Addressing climate change

Supplement to the WHO Water, Sanitation and Hygiene strategy 2018–2025

World Health Organization

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Contents

Acronyms and abbreviations

AMMREN	African Media and Malaria Research Network
ATACH	Alliance on Transformative Action on Climate and Health
COP	Conference of the Parties
COVID-19	coronavirus disease 2019
CCH	WHO climate change and health unit
DPSEEA	driving force-pressure-state-exposure-effect-action
DPSIR	driver-pressure-state-impact-response
E. coli	*Escherichia coli*
GCA	Global Center on Adaptation
GCF	Green Climate Fund
GDWQ	Guidelines for Drinking-Water Quality
GHG	greenhouse gas emissions
GIDRM	Global Initiative on Disaster Risk Management
GLAAS	UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water
GWP	Global Water Partnership
GWSP	Global Water Security & Sanitation Partnership of the World Bank
HACCP	hazard analysis critical control points
HCF	health care facility/facilities
HNAP	Health National Adaptation Plan
IN-MHEWS	International Network for Multi-Hazard Early Warning Systems
IPCC	Intergovernmental Panel on Climate Change
IWA	International Water Association
IWRM	Integrated Water Resources Management
JMP	WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene
LMIC	low and middle-income countries
NBS	nature-based solution
NCDs	noncommunicable diseases
NDC	Nationally Determined Contribution
O&M	operation & maintenance
PAMCA	Pan African Mosquito Control Association
QMRA	quantitative microbial risk assessment
qPCR	quantitative polymerase chain reaction
RBM	river basin management
RegNet	International Network of Drinking-Water Regulators
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2
SDG	Sustainable Development Goal

SSP	sanitation safety planning
SWA	Sanitation and Water for All
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNISDR	UN International Strategy for Disaster Reduction
US CDC	United States of America Centers for Disease Control and Prevention
V&A	vulnerability and adaption assessments
WASH	water, sanitation and hygiene
WASH FIT	WASH for Health Facility Improvement Tool
WFD	Water Framework Directive
WHO	World Health Organization
WMO	World Meteorological Organization
WSP	water safety plan (planning)
WWF	World Wildlife Fund

Hand washing station at the Banta border post on the Guinea/Liberia border.

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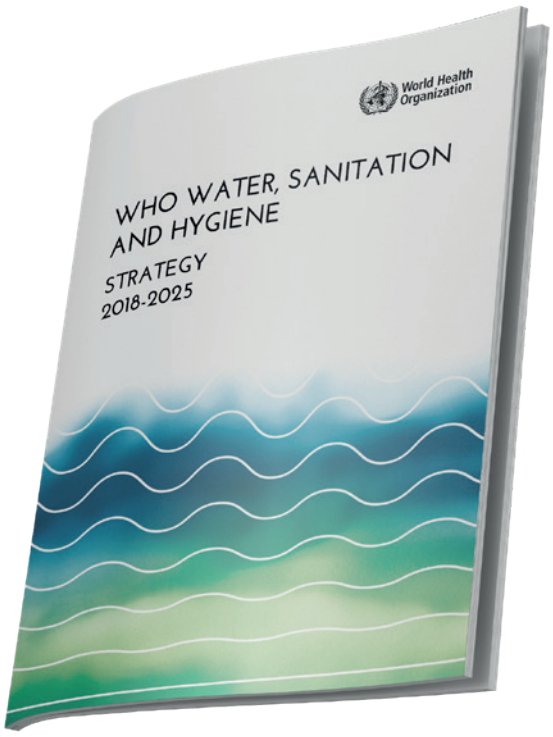
1 Introduction

Despite the World Health Organization (WHO) identifying climate change as the biggest health threat facing humanity, the most recent WHO data *(1)* shows that the majority of countries have not addressed climate risks or introduced climate resiliency into water, sanitation and hygiene (WASH) policies and planning.

As one of the cornerstones of public health, WASH is critical in supporting the transition from health vulnerability to resilience[1] in the face of climate change.

The activities in this supplement aim to complement the WHO Water, Sanitation and Hygiene strategy 2018–2025[2], and inform future strategies, in the areas of climate, WASH and health.



[1] See Annex 1 for a definition of resilience.
[2] World Health Organization. (2018). WHO Water, Sanitation and Hygiene strategy 2018-2025. World Health Organization. https://apps.who.int/iris/handle/10665/274273.

2 WASH, climate change and health

Climate change-induced risks and threats come from both extreme events – climate shocks – and slower-onset and long-term impact changes – climate stress. The changes in climate that have already occurred means there is an increasing frequency, and in some cases increasing severity, of extreme events – heatwaves, floods, droughts, wildfires, windstorms and associated storm surges – that cause illness, death and displacement of people, and disruption to services. Longer-term changes in average temperatures, precipitation and rising sea-levels will amplify threats that are already being felt.

Climate change and WASH are related in three broad ways.

- Access to WASH services and practice of hygiene behaviours are central to building health resilience to climate, and to help societies cope with extreme events and support their recovery in the long-term. They also support the ability to cope with slower-onset events by preventing disease and ensuring adequate hydration with increasing temperatures.

- WASH services and behaviours are themselves threatened by climate change and must be resilient to support building wider community resilience and health resilience. Climate threats to WASH are substantial. Increased flooding will damage infrastructure, degrade catchments, and contaminate water supplies; floods will lead to overflowing pit latrines, tanks and sewers, and by-passing of wastewater treatment works as well as bring polluted runoff from agricultural land, cities and industries; droughts will reduce water availability and degrade source water quality; increasing temperatures will change consumption requirements to maintain a healthy hydration and may adversely affect wastewater treatment processes and damage infrastructure in melting permafrost regions; the retreat of glaciers will contribute to water scarcity[3]; wildfires will degrade catchments and water quality; and sea-level rise and storm surges causes by wind storms will increase threats of salinisation of water resources.

- The WASH and health sectors emit greenhouse gases directly and indirectly. For example directly through the operation of wastewater treatment plants and burning of health care waste, and indirectly through emissions associated with transport and manufacturing of relevant equipment and supplies.

WHO's vision is a world in which all peoples attain the highest possible level of health, and its mission is to promote health, keep the world safe and serve the vulnerable, with measurable impact for people at country level. Therefore, the primacy of public health underscores WHO's work on climate-resilient WASH.

[3] Water scarcity also becomes, increasingly, a security issue, as transboundary waters account for 60 per cent of the world's freshwater flows.

3 WHO's approach to date

WHO has concentrated on the building of climate-resilient WASH services through integration of climate considerations and recommendations in various guidelines documents, tools and implementation approaches that were produced, specifically for climate-resilient water and sanitation safety planning, climate-resilient and environmentally sustainable health care facilities (HCFs), assessments (and related monitoring) of climate change impacts on WASH services, and, to a much lesser extent, assessment of WASH-related climate change impacts on health (primarily in the WHO European Region).[4] Networks and platforms where WHO engages in the work above include the WASH and Health Alliance, World Meteorological Organization (WMO) Water and Climate Coalition, and UN-Water Climate Expert Group.

