g. loss in km^2 over time)
Proportion of farmers reporting crop failure or yield reduction due to flooding
% of degraded soil area (e.g. in hectares)
Permafrost and coastal vulnerabilities
No. of buildings, roads and communities impacted by thawing of permafrost
% of coastal infrastructure affected by rising sea levels (e.g. fishing complexes, fortifications)
Annual rate of erosion of coastal and permafrost regions (e.g. loss in km^2 over time)
Health and disease
Vaccination coverage rate (%) for children younger than 5 five years
Incidence of infectious and parasitic diseases (e.g. malaria, respiratory infections, diarrhoea)
% of population affected by malnutrition in areas prone to climate events
Rate of increase in disease outbreaks during prolonged dry seasons

Flooding and displacement
Annual no. of flooding events and associated human and economic losses
Annual % of farmland damaged by floods
Proportion of coastal population migrating due to sea-level rise and flooding
Annual no. of people displaced due to coastal flooding
Infrastructure and adaptive capacity
% of districts with low adaptive capacity based on infrastructure indicators (e.g. roads, communication, drinking-water, sanitation, education)
Proportion of coastal buildings and infrastructure affected by rising sea levels
Annual rate of physical and mechanical erosion affecting critical infrastructure
% of households with access to basic sanitation and clean drinking-water
No. of initiatives promoting coordination between organizations addressing the impacts of climate change
Institutional and policy gaps
Annual no. of climate change coordination meetings held among key organizations
Existence of a national air quality monitoring system (e.g. yes, no)
% of health policies integrating climate adaptation and mitigation strategies
Proportion of national climate change adaptation plans that include health sector assessments
Climate change impact assessments
Presence of a comprehensive national assessment of climate change impacts, vulnerabilities and adaptations for health (e.g. yes, no)
% of regions with detailed climate vulnerability assessments
Climate change mitigation and health co-benefits
No. of climate change mitigation initiatives incorporating health co-benefits
% of mitigation projects promoting health co-benefits as cost-effective options
Proportion of national budget allocated to climate mitigation that avoids adverse health outcomes

Common climate-sensitive health outcomes and impacts on health systems and facilities across countries

Fig. 9 shows the climate-sensitive health outcomes and impacts on health systems and facilities identified by countries.

Fig. 9. Common climate-sensitive health outcomes and impacts on health systems and facilities

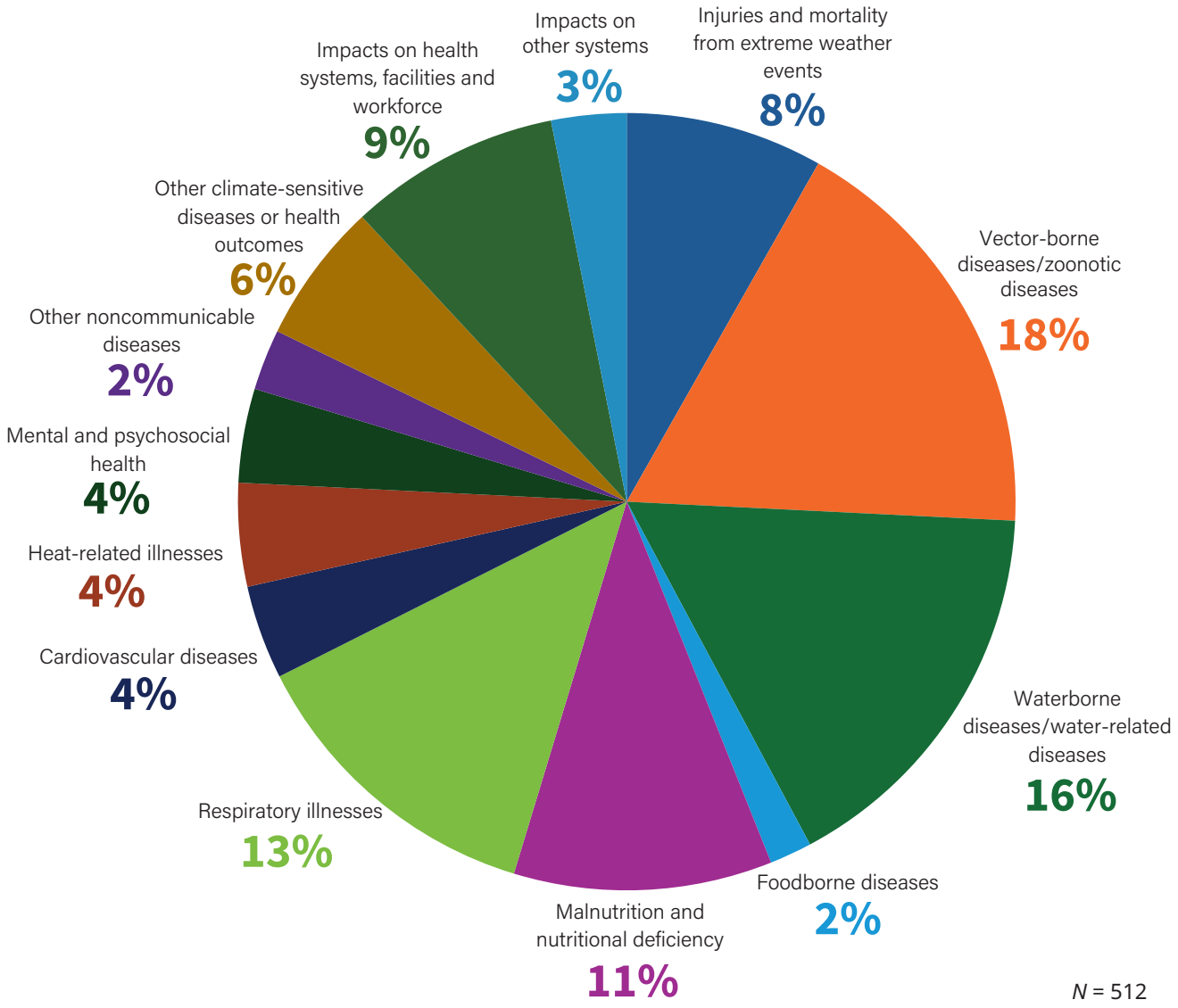


Health outcomes and impacts on health systems and facilities

- Injuries and mortality from extreme weather events
- Vector-borne diseases
- Waterborne diseases and water-related diseases
- Foodborne diseases
- Malnutrition and nutritional deficiency
- Zoonotic diseases
- Respiratory illnesses
- Cardiovascular diseases
- Heat-related illnesses
- Effects on mental and psychosocial health
- Other noncommunicable diseases
- Other climate-sensitive diseases or health outcomes
- Impacts on health systems, facilities and the health workforce
- Impacts on other systems

A total of 512 indicators and statements about health outcomes and impacts on health systems and facilities were identified. The categories vector-borne diseases/zoonotic diseases and waterborne diseases were the most commonly mentioned of all indicators and statements, with the combination accounting for 34% (Fig. 10) of indicators and statements. This is not unexpected, as these health outcomes are the focus of some assessments, given their known climate linkages and their designation as climate-sensitive diseases. These indicators were reduced to 279 after removing repetitions. Boxes 31–43 summarize the 279 final indicators of climate-sensitive health outcomes and impacts on health systems and facilities identified by countries.

Fig. 10. Distribution of indicators for climate-sensitive health outcomes and impacts on health systems and facilities among countries



Box 31. The 26 indicators for injuries and mortality from extreme weather events

General injuries and deaths from extreme weather events
Annual no. of injuries caused by extreme weather events
Annual no. of deaths caused by extreme weather events
Annual injury rate/100 000 population associated with climate-related disasters
Annual mortality/100 000 population due to extreme weather events
Annual no. of deaths and injuries per disaster type (e.g. heatwave, flood, wildfire, storm)
Annual % increase in deaths and injuries associated with rising frequency and severity of extreme weather events

Flood-related indicators
Annual no. of deaths caused by floods
Annual no. of injuries caused by floods
Annual no. of drownings attributable to floods
Mortality/100 000 population due to inland and coastal flooding
Heat-related indicators
Annual no. of deaths attributable to heatwave events
Annual no. of hospitalizations due to heat-related illnesses
Annual mortality/100 000 population from heat-related illnesses
Excess heat-related mortality during heatwave events
Cold-related indicators
Annual no. of deaths attributable to extreme cold events
Mortality/100 000 population from cold-related illnesses
Annual no. of injuries linked to cold weather events
Wildfire-related indicators
Annual no. of deaths caused by wildfires
Annual no. of injuries caused by wildfires (e.g. burns, respiratory issues)
Estimated annual no. of premature deaths due to short-term and long-term exposure to $PM_{2.5}$ from wildfires
Cyclones, storm surges and storm indicators
Annual no. of deaths caused by cyclones and storms
Annual no. of injuries caused by cyclones and storms
Annual mortality/100 000 population from storm-related incidents
No. of deaths during cyclone season from direct impacts, such as flooding, heavy rain or extreme winds
Landslide-related indicators
Annual no. of deaths caused by landslides
Annual no. of injuries caused by landslides

$PM_{2.5}$: fine particulate matter.

Box 32. The 39 indicators of vector-borne and zoonotic diseases

Malaria
Annual incidence of malaria cases/1 000 population
Prevalence (%) of malaria in the total population
Prevalence (%) of malaria in children younger than 5 years
Malaria mortality/100 000 population
% of outpatient consultations in basic health facilities attributed to malaria
Monthly mean no. of malaria cases
Correlation between no. of malaria cases and climatic variables (e.g. precipitation, humidity and temperature)
Dengue
Annual incidence of cases of dengue fever/1 000 population
Prevalence (%) of dengue fever
Incidence of dengue haemorrhagic fever/1 000 population
Mortality from dengue haemorrhagic fever/100 000 population
Monthly mean incidence of dengue
Correlation between dengue transmission and climatic variables (e.g. precipitation, temperature, humidity)
% increase in incidence of dengue fever observed during rainy season
Other vector-borne diseases
Annual no. of yellow fever cases
Annual mortality from yellow fever/100 000 population
Annual incidence of Zika virus cases /100 000 population
Annual no. of autochthonous cases of Zika virus disease
Annual no. of chikungunya cases
Annual no. of autochthonous cases of chikungunya virus disease
Annual no. of kala azar cases
Correlation between kala azar and temperature variation
Annual incidence of schistosomiasis (i.e. bilharzia) cases reported/1 000 population
Annual incidence of Lyme disease/100 000 population
Annual no. of outbreaks of Rift Valley fever
Annual incidence of Rift Valley fever (e.g. human and animal)
Annual no. of West Nile virus cases
Annual no. of Japanese encephalitis cases
Annual no. of onchocerciasis cases
Annual no. of lymphatic filariasis cases
Annual no. of African trypanosomiasis cases

