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Global Water Partnership

WASH Climate-Resilient Development

Technical Brief

Climate-Resilient Sanitation in Practice

Global Green Growth Institute

UN HABITAT FOR A BETTER URBAN FUTURE

Bill & Melinda Gates foundation

World Health Organization

UTS UNIVERSITY OF TECHNOLOGY SYDNEY

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Contents

Acronyms

AE	Accredited Entity
AF	Adaptation Fund
AFD	The French Development Agency
AfDB	African Development Bank
BOAD	West African Development Bank
COP	Conference of Parties
CLTS	Community-led Total Sanitation
CSO	Civil Society Organization
CWIS	Citywide Inclusive Sanitation
DAE	Direct Access Entities
DBSA	Development Bank of Southern Africa
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIZ	German Development Agency
GWP	Global Water Partnership
IPPC	Intergovernmental Panel on Climate Change
JMP	Joint Monitoring Programme
JICA	Japan International Cooperation Agency
M&E	Monitoring and Evaluation
NAP	National Adaptation Plan
NDA	National Designated Authority
NDC	Nationally Determined Contribution
SDGs	Sustainable Development Goals
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children’s Fund
UT-S	University of Technology, Sydney
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Executive summary

Climate change is drastically changing the world we live in. It devastates lives, causes changes in the environment, undermines progress made in improving access to sanitation, and hampers achieving the goal of universal access to climate-resilient sanitation. Addressing this ongoing threat is slowed by a general lack of understanding of the threat posed by climate change to sanitation services and how sanitation contributes to greenhouse gas (GHG) emissions. Climate change impacts sanitation by damaging service delivery through floods, sea-level rise and extreme weather hampers the effectiveness of sewerage treatment systems. Additionally, poorly managed sanitation emits GHG. Many national policies focused on water, sanitation and hygiene (WASH) and/or climate change neither prioritize sanitation's climate response nor do sanitation programmes incorporate climate-resilient approaches. The sanitation sector still lags in adapting to the impacts of climate change and taking advantage of major climate funding opportunities.

The objective of this technical brief is to help sector stakeholders better understand the rationale for climate-resilient sanitation, approaches to climate-resilient sanitation, and available resources for programming. It provides information and examples on: i) incorporating climate resilience into sanitation programming; ii) available resources that support a better understanding of the rationale for including climate resilience in sanitation; and iii) opportunities for climate financing and how the WASH sector can better access it.

The brief supports the implementation of the Strategic Framework on WASH Climate Resilience and is aimed at key sector stakeholders, including;

- Governments (national and sub-national);
- Development partners (international agencies and civil society organizations (CSOs));
- International financial institutions;
- Foundations;
- Academic and other research institutions;
- Private sector partners; and
- Climate activists (including youth and most-affected communities).

Key recommendations outlined in the brief include:

- The sanitation sector must unite in actively addressing climate change, through advocacy and action for adaptation and mitigation in all aspects of their work.
- The sector needs stronger climate-risk analysis to better direct policy efforts, mitigation and adaptation approaches, and to attract financing.
- Climate resilience should be incorporated in sanitation policies, legislation, strategies, plans, budgets, systems and services at national and sub-national levels; governments should increase their political commitments to provide climate-resilient sanitation services for the poorest and most climate-change-affected communities.
- Governments should incorporate climate-resilient sanitation in climate policies and plans, including Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs) as a demonstration of commitment and a major step towards supporting the mobilization of the financing required to support resilient sanitation services at scale.
- Mobilize domestic resources and leverage new financing options (including from the private sector). The sanitation sector suffers from chronic underinvestment, particularly from climate financing, and utilities have low creditworthiness, which inhibits their access to commercial finance. Accessing climate financing is possible for sanitation if proposals have a strong climate rationale and are technically viable and sustainable.
- Build the capacity of sector professionals, and strengthen institutional and regulatory systems to plan and promote appropriate climate-resilient sanitation approaches and services.
- Support more evidence generation on the impact of climate change on sanitation through additional research and documentation of mitigation, impacts and adaptation responses. This will support a better understanding of the link between sanitation and climate change, strengthen funding proposals, and help mainstream climate resilience in sanitation programmes.