Furthermore, the WHO's Climate Change and Health Unit (CCH) has focused on the following objectives in relation to the intersection between WASH, climate change and health:

- Integration of WASH considerations within relevant climate change and health risks policies and processes, e.g. Health components of National Adaptation Plans (HNAPs); and climate change and health vulnerability and adaption assessments (V&A) and interventions, e.g. climate-resilient and low carbon sustainable health care systems and facilities and climate-informed health early warning systems;

- Promotion of reliable access to WASH services as a critical requirement to WHO's approach to building climate-resilient health systems; and

- Monitoring of WASH-related considerations within key climate change and health monitoring initiatives, e.g. WHO Health and Climate Change Global Survey *(2)* and WHO United Nations Framework Convention on Climate Change (UNFCCC) Health and Climate Change Country Profiles *(3)*.

Activities

The third edition of the WHO Guidelines for drinking-water quality (GDWQ), published in 2004, introduced the concept of integrated, preventive risk management through water safety plans (WSPs). Using health-based targets as a point of departure, WSPs provide a systematic approach towards assessing, managing and monitoring risks from catchment to consumer. It provides a way of structuring and applying tools, methods and procedures to move away from end-of-pipe measurements as the sole indicator of safe drinking-water management and applies a hazard analysis critical control points (HACCP) approach, referring to a series of actions to be taken to ensure key control points within the drinking-water system are operating within acceptable limits to ensure safe drinking-water supply. WSPs follow the logical sequence of this chain and enable system-tailored hazard identification and risk assessment/management. Later they were complemented by sanitation safety plans (SSPs) and guidance was developed to support climate adaptation and resilience, to support the systematic assessment and management of climate risks through the WSP and SSP approach. In these safety plans, water and sanitation

[4] See Annex 2 for a list of environmental health surveillance activities.

services are targeted to become climate resilient, which means becoming more resilient and better able to adapt to climate variability (as in too little, too much or too dirty water) and to climate change (e.g. higher frequency of extreme events or sea level rise).

The work of WHO and partners in e.g. the WASH and Climate Change Alliance, or through the Protocol on Water and Health with the United Nations Economic Commission for Europe (UNECE), supports risk management and acts mainly on those aspects linking the environmental state to health impacts. Since publication of guidance on Climate-resilient water safety plans *(4)* in 2017, WHO has supported countries in these risk management processes, as well as advocacy, technical capacity building and training programmes on implementation and auditing. The need to build climate resilience has been a significant driver for countries seeking support to introduce WSPs.

Climate considerations are included in the Guidelines for drinking-water quality 4th edition, incorporating the first and second addenda *(5)* and supporting documents including: Protecting surface water for health *(6)*, Toxic cyanobacteria in water, 2nd ed. *(7)* and Domestic water quantity, service level and health, 2nd ed. *(8)*.

Experience of piloting WSPs for the management of climate risks has led to the development of national policies and guidance to support development and implementation of urban and rural WSPs. Technical guidance and support from WHO, both direct and indirect, has led to enhanced uptake of water safety planning across all WHO regions. Technical support provided by WHO has resulted in wider application of climate-resilient WSPs in, for example, Bangladesh, Ethiopia, Ghana, India, Kuwait, Liberia, Mali, Nepal, Senegal and Sri Lanka. The impacts of climate on water resources are also featuring in draft national water quality strategies in Madagascar and Mali.

For sanitation, WHO has made efforts to increase focus on SSPs as a tool to support local level risk assessments for climate resilience and support implementation of the Guidelines on sanitation and health *(9)* which now integrate climate change in specific sections. Other aspects are explored in the draft discussion paper Climate, sanitation and health *(10)* including local level vulnerability assessment and adaptation options.

In settings, there is a major push by WHO and partners to promote climate-resilient and low carbon HCFs, including resilient water and sanitation services and clean energy in HCFs, with the aim of protecting public health in a changing and unpredictable climate. Technical guidance on Climate-resilient and environmentally sustainable health care facilities *(11)* was published in 2020 to support an integrated approach to HCFs and promote interventions in the health sector including around WASH, sanitation and waste management that promote both resilience and low-carbon development but also looking at energy, infrastructure, technologies and products, and the health workforce. This guidance document has been used to develop regional and country-level guidance and improvement plans. Additionally, the second edition of Water and sanitation for health facility improvement tool (WASH FIT): a practical guide for improving quality of care through water, sanitation and hygiene in health care facilities *(12)* features climate change resilience and mitigation in WASH improvements and operations in HCFs, including surveillance and control of water supply.

Regional efforts to promote climate-resilient HCFs include developing national standards for clean and green HCFs (all regions), piloting assessment indicators of resilient HCFs and training (Western Pacific Region); advocacy toolkits and training packages on climate-resilient HCFs (South-East Asia Region) and developed as an app in English, French and Spanish (Region of the Americas); tools with minimum standards and indicators for emergency preparedness for health facilities (Region of the Americas); and promoting WASH FIT analysis (Eastern Mediterranean Region, European Region and Region of the Americas).

There are opportunities to better integrate and streamline the risk management approaches described above to simplify and clarify for field-level use, e.g. integrating key WSP and SSP steps into WASH FIT for greater water quality risk management in HCFs without requiring a separate WSP or SSP. Climate considerations have also been streamlined into the revised WSP and SSP manuals; additional guidance is also being developed based on needs identified through WSP auditing including guidance notes on accessing and integrating climate information for WSPs; auditing WSPs for strengthened climate resilience; and climate vulnerability and adaptation assessments in the WASH sector. Climate is also being considered in the forthcoming updated small water supplies guideline, including in the sanitary inspection forms.

On monitoring, climate change indicators have been integrated into the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) Report 2022 *(13)* and 2021/2022 country surveys to monitor inclusion of climate change preparedness approaches in national planning and local risk management of WASH.

To date, the efforts on assessing health effects of climate change or measuring disease burden related to WASH, be the diseases water-washed, hygiene-related issues, plus water-based issues (e.g. cyanobacteria), and vector-borne diseases, have been limited. The Intergovernmental Panel on Climate Change (IPCC) notes *(14)* in Table 1 below the key risks related to waterborne disease for mostly low- and middle-income countries (Africa and Asia); small islands; and globally for *Vibrios*:

Table 1
Key risks related to waterborne disease from climate change

Consequence that would be considered severe, and to whom	Increase in the occurrence and intensity of waterborne diseases such as Vibrios (particularly V. cholerae), diarrheal diseases, other waterborne gastrointestinal illnesses
Hazard conditions that would contribute to this risk being severe	Substantial changes in temperature and precipitation patterns, increased frequency and intensity of extreme weather events (e.g., droughts, storms, floods), ocean warming and acidification
Exposure conditions that would contribute to this risk being severe	Large increases in exposure, particularly in areas with poor sanitation, flood-prone areas, and favourable ecological environments for waterborne disease pathogens
Vulnerability conditions that would contribute to this risk being severe	Poor hygiene conditions, lack of clean drinking water and safe food, flood and drought prone areas, vulnerabilities of water and sanitation systems
Adaptation options with high potential for reducing risk	Improved water, sanitation and hygiene conditions and better surveillance system. Improved personal drinking and eating habits, behaviour change

Integration of WASH within WHO's CCH programme and opportunities for increased action

2021 and 2022 were a very important years for the health community in addressing climate change. For the first time in the UNFCCC negotiations, a formal health programme was promoted by the United Kingdom (UK) government as President of the Conference of the Parties (COP).