Zoonotic diseases
Annual no. of hantavirus cases
Annual no. of outbreaks of Lassa fever
Prevalence (%) of Lassa fever
Annual no. of human cases of rabies
No. of rabies cases in animals (e.g. domestic and wild)
Annual no. of plague cases
Trends in plague case incidence (e.g. % change year on year)
No. of leptospirosis cases after flood events

Box 33. The 24 indicators for waterborne and water-related diseases

Incidence metrics
Annual incidence of diarrhoeal diseases/100 000 population
Monthly mean no. of cases of diarrhoeal disease
Annual no. of cholera cases/100 000 population
No. of diarrhoea cases in children younger than 5 years/1 000 children
Annual incidence of typhoid fever
Incidence of enteric diseases (e.g. typhoid, dysentery) in disaster-affected areas
Annual no. of cases of hepatitis A and E
No. of *Vibrio parahaemolyticus* infections linked to harmful algal blooms
Incidence of shigella infection
Severity and mortality metrics
Annual no. of deaths from diarrhoeal disease/100 000 population
Mortality due to diarrhoeal disease in children younger than 5 years/1 000 children
Annual no. of cholera deaths/100 000 population
No. of hospitalizations and deaths of children younger than 5 years due to acute all-cause gastroenteritis
% of deaths related to diarrhoeal disease among total child mortality
Event-specific metrics
No. of cases of diarrhoeal disease following extreme events (e.g. floods, droughts)
Annual no. of cholera outbreaks
No. of cases of acute gastroenteritis during extreme weather events
Prevalence metrics
Prevalence (%) of diarrhoeal diseases among children younger than 5 years
Prevalence (%) of intestinal parasitosis linked to degradation of water quality
Prevalence (%) of schistosomiasis cases in endemic regions

Environmental and risk metrics
No. of cases of waterborne disease associated with contamination of drinking- and recreational water
No. of cases of diarrhoeal disease caused by unsanitary conditions during extreme weather events
No. of cases of waterborne infectious diseases linked to poor water quality and sanitation
Correlation between annual morbidity from diarrhoeal disease and climatic variables (e.g. rainfall, temperature)

Box 34. The 12 indicators for foodborne diseases

Incidence metrics
Annual incidence of foodborne diseases/100 000 population
Annual no. of reported cases of food poisoning/100 000 population
No. of outbreaks of foodborne disease during or following extreme weather events (e.g. cyclone, flood, drought)
Annual no. of cases of emerging and re-emerging foodborne diseases
% increase in the risk of foodborne infectious diseases due to climatic conditions
Incidence of foodborne diseases among Indigenous populations/100 000 Indigenous population
% of food-related diseases reported in vulnerable populations (e.g. children younger than 5 years, elderly people)
No. of cases of illness associated with the consumption of contaminated food caused by extreme weather events (e.g. contamination by *Salmonella*, *Escherichia coli*, *Listeria*)
No. of cases of foodborne illness caused by chemical contamination (e.g. pesticides, heavy metals)
Severity and mortality
Annual no. of deaths caused by foodborne illnesses
Hospitalization rate due to foodborne diseases/100 000 population
No. of outbreaks of foodborne illness outbreaks reported and investigated

Box 35. The 31 indicators for malnutrition and nutritional deficiency

Prevalence metrics
Prevalence (%) of stunting in children younger than 5 years
Prevalence (%) of wasting (i.e. low weight for height) in children younger than 5 years
Prevalence (%) of underweight (i.e. low weight for age) in children younger than 5 years
Prevalence (%) of overweight among children and adolescents aged 5–19 years
Prevalence (%) of anaemia among children younger than 5 years
Prevalence (%) of severe anaemia among pregnant women

Incidence metrics
Annual incidence of malnutrition/100 000 population
Annual no. of cases of severe acute malnutrition
Annual no. of cases of moderate acute malnutrition
Annual incidence of anaemia (e.g. mild, moderate, severe)
No. of undernutrition cases linked to inadequate dietary intake or disease
Annual incidence of cases of chronic malnutrition/100 000 population
Incidence of cases of acute and chronic malnutrition/100 000 population
Specific metrics
% of children aged 12–23 months with chronic malnutrition
% of children with stunting by age group
% of children younger than 5 years with wasting
% of children younger than 5 years who are underweight
% of children younger than 5 years who are malnourished due to food insecurity
Annual rise in malnutrition-related diseases (e.g. % increase in specific disease related to nutritional deficiency)
Annual mortality/100 000 children attributable to severe malnutrition in children younger than 5 years
% of women of reproductive age who are underweight
Mortality/100 000 population due to malnutrition combined with infectious and parasitic diseases
% of malnutrition cases (categorized as acute or chronic)
% of malnutrition cases linked to food insecurity, drought or other climatic factors
Food security metrics
Annual no. of food insecurity episodes
Annual no. of malnutrition cases associated with food insecurity and extreme weather events
Rise in malnutrition rates during drought or flooding events (e.g. % increase)
% of households experiencing food insecurity
Economic and nutritional impact metrics
% of reduced agricultural output attributed to climate variability
Prevalence (%) of malnutrition linked to reduced economic capacity to purchase nutritious foods
Annual no. of cases of malnutrition due to food poisoning or chronic gastrointestinal infections

Box 36. The 32 indicators for respiratory illnesses

Incidence metrics
Annual incidence of respiratory diseases associated with dry weather and fires
Incidence of respiratory diseases attributable to atmospheric pollutants in children younger than 5 years and people older than 60 years (e.g. no. of cases/100 000)
Annual incidence of acute respiratory infections
Annual no. of cases of acute upper respiratory infection in all municipalities
Annual no. of cases of acute lower respiratory infections
Annual distribution of respiratory cases per county (e.g. cases/year)
Annual no. of asthma cases
Annual incidence of bronchitis and bronchiolitis
Prevalence metrics
Prevalence (%) of acute respiratory infection in children younger than 5 years
Prevalence (%) of chronic obstructive pulmonary disease
Prevalence (%) of allergic diseases
Mortality metrics
Mortality from respiratory diseases in infants, children younger than 5 years and people older than 60 years (e.g. no. of deaths/100 000)
Annual no. of deaths due to respiratory diseases caused by wildfire smoke exposure
Annual incidence of deaths due to pneumonia/100 000 population
Annual mortality from respiratory infections (e.g. no. of deaths/year)
Annual no. of premature deaths attributable to exposure to particulate matter
Hospitalization metrics
Annual no. of hospital admissions for respiratory illness
Annual rate of hospitalizations for chronic obstructive pulmonary disease (e.g. no. of admissions/year)
Annual increase in hospital admissions for and deaths from chronic obstructive pulmonary disease
Trend and correlation metrics
Trends in acute respiratory infections over time (e.g. % change/year)
Correlation between cases of acute respiratory infection and climatic variables (e.g. temperature, humidity; correlation coefficient)
Correlation between annual morbidity from acute respiratory infection and climatic variables (e.g. correlation coefficient, other statistical measures)
Increase in acute respiratory diseases associated with changes in temperature and humidity (e.g. no. of cases or % change)
Annual increase in asthma cases due to exposure to wildfire smoke (e.g. % change/year)
Annual increase in cases of chronic obstructive pulmonary disease due to exposure to wildfire smoke (e.g. % change/year)

Disease-specific metrics
% change in pneumonia cases
No. of consultations for asthma (e.g. as % of total outpatient visits)
Seasonal peak in respiratory tract infections during rainy season (e.g. no. of cases/month)
Seasonal rise in cases of respiratory disease in children during cold waves (e.g. no. of cases/season)
Annual rise in cases of respiratory disease (e.g. no. of cases/year)
Annual increase in risk of asthma (e.g. % increase/year)
Annual increase in risk of acute respiratory infection (e.g. % increase/year)

Box 37. The 14 indicators for cardiovascular diseases

Incidence and prevalence metrics
Annual no. of stroke cases
Annual no. of cases of ischaemic heart disease
Annual incidence of hypertension (e.g. no. of cases/100 000 population per year)
Annual no. cardiorespiratory health outcomes attributable to $PM_{2.5}$ from wildfires (e.g. no. of cases/year)
Prevalence (%) of cardiovascular diseases
Mortality metrics
Mortality from cardiovascular diseases/100 000 population
Annual no. of deaths from cardiovascular diseases
Morbidity metrics
Morbidity from cardiovascular disease (e.g. no. of cases/100 000 population)
Annual increase in no. of cases of cardiovascular disease attributable to heat exposure
Annual increase in hospital admissions due to cardiovascular disease
Annual no. of hospital admissions for cardiovascular disease
Cardiovascular diseases as a % of total hospital admissions
Climate-related metrics
Annual % change in cardiovascular disorders correlated with $PM_{2.5}$ and temperature extremes
Annual increase in hospital admissions for cardiovascular disease associated with heat stress

$PM_{2.5}$: fine particulate matter.

Box 38. The 12 indicators for heat-related illnesses

Incidence metrics
Annual no. of cases of heat stroke
Annual no. of cases of heat exhaustion
Annual no. of cases of heat rash
Annual no. of cases of heat stress
Annual no. of cases of other heat-related illnesses (e.g. cramps, heat oedema)
Prevalence metrics
Prevalence (%) of heat-related illnesses among outdoor workers (e.g. % of workforce affected/year)
Prevalence (%) of cases of heat exhaustion in vulnerable populations (e.g. older people, children)
Mortality metrics
Heat-related mortality rate (e.g. no. of deaths/100 000 population per year)
No. of deaths directly attributable to heatwaves (e.g. no. of deaths/year)
No. of excess deaths during heatwaves compared with baseline mortality (e.g. no. of deaths/year)
Climate-related metrics
Correlation between heatwaves and mortality and morbidity (e.g. as % increase per degree Celsius rise in temperature)
% change in hospital admissions for heat-related illnesses during heatwaves (e.g. % increase compared with baseline)

Box 39. The 16 indicators for mental and psychosocial health

Incidence metrics
Annual no. of new cases of depression diagnosed
Annual no. of new cases of anxiety disorders diagnosed
No. of diagnoses of mental illnesses directly linked to impacts of flood or drought (e.g. no. of cases/year)
Prevalence metrics
Prevalence of mental health disorders in disaster-affected communities (e.g. % of population in affected areas)
Prevalence of anxiety and depression in populations displaced by climate-related events (e.g. % of displaced population with these diagnoses)
% of individuals experiencing delayed mental health impacts after extreme weather events
Hospitalization metrics
Rate of hospital admissions for anxiety and depression (e.g. no. of admissions/100 000 population per year)
Annual no. of hospital admissions for mental health disorders
Rate of mental health–related emergency department visits following extreme weather events (e.g. no. of visits/100 000 population per year)

Community-level metrics
% of disaster-affected populations reporting problems with psychological well-being (e.g. % of surveyed population)
Annual no. of people with mental health issues associated with food or water shortages (e.g. no of cases/year)
% of people reporting mental health stress after property loss or displacement
Correlation between mental health disorders and frequency or severity of natural disasters (e.g. % increase in no. cases due to increased disaster frequency)
% increase in cases of mental health disorders attributed to climate-related displacement or resource scarcity
% of children and adolescents experiencing a mental health disorder after a natural disaster
% of elderly individuals reporting psychological stress after displacement or extreme events (e.g. % of elderly people with psychological stress/% of elderly people experiencing extreme event)

Box 40. The 16 indicators of other noncommunicable diseases

Morbidity and mortality metrics
Annual incidence of NCDs/100 000 population
Annual mortality rate of NCDs/100 000 population
Annual incidence of neoplasms (e.g. lung cancer)
Annual no. of cataract cases linked to exposure to UV radiation
Mortality due to cold-related health conditions/100 000 population
Annual incidence of cerebrovascular diseases (e.g. stroke)
Rate of hospital admissions due to cerebrovascular diseases/100 000 population
Mortality from cerebrovascular diseases/100 000 population
Skin and dermatological diseases metrics
Annual no. of dermatological diseases (e.g. eczema, psoriasis, skin irritation)
Annual incidence of skin cancer (e.g. non-melanoma and melanoma)/100 000 population
Rate of increase in dermatological conditions linked to exposure to UV radiation (e.g. % change/year)
No. of cases of cutaneous malignant melanoma attributable to exposure to UV radiation (e.g. no. of cases/year)
Annual incidence of UV-related carcinoma/100 000 population
Dehydration metrics
Annual no. of acute dehydration cases
No. of hospitalizations due to dehydration/100 000 population
Mortality from severe dehydration during extreme heat events/100 000 population

NCDs: noncommunicable diseases; UV: ultraviolet.