- Strengthen institutional systems and capacity for data collection, research and measurement on the impact of climate change on sanitation for a better, more robust and functional monitoring and evaluation system for climate-resilient sanitation.
- Support social mobilization campaigns to increase awareness on climate change's impact on sanitation systems and the role resilient sanitation services play in strengthening community resilience to climate-related shocks and stresses.

This technical brief focuses on sanitation and climate change to make the document brief and does not include other related areas, such as sanitation in institutions (i.e., schools and health care facilities) or humanitarian response. These are important topics that warrant their own briefs.

1. Introduction

The world is on the brink of a climate crisis. Temperatures are increasing, floods and droughts are intensifying, and sea-levels are rising, with disastrous impacts on people around the globe. The release of the Intergovernmental Panel on Climate Change (IPCC) AR6 Report highlights the severity of the situation, with the United Nations Secretary-General declaring a "code red for humanity."

Low-income communities are the most vulnerable to the climate-related impacts of disrupted sanitation systems. These communities often live in flood-prone areas and are highly impacted by drought and other extreme climatic events. Subsequently, they are most impacted by waterborne diseases and the financial loss associated with non-resilient systems.[1] Climate-resilient sanitation must be prioritized for the most vulnerable, as climate-resilient sanitation services offer a major opportunity to strengthen livelihoods and equity. The IPCC concluded that "the most effective measures to reduce vulnerability in the near term are programmes that implement and improve basic public health measures such as provision of clean water and sanitation."[2]

The brief provides examples and case studies on how to improve the climate resilience of sanitation systems (adaptation) and reduce their climate impact (mitigation). The brief is aimed at sector partners, including governments, development partners, academic (and other research) institutions, the private sector, international financial institutions and climate activists, including youth and the most climate-affected communities.

The brief is accompanied by a **Call to Action** developed by sector partners. It calls on governments and the sanitation sector to take urgent and immediate action to tackle the climate crisis, across the entire sanitation service chain, in urban and rural areas, and across all settings (e.g., homes, schools, clinics, markets, etc.).

Box 1: Future climate projections

- Sea-level rise will displace more than 2 billion people by 2100, creating people displaced in the context of climate change.[3]
- Riverine flooding will displace around 50 million people each year by 2100.[4]
- 700 million people will live in regions suffering from extreme drought by 2100.[5]

These climate projections will likely impact sanitation through the destruction of sanitation infrastructure, disruption of service delivery and displacement of people, making it difficult for them to access safe sanitation services.

1 United Nations Children's Fund, 'Thirsting for a Future: Water and children in a changing climate', New York; UNICEF, 2017. https://www.unicef.org/reports/thirsting-future

2 Intergovernmental Panel on Climate Change, 'Climate Change 2014: Impacts, Adaptation, and Vulnerability', New York; IPCC, 2014.

3 Friedlander, B., 'Rising seas could result in 2 billion refugees by 2100', Connell Chronical, 19 June 2019. https://news.cornell.edu/stories/2017/06/rising-seas-could-result-2-billion-refugees-2100

4 Internal Displacement Monitoring Centre, 'Assessing the impacts of climate change on flood displacement risk', December 2019. https://www.internal-displacement.org/publications/assessing-the-impacts-of-climate-change-on-flood-displacement-risk

5 World Health Organization, 'Drought fact sheet", 2021. https://www.who.int/health-topics/drought#tab=tab_1?

Table 1: Key sanitation climate definitions

Acute shocks	Sudden, intense events that threaten a community and their sanitation systems (e.g., rapid onset flooding, hurricanes, landslides, fires and infrastructure failures).[6]
Chronic stresses	Longer-term stresses (e.g., poverty, chronic water scarcity, conflict), which may weaken the fabric of a community over time, leading to an impact on sanitation services.[7]
Climate Adaptation	"The process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities" (IPCC 2022). Examples include improving siting or design, such as raising and sealing latrines in flood-prone areas, providing alternative portable facilities during climate events, and developing early warning systems for operators of treatment plants.
Climate Mitigation	Efforts to reduce or prevent the emission of GHG from sanitation systems (e.g., capturing biogas and incorporating renewable technologies into the sanitation service chain).