The COP26 Health Programme included a total of four Health Initiatives, including on climate-resilient and low carbon sustainable health systems. As of today, a total of 60 countries have committed at Minister of Health level, to strengthen the climate resilience and lower the emissions of health systems. A summary of countries and their commitments is here *(15)*.

As a follow-up to these commitments the UK and WHO have established a WHO-led platform, the Alliance on Transformative Action on Climate and Health (ATACH) *(16)* to build on this momentum and advance action on climate change and health at country level. The ATACH aims to support countries in the implementation of their COP26 commitments as a first priority. Given the importance of e.g. maximizing health co-benefits of mitigation action, the aim is to broaden the scope of the ATACH as soon as possible.

The implementation of these commitments (including HNAPs, V&As, facilitation of access to climate change funding for health, and climate-resilient and low carbon sustainable health care systems and facilities) constitutes an opportunity for WHO to promote access to reliable WASH services at health care facility level and the integration of WASH considerations within the implementation of country commitments (e.g. HNAPs, V&As, and climate-resilient and low carbon sustainable health care systems and facilities).

Prior to the COP26 Health programme and the establishment of the ATACH, the implementation of the CCH programme has resulted in:

- Advocacy: WASH featured in WHO global conferences on climate change and health; WASH featured in WHO-led high level events on climate change and health at COPs, including within the COP26 Special report on climate change and health *(17)* and at COP27 *(18)*.

- Evidence and monitoring: WHO's global monitoring of health and climate change has strengthened since 2015 with the introduction of the WHO health and climate change global survey, a triennial survey that tracks health sector response to climate change across areas such as governance, research and evidence, implementation and finance. Since 2015, WHO in partnership with the UNFCCC also works with national governments to develop health and climate change country profiles, detailing national level climate hazards, health risks and actions to build climate-resilient and sustainable health systems.

- Country support: strengthened collaboration between Ministries of Health and Ministries of Water and Sanitation for the integration of WASH consideration within HNAPs (e.g. Bangladesh, Ethiopia, Malawi, Mozambique, Nepal and United Republic of Tanzania), V&As and the promotion of WASH within WHO's integrated approach to build climate-resilient and low carbon sustainable HCFs and systems including its adaptation by WHO Regions (e.g. South-East Asia Region, Western Pacific Region and Region of the Americas).

Wastewater treatment plant, Tunisia.

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4 Focus areas

Building on the above, WHO will leverage its comparative advantage of health leadership and advocacy, normative standard setting, monitoring and research, and strategic partnership to pursue work in the areas articulated below.

4.1 Monitoring of climate-resilient WASH and of the integration of WASH within climate change and health initiatives and processes

While work has progressed in promoting the management of climate-risks through water safety planning, there remains limited understanding of the resilience of WASH services. As noted by Howard et al, understanding and improving resilience requires reliable data in at least six domains: WASH infrastructure, the environmental setting (catchment), WASH management, community governance and engagement, institutional support, and supply chains *(19)*. Measurement of climate-resilient WASH will likely include the inclusion of process-oriented, enabling environment indicators, ideally paired with WASH output measurement. There are likely many indicators appropriate to the local or project level that are too specific to be scaled up to national and global monitoring.

As a co-custodian for the Sustainable Development Goal (SDG) indicators on monitoring of access to WASH services and the WASH enabling environment, WHO is positioned to advise, facilitate or participate in soliciting inputs, reviewing and compiling existing tools and methods for collecting data on climate and WASH, producing an inventory of tools and measures, developing gap analysis, producing a conceptual framework, recommending actions such as piloting new indicators or data collection methods, and reporting regularly.

Priority activities – UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS)

- Build in additional questions on climate-resilience in country and External Support Agency surveys and include an expanded climate analysis in future GLAAS reports.
- Contribute to systematic landscaping on how different countries/sectors around the world define/monitor resilience and what actions are being taken.
- Progressively integrate resilience assessment information in to WASH accounts over the longer-term.
- Progressively contribute to a programme of activities with existing partners such as the United Nations Children's Fund (UNICEF) to deliver resilience assessments and to use the evidence to consider outcome as well as process indicators.

Priority activities – WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP)

- Review if and how climate resilience is included in WASH monitoring.
- Identify existing data sources and tools for assessing climate resilience in the context of water, sanitation, and hygiene.
- Identify critical gaps in climate resilience measurement needs in the context of the SDG WASH targets.
- Collect additional data from households: seasonality of water supplies, multiple uses of water, and on-site sanitation storage overflow events.
- Collect additional data from utilities, service providers and governments about extreme weather events and impacts on treatment plants, and about frequency and magnitude of combined sewer overflows.
- Enhance monitoring of on-site sanitation and wastewater.

Priority activities – Global Monitoring Programme on Health and Climate Change

- Review and revise WHO health and climate change global survey for coverage of climate-resilient WASH indicators and consider case study or special focus on WASH in future reports.
- Review and strengthen climate-resilient WASH content in country profiles, particularly through collaboration with GLAAS and JMP programmes and other partners.
- Collect additional data on WASH commitments and monitoring in Nationally Determined Contributions (NDCs) through our health in NDCs assessments or by collaboration with partners conducting WASH related analysis in NDCs. Progressively integrate into ATACH monitoring function in future.
- Ensure the ATACH monitoring function includes relevant data on WASH integration within relevant policies (e.g. HNAP, healthy NDCs) and implementation mechanisms (e.g. climate-resilient and low carbon health systems and facilities).

4.2 Integrating climate resilience into WASH interventions and risk management

Drinking-water is one of the main exposure routes for water-borne diseases, together with hands-mouth contact or via food. Other routes include water contact through e.g., bathing, farming, laundry or floods. Certain chemicals and some pathogens may pass from the contaminated water and soil system into/onto crops and affect food safety. Some disease pathways involve exposure to contaminated soil, such as hookworm and other soil-transmitted helminths. Poorly managed water and sanitation facilities can create breeding sites for flies, mosquitoes, and other vectors of diseases such as trachoma, lymphatic filariasis and viral diseases. Exposure to vectors is influenced by housing, behaviour, but also level of income and access to preventive health care.

WHO will build upon the encouraging level of global WSP uptake through more targeted future support at regional and country level, especially for small systems. Lessons learned from its work on WSPs including the integration of climate resilience, will inform the development of additional resources.

WHO will continue to state its clear position on the primacy of sanitation for public health protection, elaborate criteria of how climate-resilient sanitation systems look like and how they can be improved and promote safe water reuse and consider what other interventions may be necessary and warranting high priority from WHO.

4.2.1 Drinking-water and recreational water quality and safety

Collectively, safe drinking-water, sanitation and hygiene interrupt disease transmission pathways, particularly for water-related diseases. However, WASH systems themselves are vulnerable to contamination including as a result of extreme events and require management of risks throughout the supply chain, e.g. through water safety planning. As of February 2022, based on WHO-led monitoring, 64 counties have water safety planning policies, the result of significant time and resources invested by WHO. Many of these include the active integration of climate change considerations as articulated in the second editions of the WSP manual *(20)* and the WHO European Region WSP field guide *(21)* published in 2022, which integrates climate resilience throughout. As well, in many WHO regions, capacity building around WSPs has emphasized climate resilience aspects be fully integrated in all steps. Still, it remains difficult for effective WSPs to be put in place for small systems and other resource limited settings.