Box 41. The 16 indicators for other climate-sensitive diseases or health outcomes

Animal-related and vector-borne diseases
No. of accidents involving venomous animals (e.g. no. of cases/year)
No. of confirmed cases of scrub typhus (e.g. no. of cases/year)
Fungal infections
Annual incidence of fungal infections sensitive to climate variables (e.g. *Cryptococcus gattii* infection, blastomycosis, coccidioidomycosis)
Meningitis
Annual no. of confirmed cases of meningitis
Prevalence of meningococcal meningitis (e.g. % of population)
Morbidity related to meningitis/100 000 population
Meningitis mortality rate / 100 000 population
Skin conditions and diseases
Annual incidence of skin diseases
% consultations for skin diseases among total outpatient consultations
Prevalence trends in dermatoses over time (e.g. % change/year)
Post-disaster morbidity rate for skin diseases (e.g. no. of cases/100 000 affected population)
Annual no. of cases of scabies
Correlation between scabies incidence and climatic variables (e.g. temperature, correlation coefficient).
Eye diseases
Annual no. of cases of eye infection
Annual incidence of trachoma
Trends in climate-sensitive diseases
% change in mean temperature associated with antimicrobial resistance

Box 42. The 23 indicators for impacts on health systems, facilities and the workforce

Service disruption
Annual no. of disruptions to health care service networks
Frequency of discontinuity in routine health care services (e.g. no. of events/year)
% of health care facilities reporting service interruptions due to climate-related events (e.g. as % of total facilities)
Annual no. of hospitals and health facilities forced to close temporarily due to extreme weather
No. of hospital evacuations due to climate events
Infrastructure impacts
Annual no. of health facilities damaged by floods, hurricanes or other extreme events
% of health facilities with structural damage caused by melting permafrost (e.g. % of facilities in affected regions)
Annual cost of repairs to health infrastructure following climate-related damage (e.g. in US dollars)
% of public health infrastructure damaged by climate events (e.g. as % of total infrastructure)
Annual no. of supply chain disruptions affecting food, water, energy or medical supplies (e.g. no. of events/year)
Annual no. of health care facilities reporting damp or mould after flooding (e.g. no. of facilities affected/year)
Health care services demand and capacity
Increase in emergency admissions linked to extreme climate events (e.g. % change/year)
No. of hospitalizations during heatwaves, floods or storms (e.g. no. of admissions/year)
% increase in health service utilization following climate-related events (e.g. % increase/event)
% of health facilities reporting increased demand for services for climate-sensitive diseases (e.g. as % of total facilities)
No. of outbreaks of vector-borne disease (e.g. dengue) exceeding health care capacity (e.g. no. of outbreaks/year)
Workforce impacts
No. of health personnel affected or displaced by climate-related events (e.g. no. of personnel/year)
Staff shortages during extreme weather events (e.g. as % of total workforce)
No. of health workers exposed to occupational health risks during heatwaves or extreme events (e.g. no. of cases/event per year)

Emergency and response systems
No. of disruptions to emergency response systems (e.g. no. of disruptions/system per year)
% of power grid failures impacting health care facilities (e.g. % of total facilities affected/ year)
% of emergency medical services disrupted due to climate-related hazards (e.g. as % of total services)
No. of emergency admissions due to extreme weather (e.g. no. of admissions/event per year)

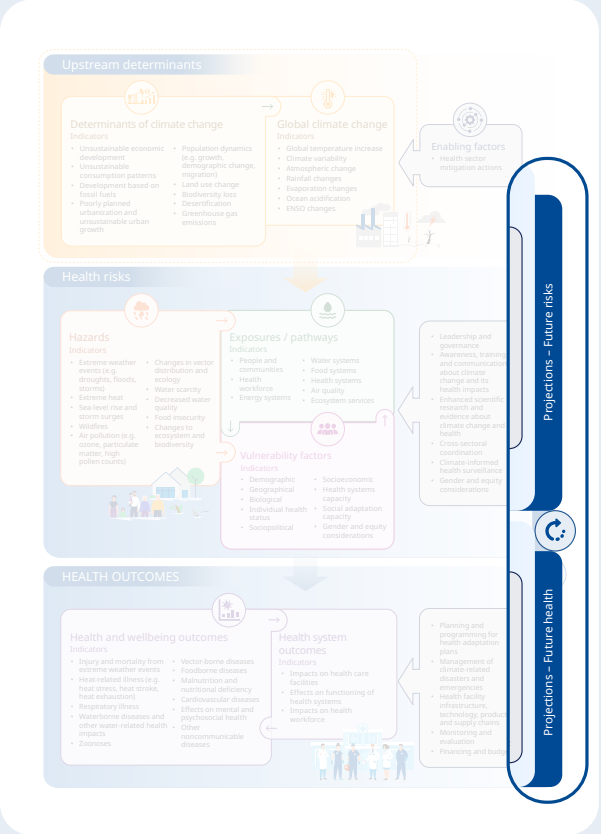
Box 43. The 18 indicators for impacts on other systems

Population displacement
Annual no. of people displaced due to climate-related events
% of affected population requiring relocation (e.g. as % of total affected)
Average duration of displacement for affected populations (e.g. no. of months/year)
Economic impacts
Total economic losses due to extreme weather events (e.g. in US dollars/year)
Annual % of gross domestic product lost due to climate-related damage
% of agricultural productivity lost due to climate events (e.g. % change/year)
Cost of infrastructure damage due to sea-level rise (e.g. in US dollars/year)
Disruption of services and infrastructure
No. of road closures or disruptions due to extreme weather events (e.g. no. of disruptions/ event per year)
Interruptions to public services (e.g. water, wastewater, power) due to climate events (e.g. % of total services affected).
No. of water treatment plants affected by extreme weather (e.g. no. of plants/year)
Cost of repairing damaged infrastructure (e.g. roads, bridges, utilities) after climate events (e.g. in US dollars/year)
Agriculture and food security
Annual no. of hectares of crops destroyed due to extreme weather events
No. of livestock deaths caused by extreme climate conditions (e.g. no. of animals/year)
% of food production reduced due to crop failures (e.g. % reduction/year)
Annual no. of people affected by food insecurity due to climate events
Environmental degradation
Annual no. of hectares of land degraded by flooding or cyclones
% of coastal ecosystems affected by sea-level rise and extreme weather
% of potable water sources degraded or contaminated after climate events (e.g. as % of total sources)

Common hazards and health outcomes linked to future changes and health risks across countries

Fig. 11 shows the common hazards and health outcomes linked to future changes and future health risk identified by countries.

Fig. 11. Common hazards and health outcomes linked to future changes and health risks

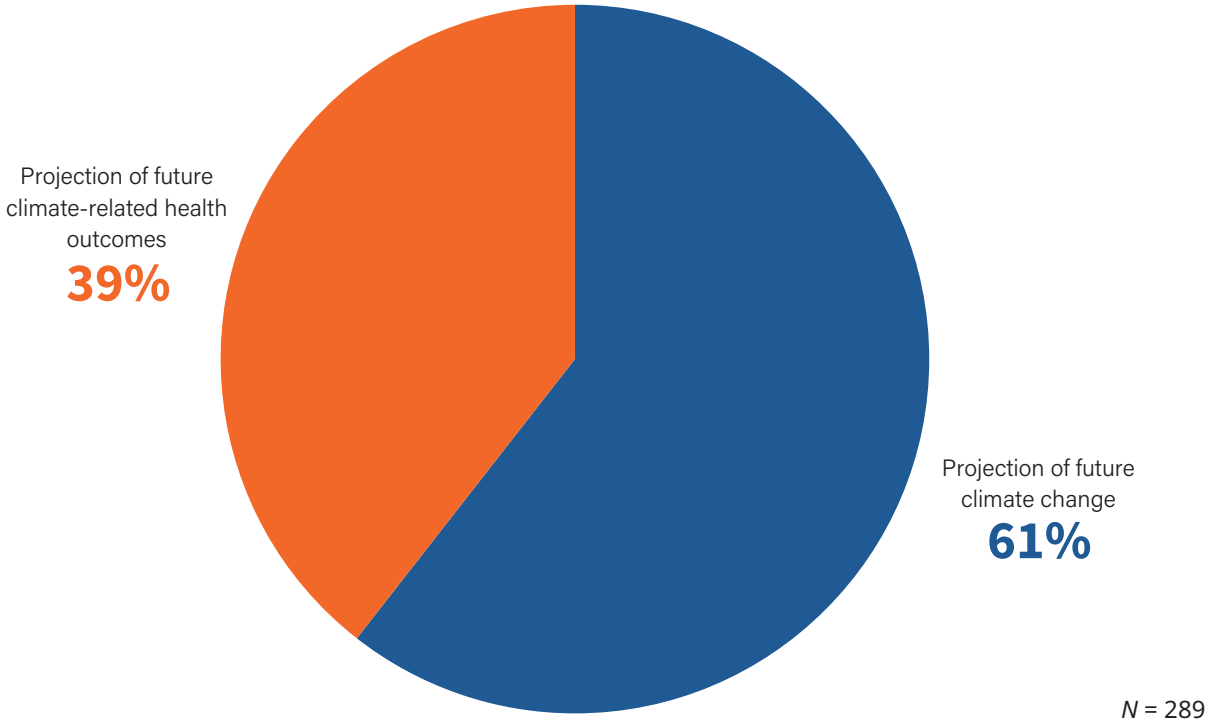


Future changes and health risks

- Projection of future climate change
- Projection of future climate-related health outcomes

A total of 289 indicators and statements were identified about future health outcomes and future health risks. The category for projections of future climate change was most prominent, accounting for 61% of all indicators and statements (Fig. 12). This may be because more is known within countries about general climate change projections than the future health impacts of climate change. These indicators were reduced to 74 after removing repetitions. Boxes 44 and 45 summarize the final 74 indicators for projections of future climate change and health risks.