Photo 1: © UNICEF/UN052114/Brazier

6 ResilienceTools.org, 'Terminology'. http://resiliencetools.net/node/14

7 Resilient Cities Network, 'What is urban resilience?', 2020.

2. The relationship between climate change and sanitation

Sanitation and climate change have a close inter-relationship. Climate change impacts sanitation through the damage and disruption of sanitation facilities and services, dislocation of people and hampering treatment due to rising temperatures and intermittent power supply. This impact is most likely to have the biggest impact on populations already in fragile contexts. Poorly-managed sanitation contributes to GHG through the breakdown of excreta to methane, transportation emissions, and the energy required for treatment.

Health, socioeconomic and service impacts

The impact of climate change on sanitation depends on the sanitation solution technologies being used, sanitation behaviours being promoted, the level of services offered and capacity available to anticipate and respond. Floods, droughts, storms, landslides, fires and rising sea levels (with associated saline intrusions) can destroy non-climate-resilient sanitation systems. While it is impossible to climate-*proof* sanitation systems, climate *resilience* can be embedded in the

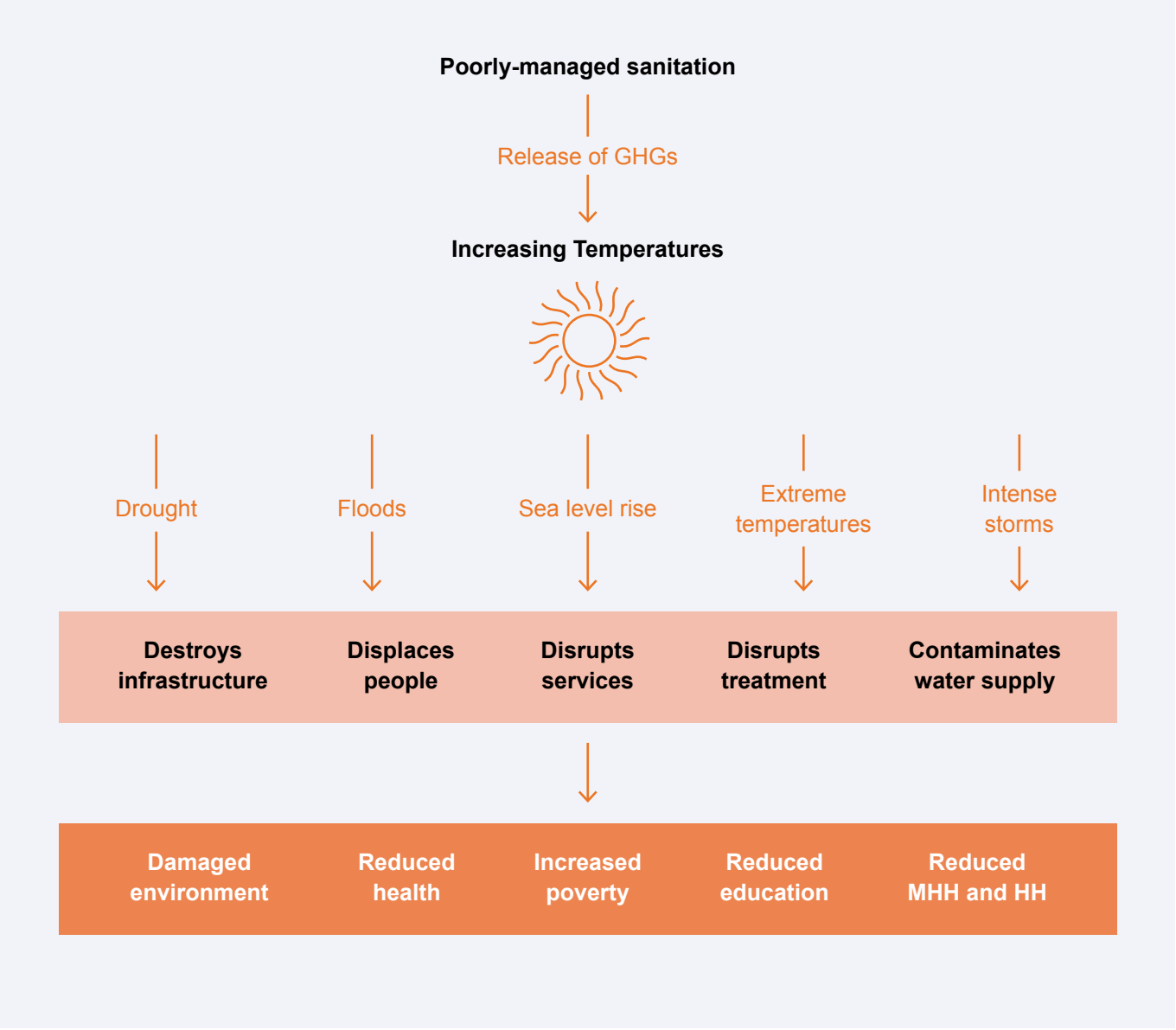


Figure 1: The relationship between sanitation and climate change

service by anticipating alternative ways to continue providing service or reducing the time to recovery.

Wastewater treatment systems may cease to function in the face of drought, extreme temperatures, or, in the case of flooding and sea-level rise, become inundated and contaminate communities. This, in turn, can result in contaminated water, leading to an increase in waterborne diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio.[8]

A reduction in water availability also makes sanitary practices more challenging.[9] Behaviour change campaigns, such as Community-led Total Sanitation (CLTS), rarely include climate change or climate-resiliency messaging and skills. This limits their effectiveness in areas where access to water is impacted by flooding and water scarcity (e.g., if latrines are constantly flooded and collapse each year, households may be reluctant to rebuild, forcing them to revert back to open defecation).