Though more research is needed to improve understanding of the increasing impact of global climate change on recreational water environments and water quality, it is generally understood that climate change can impact sewerage infrastructure and wastewater treatment plants, often sited close to sea level, causing discharges of inadequately treated human excreta into surface waters and nearby recreational areas. In some water bodies, extreme climate events could cause increased blooms of harmful algae (cyanobacteria) and other water-based pathogens during periods of low flow and warm weather. Climate change impacts on recreational water will certainly vary locally, depending on the hydrological characteristics of

Priority activities

- Working with partners, promote support mechanisms for WSP teams to access local (for planning purposes), district or national climate expertise (including by linking them to national meteorological agencies and disaster risk reduction colleagues, whom often have the greatest knowledge and capacity in country).
- Finalize global guidance to support the practical integration of climate change in water safety planning, WSP auditing for strengthened climate resilience, conducting climate vulnerability and adaptation assessments in the WASH sector, and update the WSP guidance for small supplies to integrate climate resilience.
- Support implementation of WHO's small water supplies guideline including sanitary inspections.
- Target more future country support using updated WSP global training package for organized piped supplies.
- Work with partners to promote the use of water safety planning to inform and articulate a clearer, more coherent narrative in order to mobilize climate finance for WASH and infrastructure improvement.
- Support national governments to incorporate aspects of climate resilience/adaptation into national water policy and planning.
- Plan for a systematic review and update of the GDWQ so that the 5th edition more comprehensively includes climate considerations throughout (rather than the stand-alone climate section), including in guidance on parameter selection, WSPs and surveillance and to inform the update of risk assessments.
- Support the use of system assessments which include identification of hazards and hazardous events for recreational waters, considering seasonality and predicted local climate change scenarios.

a water body, and potential local scenarios should be considered as part of an Recreational Water Safety Plan *(22)*.

4.2.2 Sanitation and wastewater

Overall understanding of the impact of climate change on sanitation, and how these impacts may be best managed, is less well developed *(23, 24)* than for water supply. However, existing guidelines and tools, including WHO Guidelines on sanitation and health, climate-resilient sanitation safety planning and Sanitary Inspection packages offer routes for managing the threats to sanitation and the public health risks that arise from impacts of climate change. WHO will continue to promote, strengthen and mainstream aspects of climate resilience in WHO sanitation guidance and tools, with a focus on strengthening the use of climate data, making the case for climate financing for sanitation and incorporating lesson from implementation into future edition of WHO documents and sector approaches.

Sanitation, particularly safe use of wastewater and sludge, offers important opportunities to increase resilience in other sectors – such as in agriculture which is in need of reliable supply of water and nutrients in increasingly water insecure areas and in the energy sector though energy recovery from methane and dried sludge. WHO will continue to integrate climate resilience within its promotion of the safe use of wastewater and its promotion of intersectoral coordination and policy coherence needed for risk management and safety along the sanitation chain though to food production and consumption.

Sanitation is associated with greenhouse gas emissions (GHG), particularly methane. As part of global efforts to reduce GHG emissions, the chain of wastewater collection and treatment, including local systems, should also be addressed. Energy generation from sludge, sewage, or solid waste may support local energy transitions, contribute to circularity, and generate revenue for water supply and sanitation services.

Climate mitigation measures should not compromise core public health protection principles. While focusing primarily on sanitation adaptation, WHO will investigate trade-offs of adaptation for sustainable services, mitigation and local contextual factors in technology, favouring low emissions technologies and management options as much as possible.[5]

[5] i.e., using biogas block-type thermal power stations to cover their energy needs and the needs of the community; wastewater heat pumps; use of enclosed digesters to prevent fugitive methane emissions, etc.

Priority activities

- Continually advocate sanitation as a human right and a public good that needs rapid acceleration with climate-resilient solutions to meet SDG targets and support health goals.
- Strengthen climate change aspects in the Guidelines for sanitation and health particularly in relation to adaptation of the enabling environment, technologies and local risk assessment acknowledging the trade-offs of adaptation, mitigation and local contextual factors in technology and management options.
- Promote and support implementation of climate-resilient SSPs, synthesize and share learning in particularly in relation to using climate risk assessment to justify climate related investment in improvement identified in SSP (and overall alignment with the WHO approach to build climate-resilient and low carbon health care facilities).
- Support national governments to incorporate aspects of climate resilience/adaptation into national sanitation policy and planning.
- Promote, and possibly update, the safe use of wastewater to support resilience to climate induced water and nutrient scarcity in agriculture.
- Increase membership of sanitation regulators in The International Network of Drinking-water and Sanitation Regulators (RegNet) and support regulators to develop climate sensitive regulation though cross-learning and WHO technical guidance (e.g. on setting standards for wastewater and sludge treatment).
- Encourage partners to use climate resilience as a driving principle to integrate SSPs (and WSPs), especially at local level (where implementing actors are the same).
- Work with partners to promote the use of SSPs to inform and articulate a clearer, more coherent narrative in order to mobilize climate finance for WASH and infrastructure improvement.

There will also be a continuing focus on ending the practice of open defecation. Though the global average reduction in open defecation appears to be on track to eliminate the practice, much of the progress in eliminating open defecation is being driven by gains in a few high population countries. Open defecation remains a persistent inequality, with nine out of ten open defecators living in rural areas, and poorer people much more likely to practise open defecation. In addition, more frequent or more intense storms or cyclones can damage or destroy latrine superstructures, conveyance pipes, power supplies etc, potentially resulting in increased slippage to open defecation and disruptions to pumping and treatment facilities *(23, 24)*.

4.2.3 Accelerating and sustaining hygiene in community settings

Hygiene and hand hygiene in particular are key elements of WASH interventions. These involve raising awareness of the water-health-environment links, so that people are more likely to change their behaviour and use the available water and sanitation facilities appropriately. This has the potential to enhance health benefits; the risks of diarrhoeal diseases are reduced by 47% if communities have appropriate hand-washing practices. Increased water availability, regardless of its quality, supports hygiene as more water can be used for bathing, washing clothes and cleaning of dwellings and utensils.

Improved hygiene has a positive impact on louse-borne diseases, eye and skin infections and other water-washed diseases, in addition to reducing faecal-orally transmitted diseases. This impact can be further enhanced by providing additional facilities, such as laundry sites or convenient slabs for cleaning household utensils. This also reduces exposure to water-based diseases such as schistosomiasis.

Priority activities

- Ensuring that upcoming WHO Guidelines on hand hygiene in community settings address increasing climate-related risks (e.g. water scarcity and increasing importance of hand hygiene as a first line of defence when other barriers fail).
- Promote hand hygiene good practices and evidence-based recommendations through the platform of the Hand Hygiene for All partnership.

Solomon Islands clinic for screening people for undiagnosed noncommunicable diseases (NCDs) and providing assessment and treatment services for those who have diagnosed NCDs. WHO has integrated climate change resilience and mitigation in WASH improvements and operations in HCFs, including surveillance and control of water supply.