Fig. 12. Distribution of indicators for projections of climate change and health among countries



Box 44. The 39 indicators for future climate change

Temperature increases
Annual increase in average air temperature (e.g. in °C/year)
Annual increase in sea surface temperature (e.g. in °C/year)
Annual no. of hot days
Annual no. of hot nights
Duration of heatwaves (e.g. no. of days/year)
Increase in maximum and minimum temperatures (e.g. in °C/year)
Rainfall and drought patterns
Annual % change in cumulative precipitation
Frequency of extreme rainfall events (e.g. no. of events/year)
Average duration of dry season (e.g. no. of days/year)
Annual increase in rainfall during wet season (e.g. % change/year)
Reduction in dry season rainfall (e.g. % change/year)
Frequency of drought events (e.g. no. of events/year)

Extreme weather events
Frequency of tropical cyclones (e.g. no. of events/year)
Intensity of tropical cyclones (e.g. % increase in wind speed)
Annual no. of extreme heat events/year
No. of flash flood events caused by heavy rainfall (e.g. no. of events/year)
Frequency of landslides linked to heavy rainfall or snowmelt (e.g. no. of events/year)
Frequency of urban flooding events (e.g. no. of events/year)
% of health infrastructure damaged by extreme weather (e.g. as % of total health infrastructure)
Sea-level rise and coastal impacts
Rate of sea-level rise (e.g. cm/year)
Frequency of saline intrusion events in coastal regions (e.g. no. of events/year)
Extent of coastal land area lost due to sea-level rise (e.g. hectares/year)
% of groundwater sources affected by salinity (e.g. as % of total)
Agricultural and water resources
% reduction in agricultural productivity (e.g. % change/year)
Frequency of crop failures linked to extreme weather (e.g. no. of events/year)
% of arable land degraded or desertified (e.g. as % of total)
Annual reduction in river flow (e.g. as % change/year, measured as m^3/s)
% decrease in aquifer recharge (e.g. % change/year, measured as m^3/s)
Biodiversity and ecosystems
No. of forested hectares affected by wildfires (e.g. hectares/year)
% change in species range due to climate-induced habitat changes (e.g. % change/year)
Rate of soil degradation linked to climate factors (e.g. % change/year).
Hydrological and oceanic changes
Frequency of extreme hydrometeorological events (e.g. no. events/year)
Rate of ocean acidification (e.g. change in pH/year)
% reduction in sea ice (e.g. % change/year)
Frequency of marine heatwaves (e.g. no. of events/year)
General indicators
Annual increase in regions affected by water stress (e.g. km^2/year)
Annual increase in extreme climate events (e.g. floods, heatwaves, droughts; no. of events/year)
Frequency of combined extreme events (e.g. heatwave followed by flooding; no. of combined events/year)
Annual variation in agroecological rainfall patterns

Box 45. The 35 indicators of projections for climate-related health outcomes

Vector-borne diseases
Annual incidence of cases of vector-borne disease /100 000 population (e.g. malaria, dengue, chikungunya, Zika virus, Japanese encephalitis)
No. of breeding sites for *Aedes* mosquitoes/km^2
Annual no. of outbreaks of vector-borne and infectious diseases
Geographical spread of vector-borne diseases, such as malaria, dengue, Zika virus, and leishmaniasis (e.g. km^2/year)
Prevalence (%) of tick-borne diseases (e.g. anaplasmosis and babesiosis) in affected regions
Waterborne and foodborne diseases
Annual no. of cases of diarrhoeal disease among children younger than 15 years
Incidence of cholera/100 000 population
Prevalence (%) of hepatitis A and E linked to unsafe water
Annual incidence of diseases related to harmful algal blooms/100 000 population (e.g. *Vibrio parahaemolyticus* infection)
No. of outbreaks of seafood poisoning (e.g. no. of outbreaks/year)
Annual incidence of cases of typhoid linked to water and sanitation issues/100 000 population
Heat-related illnesses
No. of cases of heatstroke during heatwaves (e.g. no. of cases/year)
Mortality attributable to heatwaves/100 000 population
No. of heat-related hospitalizations (e.g. no. of cases/year)
Annual no. of days classified as “heat emergency”
No. of new cases of cardiovascular disease due to heat stress and air pollution (e.g. no. of cases/year)
Respiratory diseases
Prevalence (%) of respiratory diseases (e.g. asthma, bronchitis) attributable to air pollution
No. of hospital admissions due to respiratory conditions during forest fires or high air pollution episodes (e.g. no. of admissions/year)
Annual morbidity and mortality due to particulate matter and O_3 exposure
No. of cases of bronchitis and pneumonia during extreme weather events (e.g. no. of cases/event per year)

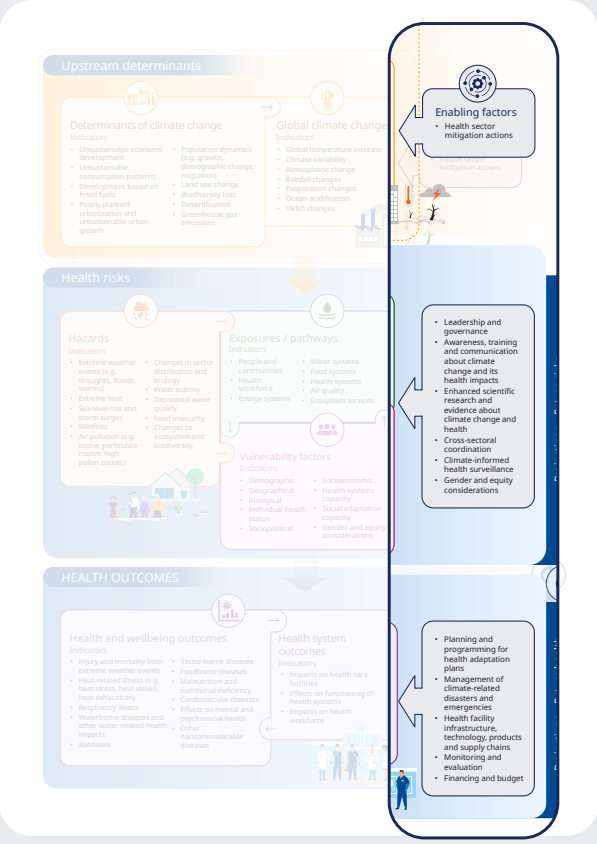
Nutrition and food security
Prevalence (%) of malnutrition in children younger than 5 years
No. of cases of severe acute malnutrition during droughts (e.g. no. of cases/drought per year)
Annual no. of people who are food-insecure in affected regions (e.g. as % population affected)
% reduction in crop yields in regions experiencing drought or flooding
Injuries and mortality from extreme events
No. of injuries reported during extreme events (e.g. floods, landslides, storms; no. of injuries/year)
Mortality from extreme weather event/100 000 population
Mental health
Prevalence (%) of mental health disorders in disaster-affected regions
No. of new cases of mental illness linked to population displacement or climate-related loss (e.g. no. of cases/year)
Health system impacts
% of health facilities damaged during extreme weather events (e.g. as % of total)
No. of patients affected by service disruptions in health facilities (e.g. no. of patients/year)
Increase over average in no. of hospital admissions during extreme weather events compared with baseline (e.g. % increase)
Overall morbidity and mortality
Annual no. of deaths associated with climate-related diseases and injuries
Morbidity from diseases exacerbated by climate change (e.g. diarrhoeal diseases, respiratory infections) (e.g. no. of cases/year)
Annual incidence of zoonotic diseases in new regions/100 000 population
% of population affected by water scarcity and unsafe water supply

O_3: ozone.

Common enabling factors across countries

Fig. 13 shows common enabling factors identified by countries.

Fig. 13. Common enabling factors

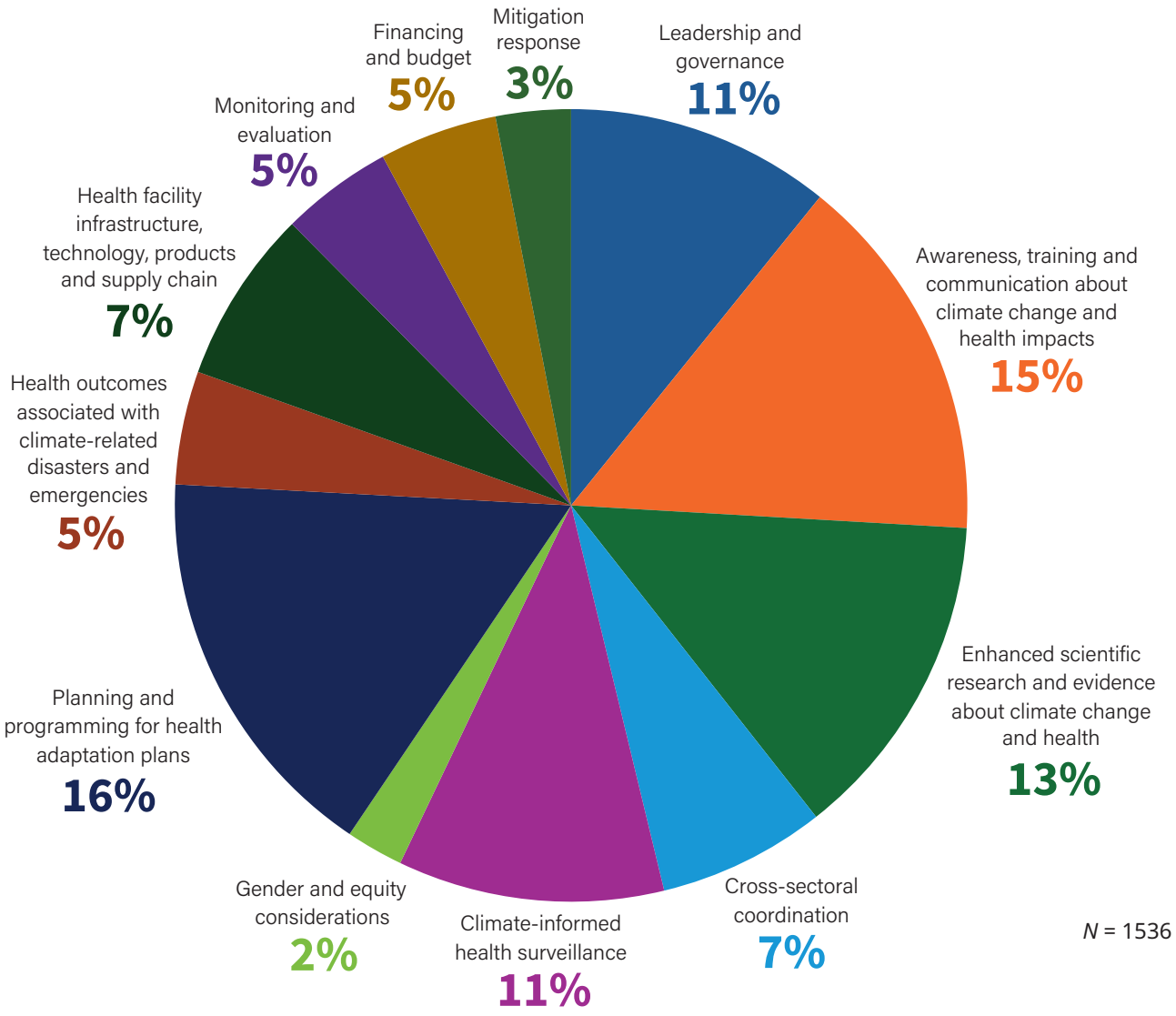


Enabling factors

- Leadership and governance
- Awareness, training and communication about climate change and health impacts
- Enhanced scientific research and evidence about climate change and health
- Cross-sectoral coordination
- Climate-informed health surveillance
- Gender and equity considerations
- Planning and programming for health adaptation plans
- Health outcomes associated with climate-related disasters and emergencies
- Health facility infrastructure, technology, products and supply chain
- Monitoring and evaluation
- Financing and budget
- Mitigation responses