Flooding can also impact non-climate-resilient faecal sludge management services, especially in urban and peri-urban areas that tend to have more faecal sludge than rural areas, disrupting the whole sanitation service chain. Flooding negatively impacts the access of emptying vehicles to communities and houses to collect and transport waste. Non-climate-resilient sewer systems are highly vulnerable to extreme temperatures that impact the digesters, power supply disruption due to climate events and flooding. The risk of damage is high, particularly when drainage systems are irregularly connected to sewerage or when there is poor solid waste collection and sea-level rise. Non-climate-resilient wastewater treatment plants are also highly vulnerable to inundation due to floods, especially if they are in low-lying areas or on the coast.

Additionally, climate change is leading to a growing number of people being displaced due to climate change. These people often resettle in areas of higher climate risk and poor access to WASH facilities or increase the burden on already overstretched facilities. This makes safe practices a challenge and increases vulnerability to diseases.

Strengthening climate resiliency and behaviours along the whole sanitation service chain is likely to improve community resilience, lessening the impact of climate change and improving the health, livelihoods, and socioeconomic well-being of people, as well as boosting efficient utilization of water resources through wastewater reuse.

Environmental impacts

Non-resilient sanitation directly releases effluent containing nitrogen and phosphorus from human urine and faeces[10] into the environment during periods of heavy rain and flooding. In addition to contaminating drinking water, this can also lead to eutrophication, where major nutrient imbalances across ecological systems promote algae growth and deplete oxygen in water systems. These harmful algal blooms are toxic to humans, kill fish and other aquatic life, which in turn impacts livelihoods.