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4.3 Building climate-resilient WASH in HCFs

WHO's work on ensuring resilient WASH in HCFs will remain a priority but shift from a focus on normative guidance and assessments to actions at country levels.

Furthermore, as a response to the Health Programme promoted by the UK government as President of COP26, 60 countries around all WHO Regions, have committed to strengthening climate resilience and low carbon sustainable health systems. Given this commitment and momentum to building climate-resilient and low carbon sustainable health systems, and the newly established ATACH, combined with the evidence from many low- and middle-income countries (LMIC) that there is very limited progress, WHO will continue to push for action on developing resilient and environmentally sustainable WASH in HCF and other public places.

WHO's WASH in HCF work includes a focus on health care waste. While the issue of health waste has existed for a long time, coronavirus disease 2019 (COVID-19), coupled with intensified global concern about environmental sustainability, has forced the world to reckon with the gaps and neglected aspects of the waste stream and how we produce, use, discard, and in some case reuse our health care resources, across the life cycle. Today, 30% of healthcare facilities (60% in the least developed countries) are not equipped to handle existing waste loads, let alone the additional COVID-19 load. This potentially exposes health workers to needle stick injuries, burns and pathogenic microorganisms, while also impacting communities living near poorly managed landfills and waste disposal sites through contaminated air from burning waste, poor water quality or disease carrying pests. As part of over efforts to support climate-resilient HCFs, WHO's 2022 report Global analysis of health care waste in the context of COVID-19 *(25)* laid out a set of recommendations for integrating better, safer, and more environmentally sustainable waste practices.

Priority activities

- Linked to the COP26 commitment, advocate for countries to strengthen climate-resilient and low carbon health systems and facilities, including conducting health vulnerability and adaptation assessments at health care facility level *(26)*.
- Advocate for long-term investment and commitment from health sector budgets and to ensure that resilient WASH in HCF is understood and integrated within, and understood as primarily a health sector issue.
- Promote action on climate resilience within WASH FIT.
- Encourage the shared use of common climate information for WSP, SSP and WASH in healthcare facilities purposes, especially at local level (where implementing actors are the same).
- Define criteria of what a climate-resilient and low carbon WASH service in HCFs looks like, for different types of HCFs.
- Collect, review and share ongoing assessments on climate change risks to health care facilities and their WASH and energy systems, including recommended actions.
- Support at country level implementation of recommendations from the Global analysis of health care waste in the context of COVID-19.

4.4 Expanding research on the influence of climate change on WASH-related health outcomes

The IPCC *(27)* has reported that more people would experience water scarcity and floods (high confidence) and identified WASH failure due to climate change as an emergent risk (medium confidence) leading to higher diarrhoea risk. In addition, it projected the risk from droughts, heavy precipitation, water scarcity, wildfire damage and permafrost degradation to be higher at 2°C warming than 1.5°C (medium confidence) and all these could potentially impact water quality and WASH services. Further, the IPCC noted waterborne diseases result from complex causal relationships between climate, environmental and socio-economic factors that are not fully understood. Exacerbating the above further will be regional variability and impact of these wider issues of water security on health. The threats posed by floods and their impacts on infectious and non-communicable disease, are also widespread and would hit differently across the WHO regions. To take one specific example,

there are very limited studies about the impacts of global climate change on hydration level.[6]

WHO will commission research that goes beyond the established reviews of the impact of climate change on waterborne diseases, which have largely focused on diarrhoea as health endpoint. The objective is to broaden our understanding of the multiplicity of linkages between climate, WASH and water-related health outcomes. This will require commissioning a wider, comprehensive review of WASH-related health endpoints and impacts.

WHO will also call for increased research on water quality security and health to improve the evidence and understanding of how climate variables influence reliable delivery of safe water for drinking, for hand hygiene, and the implications of changes on health.[7] Further, WHO will review evidence on how climate change can impact sanitation services and the degree to which improving sanitation risk management (e.g. climate-resilient SSPs) can enable adaptation to climate change and reduction of health risks.

This research will be done in the context of WHO's continuing work on estimating the burden of disease from inadequate WASH. Burden of disease data could inform further work related to economics, for example, the costs of non-action on WASH adaptation to climate change.

Priority activities

- Model how WASH-related disease burden are likely to change, considering climate scenarios, and potentially through the development and use of a dynamic quantitative microbial risk assessment (QMRA)-climate-sanitary condition model.
- Analyse the likely climate impacts on the quality, coverage and reliability of WASH service provision.
- Improve characterization of how climate change will influence occurrence of water quality contaminants, including those of emerging concern.

[6] e.g. hydration in relation to kidney problems, general health status, heat stress etc. (hydration may not be the ultimate outcome - in pastoral areas people may prioritize livestock even when water supply is low, with unknown livelihood impacts).

[7] i.e. source protection, water supply design, operation, management and technology.

4.5 Strengthening environmental surveillance, forecasting and early warning

With climate change having the potential to introduce sudden and unforeseen risks to safe water supply, sanitation and indeed influence the transmission of non-WASH-related disease, environmental surveillance (e.g. wastewater monitoring) may have an increasing role to play alongside epidemiological surveillance (see Annex 2) as an early warning signal in the detection of new or re-emerging outbreaks. This surveillance could capture trends in disease prevalence, or where relevant, in detection of pathogen variants of concern. Environmental surveillance can complement disease risk mapping to identify vulnerable areas and risk groups, inform and monitor the effectiveness of response and relief efforts, as well as identify research needs and evaluate control strategies. Such surveillance may become even more powerful when linked to existing early warning systems in the context of climate change.

Similarly, monitoring of flows and quality of surface water, groundwater and wastewater helps to identify potential threats, including climate-related, to water availability and quality, and subsequently undertake remedial action. Microbial water quality monitoring has undergone a tremendous transition in recent years, with novel molecular tools beginning to offer rapid, high-throughput, sensitive and specific detection of a wide spectrum of microbial pathogens that challenge traditional culture-based techniques. High-density microarrays, real-time quantitative polymerase chain reaction (qPCR) and pyrosequencing are emerging rapidly as tools of pathogen detection and discovery. Such tools not only detect presence, but also provide insight into quantities, i.e. actual pathogen load. Recently with the COVID-19 pandemic, progress has been made in monitoring of viruses in wastewater. Wastewater surveillance is cost-effective, particularly when compared to human epidemiological surveillance, and efficient as an early warning system. The various tools could be expanded beyond standard faecal indicators (usually *E. coli*) and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and include

other indicators such as *Legionella, Mycobacterium* or norovirus. In some countries these provide a much better representation of microbial contamination.

Besides monitoring, the application of hydrological and water quality modelling tools calibrated against existing monitoring data can provide an effective way of quantifying total catchment pollutant loads to the water system. The complete model framework could be further applied as a management tool to help evaluate the collective impacts of potential strategies for reducing pollutant inputs to the water system and steer future management objectives. The combination of big data management and water quality models also allows water quality practitioners to develop forecast and early warning system of water quality deterioration of water system, parallel to such systems for forecasting of floods or tsunamis.