A total of 1 536 indicators and statements were identified that addressed enabling factors. The categories planning and programming; awareness, training and communication; and research and evidence accounted for 44% of all indicators and statements (Fig. 14). These indicators were reduced to 429 after removing repetitions. Boxes 46–57 summarize the final 429 indicators for enabling factors.

Fig. 14. Distribution of indicators for enabling factors



Box 46. The 54 enabling factors focusing on leadership and governance

Policy development and integration
A national health policy should identify climate change and related natural disasters as critical challenges and propose separate programmes to address climate-sensitive diseases.
Develop a national urban health strategy to address the impact of climate change on urban populations, including on migration from highly affected areas.
Develop a national rural health strategy to address the impact of climate change on rural populations, including on migration from highly affected areas.
Develop and refine regulations of and policies for the health sector for managing health risks from climate change and extreme weather events.
Develop a national climate change adaptation programme for the health sector, taking into account specific vulnerabilities (e.g. such as gender).
Integrate strategies for adapting to climate change and ensuring resilience into local and national planning processes.

Propose climate resilience policies and mechanisms to address climate-sensitive health risks.
Prioritize climate change and health agendas in national health sector strategies.
Include health-related climate response content in health policies.
Strengthen the national adaptation programme of action to incorporate health risks from climate change.
Apply a Health in All Policies approach across government sectors to enhance collaborative support for addressing climate change and health.
Strategic leadership and coordination
Strengthen political and institutional governance on climate change and health.
Strengthen health leadership and governance for climate-resilient health systems.
Identify a national focal point for climate change in the ministry of health.
Institutionalize a climate change and health working group to implement health adaptation actions in the context of an HNAP.
Create a climate change oversight group to ensure there is a structured and inclusive approach to climate actions in the health sector.
Establish a national steering committee led by the ministry of health to address climate change, climate disasters and climate-related emergencies.
Establish an office of climate change and health equity to address specific strategies to protect vulnerable populations from environmental and climate risks.
Develop and endorse an HNAP, and establish a functional HNAP technical working group.
Advocate for continued governmental allocation of resources to build climate-resilient health systems.
Stakeholder engagement and collaboration
Ensure that stakeholders advocate for the inclusion of health issues in steering committees and contribute to national climate strategies.
Establish collaboration with the ministries of health and the environment to utilize environmental data to manage climate-sensitive health risks.
Ensure that memoranda of understanding to encourage collaboration between ministries on climate change and health issues are signed, reviewed and updated when needed.
Conduct information and work sessions with stakeholders, including the departments of health, environment and disaster management.
Develop a stakeholder engagement mechanism for implementing HNAP activities, and ensure roles are clearly defined.
Increase the engagement of political groups, mainstream media, civil society organizations, the corporate sector, youth groups and scientists with activities addressing climate and health.

Regulatory and institutional frameworks
Revise and strengthen legal, regulatory and institutional frameworks to address health and climate change.
Enforce public health legal requirements to protect populations from climate risks (e.g. standards for air quality, water quality, chemical discharges, and waste disposal and management).
Develop legal and institutional texts related to health and climate change.
Review and amend the climate change adaptation response functions and the responsibilities of health care agencies.
Capacity-building and system-strengthening
Strengthen institutional capacities and the skills of medical personnel and stakeholders in adapting to climate change.
Build national and subnational capacities for improving health programmes and systems to cope with climate risks.
Enhance the resilience of health service delivery systems to respond to climate impacts and disaster risks.
Develop the capacity to tap into international adaptation funds to protect health from climate change.
Provide laboratories and research institutions with equipment for environmental monitoring and for analysing climate data.
Complete vulnerability assessments at the national and subnational levels.
Research and information systems
Establish and invest in coordinated research agendas for climate and health.
Create a health and climate change observatory to analyse and monitor the effects of climate change on public health.
Develop policies and strategies based on scientific research to bolster community adaptation capabilities.
Create partnerships between universities, university hospitals and the national school of public health to conduct scientific and applied research.
Strengthen the capacities for research, surveillance and assessments of vulnerability to guide decision-making for adapting to the impacts of climate change and disaster risks.
Provide institutions with appropriate information technology equipment to manage and analyse data about health and the climate.
Community engagement and local actions
Develop city-level urban health adaptation plans to enhance community resilience.
Ensure that local emergency preparedness and resilience teams work with national teams on adaptation actions.
Promote international cooperation to share adaptation policies, science, technology and models.
Develop policies focusing on community engagement and capacity-building at local levels.
At the community and policy levels, ensure adaptation measures are adopted that address climate-sensitive diseases in at-risk populations.

Advocacy and international collaboration
Advocate for health sector capacity to anticipate and respond to climate-related health impacts.
Participate in global and regional initiatives to adapt to and mitigate the impacts of climate change on human health.
Collaborate internationally to exchange experiences and share information about adaptive policies and solutions.
Inform the public and policy-makers about the health impacts of climate change.
Resource allocation and investment
Advocate for resources to the health sector to be increased to address the impacts of climate change.
Propose policies to attract domestic and foreign investment to implement climate change activities in the health sector.
Invest in upgrading health facilities to accommodate disease prevention and control in changing climates.

HNAP: health national adaptation plan.

Box 47. The 35 enabling factors focusing on awareness, training and communication about the health impacts of climate change

Training and capacity-building
Develop training programmes for health professionals to help them identify climate-sensitive diseases.
Develop training materials and train health staff and relevant stakeholders about climate change, public health and risks from climate disasters.
Promote capacity-building in using climate information.
Develop and implement training materials about climate change and health for health professionals, stakeholders and communities.
Build capacities for vulnerability assessments, interventions and the use of climate data for early warning and surveillance of, and planning for, the effects of climate change on health.
Empower health care personnel with information and training to address the effects of climate change on health.
Train stakeholders at the central, regional and departmental levels to assess and manage the impacts of climate change.
Provide health professionals with information, education and support for communicating about climate change and its impacts on health.
Ensure communities receive information about the health risks of climate change.
Ensure that relevant health professionals in selected municipalities are trained in the diagnosis and management of climate-sensitive vector-borne diseases.
Ensure that education programmes are conducted to increase awareness of heat-related illnesses.
Develop capacity-building trainings to ensure implementation of appropriate health care waste management.
Enhance the skills of health care, public health and human services professionals to address climate change and health.

Awareness and advocacy
Promote awareness campaigns at the community level, in rural and urban populations, about climate-related health risks.
Ensure community members are reached through awareness-raising activities.
Increase public awareness of and actions taken to prevent climate change–sensitive diseases.
Increase the number and diversity of awareness-raising materials describing the health impacts of climate change and actions that can be taken to respond to them
Ensure that messages about the effects of climate change on health are available through social media
Organize community-based communication activities about health protection and adapting to climate change.
Develop communication materials about the impacts of climate change and solutions for adaptation and mitigation.
Raise the awareness of health professionals about the psychosocial impacts of extreme weather events (e.g. droughts, cyclones, floods).
Promote public awareness of and establish communications strategies to address the risks of UV radiation and behavioural changes that can help avoid risks.
Improve education for clinicians, patients, health care institutions and the public about the health effects of climate and environmental changes.
Build community resilience by increasing community awareness of the risks of climate change and vulnerabilities to it.
Strengthen public awareness of the health risks of climate change that are related to water, sanitation, hygiene, food security, air pollution and malnutrition.
Knowledge-sharing and information dissemination
Develop a climate change guide to be used for communication by the public health sector.
Produce tutorials for distance learning about climate change and health.
Integrate the themes of health and climate change into an e-learning training project.
Produce and distribute bulletins about the effects of climate change on health.
Develop capacity-building programmes to facilitate research about adapting to climate change, and provide training in data analysis.
Conduct a specific assessment to determine what the health workforce knows about climate change and health to integrate climate change–related impacts into workforce planning.
Promote training and risk communication to improve the knowledge of both health professionals and the general public.
Monitoring and evaluation
Develop reports about the implementation of awareness, monitoring and behavioural change programmes.
Provide monitoring capacity to address the changing burden of climate-sensitive health outcomes as the frequency and intensity of extreme weather and climate events increases
Regularly monitor the effectiveness of training and awareness initiatives.

UV: ultraviolet.

Box 48. The 42 enabling factors focusing on scientific research and evidence about climate change and health

Research development and implementation
Establish a network for study, research, monitoring and communication about climate and health to expand technical and scientific knowledge for health system decision-making.
Set up centres to study and conduct research on climate and health.
Conduct studies on the impacts of climate change on health and health systems.
Strengthen research into the health impacts of climate-sensitive diseases, vector-borne diseases and zoonoses.
Conduct health vulnerability assessments and develop composite indices of health and climate vulnerabilities.
Develop predictive models of the behaviour of vector-borne diseases and zoonoses that are linked to climate change.
Map vulnerable health care facilities and urban sectors exposed to climate hazards.
Conduct epidemiological studies to assess daily mortality and morbidity in relation to weather variables.
Conduct research into the effects of climate change on mortality, morbidity and demands on the health care network.
Estimate the socioeconomic impacts of climate change on the health sector.
Strengthen research into technological solutions for the use of clean and renewable energy by health facilities.
Develop research to improve the treatment and diagnosis of climate-sensitive diseases.
Conduct research that includes groups vulnerable to climate impacts (e.g. gender-related impacts, impacts on ethnic minorities or children).
Research the impacts of climate change on noncommunicable and infectious diseases.
Enhance scientific research into the impacts of climate change on public health and adaptive measures.
Develop partnerships for research and community awareness.
Knowledge-sharing and data integration
Develop and disseminate tools to support health adaptation actions.
Document and disseminate information about lessons learned from research and adaptation practices.
Use research findings to develop strategies and policies to address climate change and health.
Establish a national health and environment observatory and a data exchange platform.
Integrate health and climate change data into national surveillance and information systems.