Sanitation and greenhouse gas emissions

Data on GHG emissions due to sanitation are sparse, and there is a strong need for more timely data on the issue. A 2022 report estimates that global methane emissions from non-sewered sanitation systems are equivalent to approximately 377 metric tons of carbon dioxide per year, or 4.7 per cent of global anthropogenic methane emissions.[11] In 2019, the US Environmental Protection Agency estimated that GHGs emitted by wastewater treatment plants would amount to 632 metric tons of carbon dioxide per year in 2020.[12] Methane and nitrous oxide are the most significant GHG emitted by sanitation systems,[13] and have heating potential 25 and 300 times greater (respectively) than carbon dioxide. They are directly produced from faecal matter as a result of anaerobic processes. Carbon dioxide is also produced from aerobic processes (e.g., using oxygen during wastewater treatment), but is less impactful due to the stronger climate-changing nature of methane and nitrous oxide.

8 World Health Organization, 'Sanitation fact sheet', Geneva: WHO, http://www.who.int/mediacentre/factsheets/fs392/en/

9 United Nations Children's Fund, 'Thirsting for a Future: Water and children in a changing climate', New York; UNICEF, 2017. https://www.unicef.org/reports/thirsting-future

10 Sustainable Agriculture Research and Education, 'Practical strategies for reducing ammonia volatilization from urine-derived fertilizers', SARE, April 2022. https://projects.sare.org/project-reports/one18-318/

11 Cheng, S., et al. 'Non-negligible greenhouse gas emissions from non-sewered sanitation systems: A meta-analysis' Environmental Research, Volume 212, Part D, 2022. https://www.sciencedirect.com/science/article/pii/S0013935122007952

12 United States Environmental Protection Agency, 'Global Non-CO2 Greenhouse Gas Emission Projections & Mitigation: 2015–2050', Washington. DC: USEPA. 2019/

13 Reid, MC et al. 'Global methane emissions from pit latrines', Environmental science & technology, vol. 48,15 (2014): 8727-34.

Box 2: Safely managed versus climate-resilient sanitation systems

In 2015, the WHO/UNICEF Joint Monitoring Programme (JMP) added safely managed sanitation services to the ladder used for global monitoring. Safely managed sanitation is defined as an "improved sanitation facility that is not shared with other households from which excreta are either safely disposed of in situ or transported and treated off-site".

Both on-site sanitation systems and sewer-connected systems can be safely managed as long as waste is effectively contained and treated. **However, just because a sanitation system is "safely managed", does not make it climate resilient, and vice versa.** Basic and limited sanitation can also be climate resilient, though they would not be considered safely managed. For this reason, the JMP is exploring potential new indicators that could be used for future national and global monitoring of climate-resilient sanitation services.

In 2020, more people used on-site sanitation than sewered connections for the first time.[14] Use of pit latrines is progress for improving health via the reduction of open defecation. However, researchers report that, "[E]very person…who abandons open defecation and uses non-sewered sanitation systems would add about the equivalent of 111 kg of carbon dioxide per year, which means an increase of 55 metric tons of carbon dioxide equivalency per year when open defecation is completely eliminated".[15] This potential impact can be mitigated through increasing the implementation of safely-managed sanitation that is regularly emptied or used as biogas.

As such, progress toward universal access to both basic and safely-managed sanitation services, combined with population growth in urban areas, requires a shift in how sanitation services are designed and delivered to carefully assess the trade-offs between minimizing sanitation-related GHG emissions and providing affordable safely-managed sanitation for all. In the face of these challenges, the sector must develop and promote appropriate climate-resilient sanitation systems that minimize emissions while working towards access to universal safely-managed sanitation.

Key messages from this section include:

- **Climate change and sanitation are intrinsically intertwined.** Poorly managed sanitation emits significant GHGs, contributing to the global climate crisis. At the same time, climate change is damaging sanitation services and infrastructure, and displacing people into areas with limited access to safely-managed sanitation.
- **Climatic impacts on sanitation damage human and environmental health.** Damaged sanitation systems expose communities to harmful pathogens, and release effluent into waterways, negatively impacting ecosystems.