Priority activities

- Continue to provide guidance on technologies, methods and interpretation of data associated with environmental surveillance, including monitoring of source water and wastewater.
- Support capacity development for improved water quality lab facilities and testing equipment.
- Support integration of WASH-related climate sensitive disease surveillance within existing early warning systems where applicable.
- Investigate whether use of "big data" coupled with water quality modelling could provide enable forecasting and early warning to predict water quality deterioration in water systems.

4.6 Controlling the spread of climate/ water-influenced vector-borne disease

The environmental pressures change the state of water quantity, water quality, and ecology, of groundwater and surface water. Emission runoff and saltwater intrusion not only deteriorate chemical and biological water quality, but also change the ecosystem, which in turn impacts water availability and may affect habitat for vectors such as mosquitoes, snails, flies, ticks, and rats. Lower water quality also means less available water and higher treatment costs. Several of these environmental and climate effects may be cascading. For instance, high nutrient loads into surface water bodies combined with higher temperature may lead to harmful algal blooms, particularly cyanobacteria. Droughts followed by inundations may create myriads of organically polluted vector breeding sites, or, plastic waste, resulting from industrial processes high in GHG combined with poor solid waste[8] management, and worsened with floods and typhoons, may contribute to chemical pollution, create additional vector habitat and provide both substrate and transport for pathogenic or microbial-resistant bacteria.

As a consequence of climate change and other pressures, environmental vector control, may play an increasingly important role in the prevention of malaria, dengue fever and other vector-borne diseases. Construction, operation and maintenance of water and sanitation facilities should include measures to reduce vector breeding. Various options of larval source reduction are available for integration into the design of the facilities, thus reducing the need for additional vector control measures later. A related measure, which could be integrated into household hygiene campaigns, is the removal or regular emptying of household containers to reduce mosquito breeding. This is particularly relevant in urban areas with high incidence of dengue fever. However, as all water-based investments, nature-based solutions (NBS) and other (urban) climate adaptation measures have the potential to increase vector habitat.

In rural areas, separate basins for watering animals reduce the risk of contamination of water points with manure, though these have to be carefully constructed to reduce trampling around such troughs and creating of hoofprint puddles (ideal potential breeding sites for *Anopheles*

[8] Solid waste refers to any type of garbage, trash, refuse or discarded material. It can be categorized according to where the waste is generated, for example as municipal solid waste, health care waste and e-waste. Over 2 billion tons of municipal solid waste are produced annually. Poor waste collection leads to environmental and marine pollution and can block water drains. Resulting flooding and other standing waters in waste items favour cholera and vector-borne diseases such as malaria and dengue.

mosquitoes). If possible, provisions for other productive uses of water, such as irrigation of home gardens or small businesses, can support livelihoods and thus increase the ability to pay for protective health care.

Priority activities

- Develop guidelines and advocacy for considering health dimensions in design, construction and operation of WASH facilities, including in the contexts of humanitarian or public health emergencies, to prevent vector-borne disease spread.

4.7 Integrating WASH within climate change and health policy and implementation processes

Human health cannot be protected and promoted only by the health sector; it depends on efforts by other sectors such as food and agriculture, energy and urban planning. The active involvement of these sectors in climate change National Adaptation Plan development and implementation will make them more effective. Strategies such as building climate-resilient health systems and developing low carbon sustainable health systems have already been integrated into the health chapters of National Adaptation Plans and are a focus of stand-alone HNAPs *(28)*.

These efforts will be pursued in the context of ATACH, and within efforts to strengthen pandemic prevention, preparedness and response.

Priority activities

- Promote integration of WASH and health into national level climate adaptation/resilience strategies. Health Impact Assessments are commonly part of environmental assessments required by governments and financing organizations when large water (infrastructure) projects are planned.
- Using the ATACH governance mechanism recently established, WHO will aim to better integrate WASH within the implementation of the COP26 health commitments for climate-resilient health systems (e.g. HNAPs, V&As (29) and funding opportunities).
- Furthermore, WASH considerations will also be promoted for the implementation of national commitments to low carbon sustainable health systems (i.e. establishment of baseline information on health systems/facility emissions; and development of improvement plans for low carbon health systems).

4.8 Integrating WASH within Integrated Water Resources Management (IWRM)

Addressing the dependencies and interactions between WASH and the broader catchment through IWRM, together with their uncertainties, is crucial to achieve water security and safe and sustainable water and sanitation services, e.g. protection of water quality and quantity the upper watershed leads to more reliable and cleaner water supply, while proper wastewater management offers opportunities to increase food security, particularly around cities, and reduces environmental impacts downstream. Effective IWRM is based on the active involvement of multiple sectors such as water, energy and agriculture, and across sectors, scales and governance levels. It has the potential to reduce fragmentation, which could be strengthened by the inclusion of additional sectors such as climate, housing and health. At local levels, IWRM could be applied by providing multipurpose water services that consider all local water sources and all intended uses, thus aiming not only at improving human health, but various other benefits as well.

Increasingly, water quality aspects are taken into consideration as well, for instance via upstream ecosystem management, reduction of emissions from industry, or downstream wastewater treatment. Wastewater management systems are designed to prevent waterborne pollutants from contaminating surface or groundwater sources. As water scarcity increases, more communities and wastewater utilities are considering wastewater as a commodity with potential for resource recovery and reuse, especially in agriculture (where education of farmers on safe use is critical), but sometimes with considerable health risks. Similarly, sludge could be turned into fertilizer or energy. Stormwater runoff results from precipitation as it flows over land or impervious surfaces and includes pollutants and toxins that can impair waterways. Stormwater systems include traditional grey infrastructure, such as storm sewers, as well as green or nature-based infrastructure. Where solid waste streams may affect groundwater or surface water quality, local authorities may bring these aspects into IWRM as well.

IWRM can be made more climate resilient by addressing climate risks in planning and decision making[9] and including dedicated measures, such as rainwater harvesting, or by implementing NBS, which are "actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits".

Priority activities

- Support partners and countries to include WASH and health perspectives (including through the use of Health Impact Assessment methodology) when developing IWRM plans at transboundary, river basin and local levels.

[9] Such as this supplement's Focus Areas 4.5 – 4.8.

Imaad, a resident of Shabara village in Charsadda district, wades through floodwaters to bring food to his cattle on 31 August 2022.