Standardize case definitions and geocode notification data about health outcomes to enable empirical analyses.
Promote the exchange of knowledge through intersectoral platforms and stakeholder engagement.
Maintain a web platform dedicated to data about climate change and health.
Ensure research projects looking at climate change and health are completed and that results are disseminated.
Capacity-building and training for research
Integrate training in climate change and health into public health and medical education programmes.
Train national and subnational staff to use climate data for decision-making and planning.
Develop technical guidelines for health system adaptation and reducing risks from disasters.
Develop training materials and modules about climate risks for health staff at all levels.
Conduct targeted training for health professionals about climate-sensitive diseases and their management.
Policy integration and strategic planning
Ensure that the impacts of climate change are incorporated into public health policies and academic curricula.
Prioritize vulnerable groups in research and in adaptation planning.
Develop national standards and guidelines for food safety, air pollution and heat-related illnesses.
Support the creation of a health national adaptation plan that integrates resilience for health systems.
Develop interdisciplinary tools for the management of emerging and re-emerging vector-borne and zoonotic diseases, considering the One Health approach.
Develop surveillance-based evidence, including from passive and active disease surveillance.
Conduct regular assessments of entomological status and insecticide resistance.
Publish research findings, and ensure they are used in decision-making and advocacy programmes.
Intersectoral collaboration
Promote collaboration between health ministries and research institutions to advance evidence-based actions.
Promote collaboration between ministries, research institutions and international organizations to share knowledge about climate change and health.
Develop partnerships for multisectoral research that integrate environmental and public health perspectives.
Organize consultation forums to align research priorities with national climate and health goals.

Box 49. The 33 enabling factors focusing on cross-sectoral coordination

Strengthening multisectoral coordination
Establish a cooperation agreement among organizations working on climate change and health, such as centres for studies, research, monitoring and communication networks.
Create multisectoral working groups to exchange information and actions to address the health impacts of climate-related risks.
Strengthen intersectoral collaboration and maximize synergies with other sectors to improve health.
Ensure that an intersectoral approach is taken to understand and address the health risks of climate change through the development of an action plan.
Develop and sign collaboration agreements between ministries (e.g. health and meteorological services) to enable data-sharing and better planning.
Integrate data-sharing across departments and ministries to enable evidence-based planning, monitoring and evaluation.
Promote collaboration among government agencies, research institutions and subject matter experts.
Establish national coordination groups among related agencies and partners, and ensure that diverse stakeholders are represented.
Support collaboration and networking between government and nongovernment entities.
Promoting public–private partnerships
Develop a roadmap to engage the private sector in addressing the risks of climate change to public health.
Establish public–private partnerships to support adaptation to climate change and to reduce risks from disasters.
Organize meetings with public and private partners to provide essential resources to victims of climate-related disasters.
Promote public–private partnerships to implement plans to adapt to climate change and reduce risks from climate-related disasters.
Integrating health into policies across sectors
Mainstream climate change and health into policies in health-determining sectors, such as water, sanitation, food security, housing and urban planning.
Integrate health components and climate change dimensions into programmes and projects in sectors such as energy, transport and waste management.
Promote a Health in All Policies approach across sectors.
Ensure intersectoral collaboration to address the health risks of climate change through action plans.
Respond to the environmental health impacts of climate change as a cross-cutting issue in developing various policies.

Enhancing coordination mechanisms
Establish coordination mechanisms between health staff and disaster management committees at the provincial and local levels.
Develop coordination structures at central, regional and local health facilities to manage climate-related health impacts.
Set up local coordination committees to conduct public health impact assessments and implement climate change adaptations.
Strengthen multisectoral and multistakeholder national dialogues about climate change and health.
Bolster coordination among different units and agencies of the ministry of health to ensure alignment of tasks and functions.
Encouraging community engagement
Engage community action groups in intersectoral collaborations to minimize the risks of climate-induced health hazards.
Promote community involvement through building partnerships with faith groups, industry and other stakeholders.
Mobilize local stakeholders to support disaster response activities, including disease prevention and food distribution.
Monitoring and evaluation
Establish technical monitoring committees, and collect statistical evidence about health risks.
Streamline sectoral emergency plans and evaluate their effectiveness.
Coordinate health impact assessments across sectors.
Advocacy
Advocate for the inclusion of health concerns in steering committees developing climate strategies.
Promote intersectoral and international collaboration to develop and implement options for health adaptation.
Support the development of standardized communication materials about climate change and its health impacts to raise public awareness.
Facilitate collaboration between stakeholders to improve the planning and implementation of options for health adaptation.

Box 50. The 37 enabling factors focusing on climate-informed health surveillance

Strengthening surveillance systems
Establish or strengthen the surveillance system for climate-sensitive diseases, including vector-borne, waterborne and respiratory diseases.
Develop and implement monitoring systems for emerging and re-emerging diseases.
Expand sentinel health facilities to include surveillance for climate-sensitive diseases.
Conduct entomological monitoring, and improve the analysis of vector ecology data.
Include epidemiological and entomological data in nationwide networks of vector-borne disease surveillance.
Integrate meteorological data and data on climate-sensitive diseases into risk mapping and early detection activities.
Enhancing early warning and alert systems
Establish early warning systems for climate-sensitive health risks, such as extreme heat, flooding, wildfires, droughts and vector-borne diseases.
Develop and operationalize early warning systems at the local and district levels.
Create alert systems for elderly people and vulnerable groups that include notifications about heatwaves, poor air quality and other risks.
Integrate meteorological data into early warning systems and bulletins disseminated to the public.
Pilot models for surveillance, forecasting and early warning for diseases such as malaria, dengue and heat-related illnesses.
Implement forecasting systems for health risks related to extreme weather.
Enhance early warning systems to support epidemic prediction and preparedness activities.
Monitoring environmental determinants
Strengthen the monitoring of air and water quality affected by climate factors.
Establish robust surveillance of water sources, including by monitoring drinking-water quality and borehole maintenance.
Develop tools for tracking the effectiveness of health adaptation measures related to environmental determinants (e.g. air pollution and water quality).
Monitor seasonal patterns of climate-sensitive diseases.
Use satellite imagery and remote-sensing technologies for environmental surveillance.

Integrating data and information systems
Integrate climate and health data into information systems.
Develop platforms to share data among surveillance entities.
Build and manage databases for and maps of areas with climate-related health impacts.
Develop systems for monitoring, forecasting and delivering early warnings of climate impacts on health.
Consolidate and use health information technology systems to track climate-sensitive diseases.
Update and manage indicators and protocols for surveillance programmes to ensure continual and standardized monitoring.
Enhancing community-based surveillance
Involve communities in monitoring and early warning systems for climate-sensitive diseases.
Establish community-based surveillance systems and ensure local participation.
Ensure timely communication of alerts to decision-makers, health professionals and the public.
Mapping and analysing risks
Develop and update maps of areas vulnerable to climate-related health risks, including heatwaves and vector-borne diseases.
Conduct risk mapping for food insecurity, water scarcity and malnutrition related to droughts and climate change.
Develop methodologies for conducting risk assessments and mapping vulnerabilities at the regional and local levels.
Improve epidemic forecasting by studying transmission dynamics and vector ecology.
Develop country profiles of climate-sensitive diseases, and monitor trends in these.
Analyse epidemiological data to establish baselines, and monitor trends in climate-sensitive health impacts.
Strengthening institutional capacity
Establish regional alert and response teams to address climate-sensitive diseases.
Strengthen national and subnational capacities for disease monitoring and for managing climate-related health risks.
Train health personnel in the use of early warning systems and response strategies.
Create and operationalize platforms to validate and disseminate surveillance data.

Box 51. The 26 enabling factors focusing on gender and equity in climate-related health risks

Gender-inclusive data and research
Conduct research on vulnerable groups in climate-affected areas, accounting for gender, ethnicity and socioeconomic status.
Ensure gender components are included in surveys and assessments, addressing the specific needs of men, women, pregnant women, elderly women and marginalized groups.
Promote sex-disaggregated data about health outcomes and equity factors to identify gaps and support informed decisions.
Ensure that nationwide mapping of vulnerable populations at risk of malnutrition focuses on gender-specific needs.
Mainstreaming gender and capacity-building
Provide training in gender and climate change adaptation for health professionals, including those at the ministry of health, provincial health departments and for community focal points.
Follow up on gender mainstreaming and action plans to provide feedback and encourage improvements.
Implement gender-sensitive and equity measures in HNAP actions.
Ensure that gender is mainstreamed in all health projects.
Establish mandatory training about climate, health and equity for public health officers by offering customized materials relevant to their roles.
Integrate gender-sensitive and socioeconomic perspectives into HNAPs following recommended guidelines (e.g. WHO guidance).
Community engagement and empowerment
Disseminate information about gender and adaptation to climate change in communities, ensuring equal participation of men and women.
Conduct gender-sensitive focus groups with women's groups and community stakeholders.
Promote gender empowerment strategies, particularly for women reliant on natural resources or leading households in urban poverty.
Gender-sensitive health services and social protection
Provide livelihood activities and nutritional support for women and girls in areas where malnutrition is common.
Improve access to health services and nutrition for pregnant women, elderly women and caregivers.
Ensure that social protection measures reduce inequalities in access to health services for vulnerable populations, including women, children and older people.
Strengthen the capacity for climate adaptation among vulnerable groups, such as pregnant and lactating women, children younger than 5 years, older persons, poor populations and displaced groups.
Establish coordination between health centres and women's and children's focal points to address targeted diseases and domestic violence.

Policy and institutional development
Include gender-sensitive health risks and climate-related needs in regional and district health development plans.
Support the fight against climate change by adopting inclusive and just policies that incorporate a gender perspective.
Ensure that considerations of gender equity are integral to health communication strategies related to climate change.
Include culturally specific indicators of climate change and health to enhance Indigenous and community adaptation efforts.
Indigenous and marginalized communities
Enhance surveillance and early warning systems for Indigenous communities, ensuring culturally appropriate adaptation.
Address gender-related health risks among Indigenous and marginalized populations.
Promote Indigenous-led adaptations for Indigenous communities.
Improve the resilience of health care facilities in Indigenous areas, integrating gender-sensitive perspectives.

HNAP: health national adaptation plan.