Photo 2: © UNICEF/UN0388662/Panjwani

14 World Health Organization and the United Nations Children's Fund, 'Progress on household drinking water, sanitation and hygiene 2000-2020: five years into the SDGs' Geneva: WHO, 2021.

15 Cheng, S., et al. 'Non-negligible greenhouse gas emissions from non-sewered sanitation systems: A meta-analysis' Environmental Research, Volume 212, Part D, 2022. https://www.sciencedirect.com/science/article/pii/S0013935122007952

3. What is climate-resilient sanitation?

Climate-resilient sanitation refers to sanitation systems (both non-sewered and sewered), services and behaviours which can survive, function or quickly recover in the face of a range of climate-related shocks, chronic stresses and seasonal variabilities, ensuring that faecal matter is safely contained throughout the sanitation service chain[16] (see Figure 2) and does not contaminate the environment, emit excessive GHGs or cause risk to public health. Ideally, climate-resilient sanitation both adapts to climate change and mitigates contributions to climate change simultaneously.

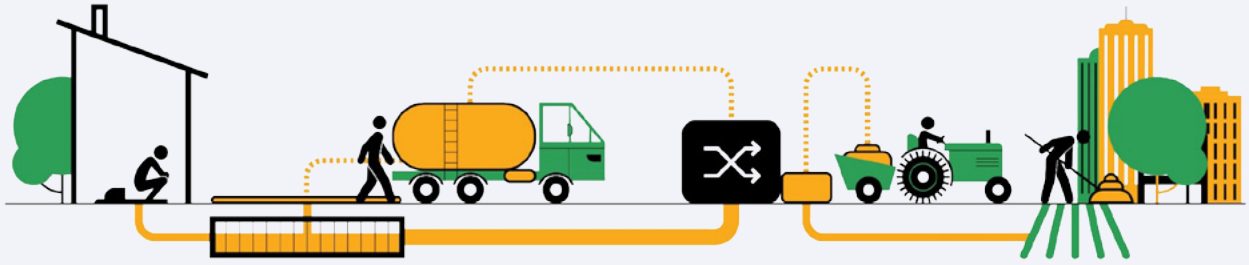
Climate-resilient sanitation ultimately strengthens the overall resilience of communities and households, allowing the continuation of essential public health services in the face of climate-related crises. As such, resilience to climate change is important for sanitation, just as resilient sanitation is also important for community resilience.[17]

It is important to be clear about the rationale for climate-resilient sanitation, and to differentiate it from non-climate-resilient approaches. Below are two examples of the rationale for climate-resilient sanitation, one for adaptation and one for mitigation:

Adaptation

Given the urgency the world is facing with climate change, the sanitation sector should prioritize adaptation approaches. This will help strengthen the sustainability of this essential service and human right that underpins all aspects of health and the economy.

All steps of the sanitation service chain are vulnerable to climate change. However, a key challenge for the sector is the limited data on the relative risk and impact on each component of the service chain and the costs for adaptation.



Toilet →	Containment - Storage/Treatment →	Conveyance →	Treatment →	End use/Disposal
Non-resilient toilets and containment systems are destroyed and non-functional during floods, droughts, storms, landslides and directly release effluent into the environment		Flooding negatively impacts the access of emptying vehicles to communities and houses to collect and transport waste.	Wastewater treatment systems may cease to function in the face of drought, extreme temperatures, or, in the case of flooding and sea-level rise, become inundated and contaminate communities.	Climate change negatively impacts the efficient utilization and reuse of wastewater

Strengthening climate resiliency and behaviours along the whole sanitation service chain is likely to improve community resilience and lessening the impact of climate change

Figure 2: Sanitation service chain

16 IRC, 'What does sanitation systems strengthening mean?', IRC: 2019. https://www.ircwash.org/news/what-does-sanitation-systems-strengthening-mean

17 United Nations Children's Fund and Global Water Partnership, 'WASH Climate Resilient Development, Linking risk with response: options for climate resilient WASH', New York: UNICEF, 2017.