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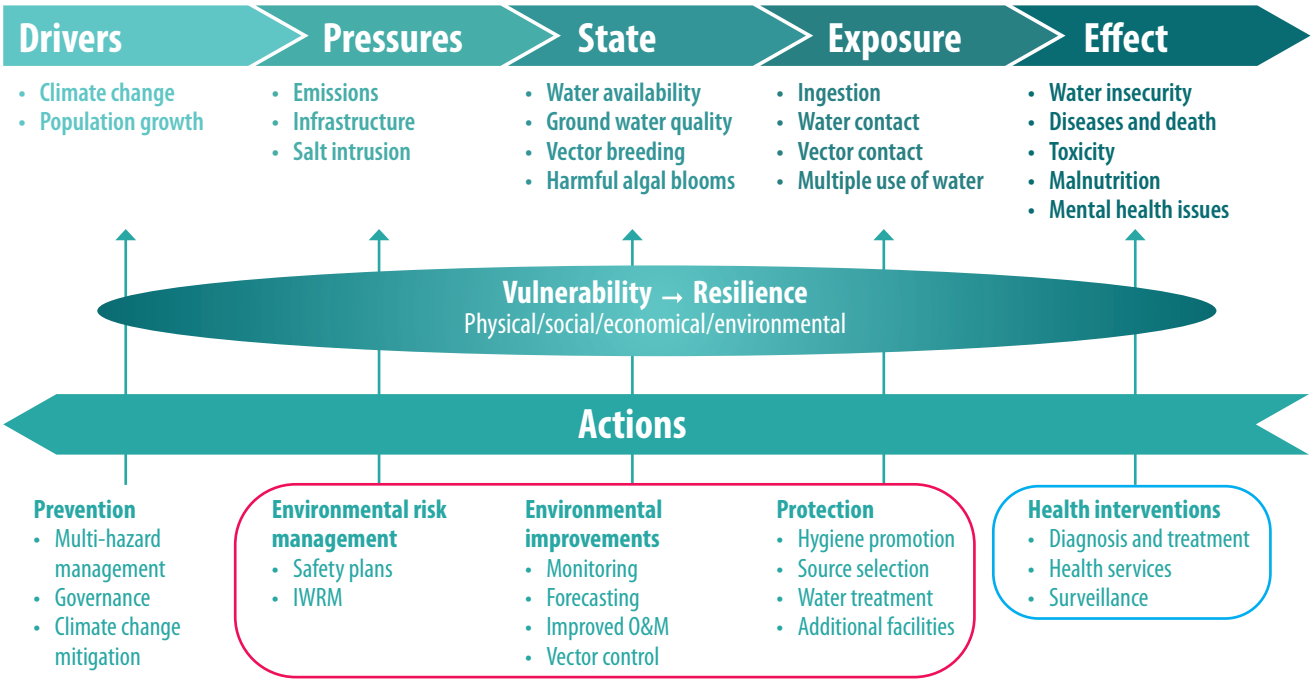
5

Conceptual framework

Understanding the impacts of climate change on WASH resilience requires a broader assessment of determinants, which can be informed by a Driver-Pressure-State-Impact-Response (DPSIR) Framework. This can help visualize cause-effect relations from political and environmental drivers to health impacts in people, with potential responses that can be targeted at each level – many responses are already taken by WHO, or potentially could be taken by WHO with partners, and by intra-sectoral and extra-sectoral stakeholders. By accounting for exposure, the framework can be further adapted to environmental human health, creating a Driving Force-Pressure-State-Exposure-Effect-Action Framework (DPSEEA). This is a necessary step to link the environmental state to health impacts. A dedicated version of the DPSEEA framework can provide more insights into the broader context and causal links between climate change, WASH, and health impact (Figure 1), with WHO's WASH contributions circled in red (i.e. WSPs and SSPs, monitoring) and blue (i.e. WASH disease prevention role when deployed in HCFs) below.

Fig. 1
Draft DPSEEA framework for understanding the broader context and causal links between climate change, WASH, and health impact



Note: Some actions, such as WSPs and SSPs, may contribute to multiple categories, i.e. environmental risk management and protection.
Source: Deltares.

6 Means of implementation

The activities in this supplement aim to complement the WHO Water, Sanitation and Hygiene strategy 2018–2025, and inform future strategies, in the areas of climate, WASH and health. Activities will be implemented at WHO headquarters, regional offices and country offices, with partners, and through alliances, partnerships and mechanisms (see Table 2 below) – such as the Alliance for Transformative Action on Climate and Health, the UN-Water Task Force on Climate Change, the UNECE Task Force on Water and Climate, and the Alliance for Climate, Health and WASH[10] – with a view to influence and assist planners, policy makers and practitioners.

Implementation of the activities in this supplement is dependent on sufficient financial and human resources with relevant expertise and experience especially at country office level. Within the WHO Environment, Climate Change and Health Department, which includes the units for WASH and for Climate Change and Health, the supplement's activities will promote increased coordination and collaboration on WASH and climate change, which will improve the effectiveness and cost benefit of country technical support.

[10] Participants include the Alliance for Global Water Adaptation, Bill & Melinda Gate Foundation, Bristol University, Foreign, Commonwealth & Development Office (UK), Global Water Partnership, International Federation of Red Cross and Red Crescent Societies, International Water Management Institute, Stockholm International Water Institute, SNV (Netherlands), Sanitation and Water for All, United Nations Development Programme, University of Technology Sydney, Water.org, WaterAid, WHO, WMO and the World Bank.

Table 2
Illustrative actors or partners to guide or implement actions on WASH-climate change-health

Actions	Guiding/advising partners	Implementers	Illustrative examples
Prevention • Multi-hazard management • Policies • Climate change mitigation	• Global Initiative on Disaster Risk Management (GIDRM) • Green Climate Fund (GCF) • Global Center on Adaptation (GCA) • International Financing • Institutions/public development banks • United Nations Development Programme (UNDP) • UNFCCC • UN International Strategy for Disaster Reduction (UNISDR) • WHO • WMO	**National** • Ministry of Planning • National Board for Disaster Management • National Meteorology, Climatology, and Geophysical Agency	**Global Water Security & Sanitation Partnership (GWSP) of the World Bank** – supporting the reduction of GHG emissions from the water sector, promoting renewables in sanitation, irrigation, water resources management, and water supply investments.

Table 2 *continued*

Actions	Guiding/advising partners	Implementers	Illustrative examples
Environmental risk management • IWRM • Nature-based solutions • Safety plans • Climate change adaptation	• Global Water Partnership (GWP) • International Network for Multi-Hazard Early Warning Systems (IN-MHEWS) • International Water Association (IWA) • UNFCCC • UNICEF • WHO • World Wildlife Fund (WWF)	**National** • Ministry of Health • Ministry of Environment / Nature • Ministry of Marine Affairs • Ministry of Public Works • Water Authority • Met and Hydrological Services **Transboundary** • River basin authority	**IWA's Climate Smart Utilities initiative** is supporting utilities to strive towards achieving carbon neutrality while adapting to climate change. **ATACH**
Environmental improvements • Monitoring • Forecasting and early warning • Improved O&M	• IWA • Water Framework Directive WFD • WHO • WMO • United Nations Environment Programme UNEP • United Nations Educational, Scientific and Cultural Organization (UNESCO): Guideline for groundwater monitoring	**National** • Environmental Protection Agency • Ministry of Environment / Nature • Water Authority	**The GWP-UNICEF climate-resilient WASH framework** offers guidance on climate risk assessments and appraising options to address prioritized risks. It also proposes a comprehensive list of indicators at the national and sub-national level that can be used to monitor adaptation measures.
Protection • Hygiene promotion • Water treatment • Source selection • Vector control	• United States of America Centers for Disease Control and Prevention (US CDC): Guidelines • River basin management (RBM) • UNICEF • WHO	**National** • Ministry of Environment/Nature • Ministry of Health **Local** • Community • Local authorities • Schools /education institute **Private sector** • Water treatment company **Regional** • African Media and Malaria Research Network (AMMREN) • Pan African Mosquito Control Association (PAMCA)	
Health interventions • Surveillance • Treatment • Health services • Climate-resilient and low carbon sustainable health systems and facilities	• WHO	**National** Health institute Ministry of Health Statistical Agency **Private sector** Health care facilities Pharmaceutical industry	**Advocacy and promotion of integration of environmental health** aspects in National Ministries of Health 'vertical' programmes for malaria and other diseases.