Box 52. The 40 enabling factors focusing on planning and programming in health national adaptation plans

Preparedness and capacity-building for health systems
Improve the preparedness of the health system at the local level.
Strengthen health care delivery and services at the prefectural and community levels.
Develop plans for adapting infrastructure, technologies and work processes to promote climate resilience.
Ensure implementation of a health system recovery plan to improve operational capacities for climate adaptation.
Develop appropriate training courses to improve skills in vulnerability assessments, preparedness, disaster management and epidemiology.
Periodically assess gaps in indicators for climate factors and health in national and subnational databases.
Develop capacity-building plans for climate change adaptation that address identified gaps in capacity.
Surveillance, risk assessment and vulnerability mapping
Implement climate change and health V&As.
Conduct assessments of vulnerabilities to, and adaptation capacities for climate-sensitive health risks.
Perform vulnerability assessments at the district and municipal levels to identify populations at risk.
Update risk maps and vulnerability studies to reflect current and projected climate impacts.

Develop and integrate adaptation plans
Develop and implement health national adaptation plans based on V&A findings.
Integrate climate adaptation measures into health programmes at all levels of the health system.
Mainstream climate change adaptation into national health planning processes.
Ensure climate resilience is integrated into health sector action plans across provinces and cities.
Support health programmes in adjusting to the potential impacts of climate change (e.g. by including impacts affecting water, sanitation and hygiene; nutrition mental health; and occupational health).
Integrate climate change into strategic health planning for climate-sensitive diseases.
Strengthening disease management and prevention
Strengthen health prevention actions for waterborne, vector-borne and noncommunicable diseases.
Strengthen psychosocial support structures in areas prone to climate disasters.
Promote preventive actions against climate-sensitive diseases such as malaria, cholera and respiratory illnesses.
Adapt health services to improve the management of climate-sensitive diseases.
Develop climate-resilient health facilities that have strengthened surveillance systems for climate-sensitive diseases.
Enhance laboratory capacity for diagnosing and managing climate-sensitive diseases.
Community engagement and awareness
Promote awareness campaigns at the community level that address the health risks associated with vector- and waterborne diseases.
Design community-focused adaptation programmes in at-risk districts to build resilience.
Ensure community involvement in programmes to prevent health risks during extreme weather events.
Provide educational programmes to vulnerable populations about climate-sensitive diseases and preventive measures.
Assist communities to practise appropriate water treatment, sanitation and safety, and safe food storage.
Policy development and strategic planning
Integrate information about climate conditions into strategic planning for climate-sensitive diseases.
Update plans for extreme events according to the findings of risk mapping and based on the results of assessments.
Develop a uniform, system-wide plan for health services during severe weather.
Promote climate-resilient safety planning for water and sanitation services.
Ensure that climate adaptation is incorporated into the planning of health-determining sectors (e.g. water, energy, agriculture, and urban and rural planning).

Provide specific interventions and timely responses to identified populations and geographical regions at the subnational level that are currently and will be more vulnerable to climatic variability and change.
Strengthen the capacity of vulnerable groups to adapt to climate change and its impacts on health.
Promote and implement innovative approaches to climate resilience in health care, public health and human services.
Ensure operational continuity of health care services during severe weather events.
Monitoring and evaluation
Assess the integration of climate change adaptation into health programmes and policies.
Monitor and evaluate the effectiveness of health adaptation measures and interventions.
Conduct periodic reviews of climate adaptation plans and update them as new risk mapping becomes available.

V&A: vulnerability and adaptation assessment.

Box 53. The 34 enabling factors focusing on health outcomes during climate-related disasters and emergencies

Policy development and strategic planning
Develop or strengthen national and local emergency and disaster preparedness, response and recovery actions to address climate-related hazards and growing risks.
Integrate health systems into national committees for disaster risk management.
Develop response plans for climate disasters and plans for emergency management for health facilities.
Ensure good coordination between health facilities and other disaster response bodies (e.g. police, army, civil protection).
Strengthen health emergency preparedness and response plans at the institutional and community levels, incorporating learning from the COVID-19 pandemic.
Ensure that disaster risk reduction strategies incorporate trends in climate change identified as part of a comprehensive approach to health sector preparedness.
Develop a national management plan for the health system to address disasters and emergency preparedness, and involve the community in developing it.
Establish a national disaster risk register that includes risks related to climate change.
Integrate the climate change adaptation and disaster risk management programmes.
Ensure continuity of care and access to health services in disaster-exposed areas.

Capacity-building and training
Provide supplementary training for rescue teams in all districts to ensure they can be actively mobilized for disaster management and epidemic control.
Conduct regular drills or simulation exercises to test current emergency plans.
Ensure that vulnerable groups, such as women and children, are included when making improvements to institutional and community capacities to prepare for and respond to climate change–induced natural disasters.
Increase investment in disease outbreak and emergency response activities.
Train emergency medical teams to respond effectively to disasters.
Strengthen epidemiological surveillance of diseases with epidemic potential, particularly in disaster-prone areas and areas where disasters have occurred.
Improve institutional capacity to assess the health risks associated with natural disasters.
Risk assessment and early warning systems
Integrate climatic, environmental and socioeconomic risk analyses into health system procedures for monitoring public health emergencies.
Develop a national plan for disaster management to address health system vulnerabilities and resilience during extreme weather events.
Improve the early warning system for epidemics.
Promote integrated disaster risk assessment by considering climate change projections and scenarios.
Develop risk maps for extreme events.
Establish updates to and simplify emergency preparedness requirements.
Regularly identify risks to services whose interruption would aggravate health risks.
Community engagement and awareness
Empower communities with better communication channels to respond to the risks of extreme weather events and to alerts.
Conduct awareness-raising and education activities about water treatment, hygiene and sanitation in disaster-prone areas.
Promote and implement strategies to reduce and manage the risk of disasters related to climate change at the community level.
Establish community emergency response forces.
Infrastructure and resource allocation
Ensure resources are allocated for activities throughout the year, especially for emergencies.
Provide safe drinking-water to all communities, with routine quality testing in disaster-hit regions.
Ensure the continuity of water, hygiene and sanitation services in disaster-hit areas.
Build resilience in the community and health care service systems before, during and after disasters.
Update maps of health services at risk of interruption during disasters.
Develop technological solutions for epidemics and diseases in post-disaster contexts.

Box 54. The 28 enabling factors focusing on health facility infrastructure, technology, products and the supply chain

Policy development and strategic planning
Develop guidelines and regulations for ensuring the health infrastructure is adapted to climate risks.
Ensure new building codes for health facilities integrate standards for climate resilience and energy efficiency.
Promote climate- and disaster-proofing in health care infrastructure at the national and subnational levels.
Ensure that the siting, construction and renovation of health facilities account for climate risks.
Create specific climate-related regulations for health facilities.
Develop guidance for standardizing the architecture of health facilities to ensure climate resilience.
Assessments
Assess the resilience and adaptive capacity of health care facilities to climate risks.
Regularly assess the vulnerabilities of medical supply chains and the resilience of health infrastructure.
Conduct diagnostic reviews of health infrastructure and the response capacity to extreme events.
Conduct risk mapping for health facilities in disaster-prone areas.
Inventory the health system's infrastructure, equipment and all health supplies.
Regularly assess the resilience to climate-related impacts of health infrastructure and supply chains.
Climate-resilient infrastructure and technology
Ensure the electrification of health facilities is adequate to maintain the cold chain for medicines and vaccines.
Build new health infrastructure that meets current standards for climate resilience.
Train health facility staff about climate resilience measures, including maintenance and disaster readiness.
Promote planning for business continuity during severe weather events for health facilities.
Equip health facilities with climate-resilient water, sanitation and hygiene infrastructure.
Provide health facilities with flood defence and wastewater management systems, and waste management mechanisms.
Relocate critical infrastructure to higher floors in flood-prone facilities.
Secure functional hospital vehicles and access to ambulance services for disaster responses.

Monitoring, evaluation and reporting
Monitor and report on the infrastructure and equipment standards necessary for climate resilience.
Develop tools to evaluate the impact of severe weather events on health facilities.
Strengthen information systems to support the life cycle assessment of health care products and infrastructure.
Community and grassroots focus
Strengthen adaptive capacity at the grassroots level, prioritizing commune- and district-level health facilities.
Improve access to health care services in disaster-prone areas.
Engage local stakeholders in infrastructure planning and disaster readiness activities.
Provide climate-resilient water, sanitation and hygiene infrastructure in health care facilities in vulnerable settings.
Ensure the supply of drinking-water to communities during climate emergencies.

Box 55. The 31 enabling factors focusing on monitoring and evaluation

Framework and systems development
Develop and operate a monitoring and evaluation framework in the health sector for climate change adaptation and disaster risk reduction.
Establish mechanisms for monitoring and evaluation at the national, municipal and community levels.
Integrate HNAP monitoring and evaluation into national systems to ensure coordination and avoid duplication.
Develop a monitoring mechanism to track financial records and documentation.
Formulate process indicators for monitoring and evaluation of health adaptation actions (e.g. for the HNAP).
Monitoring indicators and reporting
Develop and update essential baselines for monitoring climate-sensitive health risks, environmental variables and health system capacities.
Develop indicators for adaptation actions.
Establish a monitoring and evaluation system using indicators such as those for processes, sustainable development and outcomes.
In monitoring systems, include climate change–related health outcomes, vulnerabilities and response capacity, and preparedness indicators.
Monitor trends in climate-sensitive diseases and risks using robust indicators.
Develop national indicators for tracking climate-related health outcomes and community resilience at all levels.
Regularly analyse risks, vulnerabilities and emergency preparedness capacities.
Regularly update monitoring frameworks and indicators based on evolving risks and vulnerabilities.
Provide annual monitoring reports for HNAP implementation and other national adaptation plans.

Strengthening institutional capacity
Strengthen health systems to monitor and evaluate the impacts of climate change on health.
Enhance institutional capacity for integrating climate change monitoring into existing monitoring and evaluation systems.
Strengthen services to establish monitoring mechanisms for the environment and health.
Establish an interministerial platform to oversee monitoring and evaluation of environmental and health action plans.
Data collection, analysis and dissemination
Establish an electronic health record system to identify patients at risk from climate-related hazards.
Compile, analyse and disseminate data at the community, local and central levels.
Provide regular reviews of health system performance based on data and indicators.
Develop projection models to monitor the evolution of climate-sensitive diseases.
Evaluation and impact assessment
Conduct periodic evaluations of HNAP effectiveness, efficiency and sustainability.
Perform pilot evaluations of health programmes that integrate climate and health indicators.
Incorporate impact evaluations and cost-effectiveness analyses into monitoring systems.
Evaluate, document and disseminate programme indicators and the results of implementing them.
Assess the resilience and performance of health systems in addressing climate-related risks at all levels.
Integration and collaboration
Integrate monitoring activities into a health and environment observatory.
Establish multisectoral processes to oversee the development of policies addressing climate change and health.
Align monitoring and evaluation indicators with local contexts.
Include monitoring outputs in public health reports to inform decision-making and public awareness.

HNAP: health national adaptation plan.