Moving from vulnerability to resilience will also demand that further financial investment is made for WASH, climate change and health. As the IPCC notes: 'ensuring access to climate-resilient 'WASH' infrastructure and practices represents a key adaptation strategy that can protect beneficiaries against water-related diseases induced by climate change (high confidence).' This is true of both rural and urban contexts. With its own relatively modest WASH and CCH budget for activities, WHO will continue to rely on its recognized roles in leadership, normative guidance, capacity building and country support, monitoring and research to catalyse greater climate-sector sourced financial flows, for example from the Green Climate Fund (GCF) to the WASH sector for implementation at the national level under Member State leadership. WHO and partners could work in this effort with Sanitation and Water for All, which has climate financing a key component of Sanitation and Water for All (SWA) Strategic Objective 3 that calls for attracting new investments to the sector. The GCF itself has eight Strategic Impact Areas, many of which link to WASH and therefore could support GCF in its aim for a minimum of 50 percent of the fund allocation to particularly vulnerable countries, including Least Developed Countries, Small Island Developing States, and African States.

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Annex 1. Defining resilience

IPCC defines resilience as “The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.” The IPCC definition of adaptation is “The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.”

Although both terms are sometimes used interchangeably, they are different. In relation to health systems, WHO considers that “resilience relates to the capacity of the system itself to cope with and manage health risks in a way that the essential functions, identity and structure of health systems are maintained. While health adaptation seeks to moderate harm or exploit beneficial opportunities, the preservation of a certain level of quality and sustainable performance of the system itself is not ensured”. The incorporation of a climate-resilient approach to health and water systems contributes to ensuring the performance of the system and therefore to sustainability and maximization of value for money of health and water investments. However, when the magnitude of climate-induced changes or shocks is significant, maintaining system resilience may not always be possible, and the system may collapse or fail. WHO guidance promotes adaptation (or control) measures that strengthen the resilience of the water system itself. Increasing the adaptation and resilience of water supply systems to climate change risks requires long-term planning for continuing access to freshwater sources; managing water demand among competing needs; reviewing the resilience of the supply system itself; addressing policy needs, such as for water storage and flood control; implementation of control measures to ensure water quality (and quantity); and improving operation and maintenance to ensure continued effectiveness of control measures.

Annex 2. Environmental health surveillance activities for water quality and sanitation, plus some elements from chemical safety, HCFs and climate change

Table A2.1
Environmental health surveillance activities

Environmental issue	Environmental health surveillance
Drinking water	Routine water quality surveillance of households, schools, and health care facilities. Can include monitoring of physical, biological, chemical and radiological parameters Health surveillance to confirm safety of the drinking water Surveillance as a component of Water Safety Plans
Sanitation	Surveillance to target sanitation services to settings with high disease burden and support outbreak prevention efforts Surveillance and local risk assessments to prioritize improvements and manage system performance Surveillance as a component of Sanitation Safety Plans
Recreational water	Surveillance of: • microbial quality of coastal and fresh recreational waters using indicator values for intestinal enterococci; • harmful algal blooms in freshwater using indicator values for cyanobacterial biomass and cyanotoxins; • other hazards (beach sand, chemicals, other microbial hazards, nuisance); • swimming pool physical and chemical parameters; • recreational water illnesses. Surveillance as a component of Recreational Water Safety Plans
Hygiene	Surveillance of hand-washing facilities in public places (e.g., schools, health care facilities)
Chemicals in air, drinking water, and soil	Surveillance to determine potential exposures and health burdens. Selected chemicals of concern include arsenic, asbestos, pesticides, dioxin and dioxin-like substances, mercury, and lead (particularly prenatal and children's exposures)
Health care facilities	Assessment of the environmental health impact, sustainability, and climate-resilience of health care facilities, including water and sanitation services, energy emissions, waste management, and material use (e.g., mercury thermometers, radiation) Surveillance to detect antimicrobial-resistant strains of microorganisms in the environment
Climate change	Assessments and surveillance of extreme weather events, temperatures, water availability and quality, etc. Surveillance of climate-related disease Development of integrated monitoring systems allowing collection and analysis of data on environmental hazards, socioeconomic factors, and health outcomes

Annex 3. WHO WASH, climate change and health-related guidelines, guidance, reports, manuals technical documents, training material and toolkits

WASH evidence and monitoring

- UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) 2022 report (2022)
- The measurement and monitoring of water supply, sanitation and hygiene (WASH) affordability: a missing element of monitoring of sustainable development goal (SDG) targets 6.1 and 6.2 (2021)
- UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) 2019 report (2019)

Drinking-water quality and safety

- Water safety plan manual 2nd edition (2023)
- State of the world's drinking water: an urgent call to action to accelerate progress on ensuring safe drinking water for all (2022)
- Guidelines for drinking-water quality: Fourth edition incorporating the first and second addenda (2022)
- Guidelines on recreational water quality: Volume 1 coastal and fresh waters (2021)
- Toxic cyanobacteria in water, 2nd ed. (2021)
- Domestic water quantity, service level and health (2020)
- Safer water, better health (2019)
- Climate-resilient water safety plans: Managing risks associated with climate variability and change (2017)
- Protecting surface water for health (2016)

Sanitation

- Sanitation safety planning - Second edition (2022)
- State of the world's sanitation: An urgent call to transform sanitation for better health, environments, economies and societies (2020)
- Discussion paper: Climate, sanitation and health (2019)
- Guidelines on sanitation and health (2018)

WASH in HCFs and schools

- WASH FIT: A practical guide for improving quality of care through water, sanitation and hygiene in health care facilities. Second edition (2022)
- WASH FIT manual for trainers (2022)
- Global analysis of health care waste in the context of COVID-19 (2022)
- Checklists to assess vulnerabilities in health care facilities in the context of climate change (2021)
- WHO guidance for climate-resilient and environmentally sustainable health care facilities (2020)
- Global progress report on WASH in health care facilities: Fundamentals first (2020)

Integration of WASH and other health programmes

- Ending the neglect to attain the sustainable development goals. A global strategy on water, sanitation and hygiene to combat Neglected Tropical Diseases 2021–2030 (2021)

Climate change and health

- Health and climate change country profiles (2022)
- 2021 WHO health and climate change survey report (2021)
- COP26 special report on climate change and health: the health argument for climate action (2021)
- Climate change and health: vulnerability and adaptation assessment (2021)
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- Quality criteria for the evaluation of climate-informed early warning systems for infectious diseases (2021)
- Compendium of WHO and other UN guidance on health and environment (2021)
- Climate change and health research: Current trends, gaps and perspectives for the future (2021)
- Health in National Adaptation Plans (2021)
- Quality criteria for Health National Adaptation Plans (2021)
- WHO global strategy on health, environment and climate change (2020)
- Health in National Determined Contributions (NDCs): a WHO review (2020)
- Technical series on adapting to climate sensitive health impacts: undernutrition (2019)
- Global climate change and child health: training for health care providers (2019)
- Operational framework for building climate-resilient health systems (2015)

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