Box 56. The 35 enabling factors focusing on financing and budget

Resource allocation and mobilization
Determine the percentage of the health sector budget allocated to respond to climate change.
Determine the percentage of the national health budget allocated to climate change adaptation and disaster risk reduction activities.
Mobilize additional funding from external development partners for activities not covered by available financial resources.
Mobilize financial resources to implement the HNAP (e.g. from central and local budgets).
Allocate state funds to implement the health sector's action plan at the central and local levels.
Mobilize and coordinate resources for intersectoral health and environment programmes.
Strengthen institutional capacity for mobilization of internal and external financial resources.
International and donor funding
Determine the number of projects or programmes aiming to build health system resilience submitted to and granted by international climate change funds (e.g. Green Climate Fund, Global Environment Facility, Adaptation Fund).
Develop and submit projects to international climate funds to strengthen health system resilience.
Conduct systematic and integrated resource mobilization activities to support plans by preparing and submitting proposals.
Advocate to donors to mobilize the additional resources required.
Map potential donors for future funding to address climate change and health.
Submit project proposals to various climate financing mechanisms within the framework of the HNAP.
Dedicated budget mechanisms
Establish a budget line-item at the national level to finance critical preparedness activities and adaptation interventions.
Include climate change considerations and identified adaptation actions in all national budgeting and strategic health planning processes.
Determine the percentage of the budget allocated to increase resilience to climate change and disaster risk reduction in health investment plans.
Integrate the budgets of related programmes, projects, schemes and plans handled by central and local agencies.
Establish health care funds, and integrate these with climate actions.
Inventory the climate financing that is available.

Sector-specific financing
Develop health-specific funding mechanisms for climate change adaptation.
Strengthen sustainable financing for climate and health initiatives.
Increase investment in research and development for climate-resilient health systems.
Identify technical and financial contributions from domestic and foreign organizations and businesses for climate change activities in the health sector.
Include climate change considerations in projects addressing climate-sensitive diseases that are financed by traditional health mechanisms.
Equity and accessibility
Improve the adoption of equitable and adequate financing.
Ensure the equitable distribution of resources to support sustainable development.
Promote or support the development of climate risk insurance linked with national social protection systems, including with national health insurance.
Expand community health insurance to address climate-related disasters such as droughts and floods.
Monitoring and reporting
Establish mechanisms to track financial records and documentation required for climate-related health funding.
Develop programmes and projects to mobilize technical and financial resources from the international community and enterprises.
Ensure that an annual budget for climate change and health is available and monitored.
Policy integration and innovation
Develop and implement programmes to climate-proof new infrastructure investments in coastal and rural areas.
Increase funding for renewable energy projects, health care decarbonization and climate resilience.
Promote financial innovation to fund climate resilience projects, such as offering grants, incentives and tax-related supports.
Establish funding and financing mechanisms to develop or maintain health care system resilience and decarbonization.

HNAP: health national adaptation plan.

Box 57. The 34 enabling factors focusing on mitigation responses

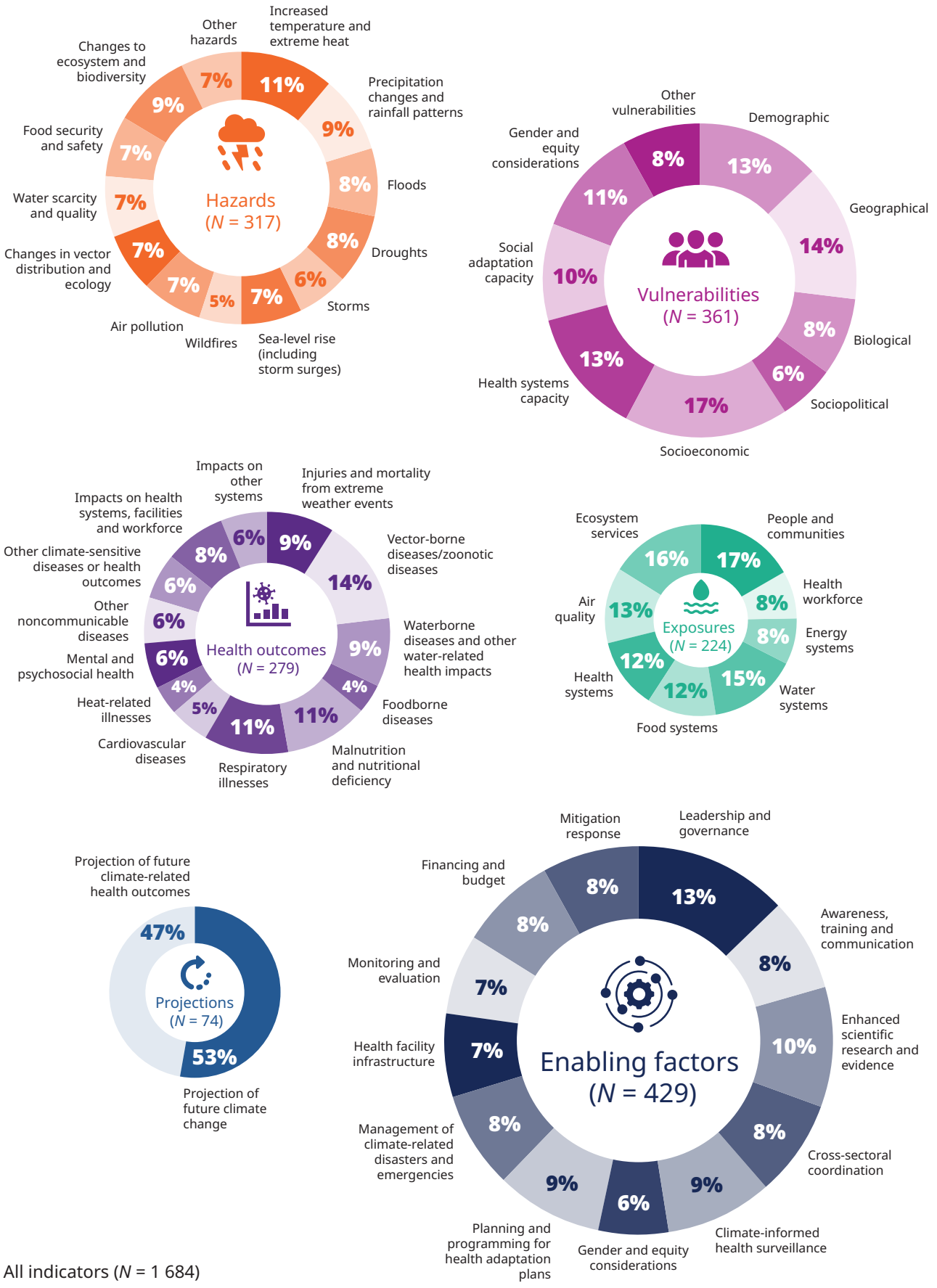
Policy development and strategic planning
Consider the health implications (e.g. risks or co-benefits) of mitigation actions in the national strategy for climate change mitigation.
Develop and implement a low-carbon development strategy to engage the country in a long-term mitigation process.
Formalize and systematize energy-saving standards, and integrate them into the guidance for purchasing services and equipment.
Provide a framework for coordinating climate change programmes to ensure that development pathways are climate-resilient and low carbon.
Promote the use of technologies that have a low impact on climate change, ensuring the viability and sustainability of technologies, medical products and supply chains.
Study and recommend resilient technologies for health facilities that address climate change adaptation, save energy and mitigate GHG emissions.
Green energy and emission reduction
Promote alternative, safer sources of energy to reduce GHG emissions.
Develop policies to use renewable energy.
Propose the promulgation and implementation of policies at health facilities that encourage the use of clean and renewable energy to support environmental protection and reduce GHG emissions.
Support resilient health facility microgrids with renewable energy production and battery backups.
Map internal adaptive activities, and actively mitigate GHG emissions through the use of clean and renewable energy.
Improve the energy efficiency of buildings.
Support the provision of energy-efficient technologies.
Infrastructure and facility-level interventions
Green urban spaces by planting trees and creating parks, thus mitigating urban heat islands.
Develop environmentally friendly health institutions.
Develop standardized measures, through consensus processes, of facility resilience, sustainability and energy efficiency.
Promote waste management with non-burn (i.e. non-incineration) technology at the household, community and institutional levels.
Promote the use of electric vehicles in the health service.
Ensure health facility processes and devices are compatible with reducing GHG emissions.

Data, research and metrics
Provide research into comprehensive life cycle assessments of health care products and services to identify products with the highest emissions to target them for reduction.
Develop research into the impact and distribution of scope 3 (i.e. indirect) emissions for different health sector components.
Establish tools and resources to support organizations in developing inventories of scope 3 emissions.
Aggregate facility emissions of GHGs to track progress at the city, county, state and national levels.
Study and recommend regionally applicable technologies for climate change adaptation and mitigation of GHG emissions in the health sector.
Behavioural and cultural changes
Encourage people to practise climate change mitigation activities.
Promote behavioural change among health personnel that will have beneficial effects on health and help mitigate the effects of climate change.
Promote activities across communities and institutions to mitigate climate change.
International and intersectoral collaboration
Establish intersectoral collaboration to mitigate GHG emissions and develop public health adaptation plans.
Establish international partnerships to provide guidance to health sector suppliers about emissions reporting and target-setting.
Promote collaboration to address emissions in the production of medicines, technology and equipment.
Tracking, monitoring and innovation
Develop tools and resources to support the tracking of carbon emissions by facilities.
Develop new measures of quality that address the harms associated with a facility's carbon emissions.
Support providers by offering enhanced tracking of GHG emissions.
Develop optimal approaches to on-site decarbonization through innovations in operations and care delivery.

GHG: greenhouse gas.

Fig. 15 provides a visual summary of all indicators sets, showing the relative size (i.e. number of indicators) of each category and subcategory.

Fig. 15. All sets of indicators, with relative sizes according to the number of indicators in each category



All indicators (*N* = 1 684)

Conclusions

This indicator mapping exercise shows that countries are utilizing many useful indicators and are also identifying areas for which indicators can be easily constructed. This report identified 3 880 indicators and enabling actions, which were reduced to the most relevant indicators. This reduced set contains 1 684 indicators, which is still too many, but provides a menu showing what is currently being used by countries. The fact that so many indicators are identified by countries calls for an assessment of quality, sustained capacity to monitor and standardization at the national and international levels.

This review noted that although WHO's guidance on both V&As and HNAPs outlines specific steps, which could facilitate the mapping of indicators, the guidance was not, or only partially, followed by some countries. In addition, while this report found that there are some inconsistencies among countries in the understanding of indicators, their definitions and their use, countries are still able to use their indicators to support national and local decision-making about issues relating to climate change and health.

Consultations within countries would help assess the relevance, quality, and availability of indicators before using them. However, a global process can play a role in ensuring that a small set of indicators is fully assessed and recommended for adoption by countries. Consultation with countries and experts could help decide whether a core set of common indicators would be useful for countries to facilitate their work in conducting both V&As and HNAPs in future.This would complement current indicator processes by including additional indicators not currently covered by global processes, such as the GGA.

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