Box 3: Climate-resilient sanitation criteria

From a technical standpoint, a sanitation system and service could be considered climate-resilient if the following criteria are met:

- Risk analysis (hazard, exposure, vulnerability and capacity) identifies potential impacts of climate and extreme weather events, and preventive measures have been incorporated.
- Mitigation measures to reduce the risk of sanitation system failure are identified and put in place.
- Sanitation services and systems are designed for reliability, flexibility, robustness and responsiveness to seasonal variability and extreme weather events (e.g., during droughts/ floods) or quick recovery after a shock.
- Contingency plans and capacity are in place to anticipate, cope with and respond to climate shocks, while ensuring minimal disruption to services.
- Where possible, emissions are reduced (e.g., biogas capture), and wastewater is effectively treated and water reused, using low-carbon or nature-based solutions.

The rationale for climate-resilient sanitation needs to be strengthened with additional evidence for each step.

Flooding, fires, storms, temperature change, droughts, landslides and sea-level rise all risk damaging **capture**, **containment**, **transport** and **treatment** infrastructure. These same hazards impact sanitation services of **emptying**, **transport** and **disposal/reuse**. Additionally, chronic events, such as drought and sea-level rise, contribute to forced migration, driving people to settle in climate-vulnerable areas where safely-managed sanitation services are unavailable.

The United Nations High Commissioner for Refugees (UNHCR) reports that over 20 million people leave their homes due to climate change annually.[18] We can assume a significant number–if not all–of these people face challenges in accessing climate-resilient sanitation.

The impact of these events is that people likely move down the sanitation ladder, and have access to a lower level of service or lose access to safely-managed sanitation. This results in sanitation contaminating water supplies and waterways, increased mortality and morbidity due to diarrhoeal diseases, and potentially increased GHG emissions from poorly-managed sanitation.

A recent study in Indonesia found that faecal contamination from unprotected septic tanks occurred during periods of heavy rainfall and flooding, contaminating 90 per cent of households' drinking water, despite 85 per cent of the population reportedly having access to improved water sources.[19] A further study on the impacts of climate events on sanitation in four cities also showed flooding and water shortages reduced access to toilets multiple times per week for 29 per cent of drought-impacted households and 11 per cent of flood-impacted households, with 50 per cent of surveyed drought-affected households returning to open defecation. In Basra, Iraq, at least 118,000 residents required hospital treatment in 2018 after drinking water polluted with sewage and toxic waste driven by unusual flooding coupled with ineffective water treatment.[20] Note that these data are critical to developing a rationale for climate-resilient sanitation, but to avoid biasing interventions towards data-strong environments, resources need to be directed towards improving data collection systems in weaker areas.

Based on this situation, the rationale for climate-resilient sanitation adaptation actions is to implement solutions that, for example, minimize damage to sanitation infrastructure and services. This may include developing a market for elevated latrines, with accessibility ramps, that are both resistant to flooding and accessible for persons with disabilities.

18 United Nations High Commissioner for Refugees, 'Climate change and disaster displacement', Geneva: UNHCR, 2021. https://www.unhcr.org/en-us/climate-change-and-disasters.html

19 Odagiri, M. et al. 'Safely managed on-site sanitation: A national assessment of sanitation services and potential fecal exposure in Indonesia', *International Journal of Environmental Research and Public Health*; vol. 18,15 8204. 3 Aug. 2021.

20 Human Rights Watch, 'Basra is thirsty: Iraq's failure to manage the water crisis', New York: HRW, 2018. https://www.hrw.org/report/2019/07/22/basra-thirsty/iraqs-failure-manage-water-crisis#

Mitigation

As noted above, the current management of the sanitation value chain in most developing economies is a significant emitter of GHGs. While data on the sanitation-related emissions of GHGs are limited (but growing), a recent assessment of Kampala, Uganda, estimates that sanitation produces 189 kilotons of carbon dioxide equivalent annually, which represented over 50 per cent of the city's total emissions.[21]

Table 2 provides a simplified analysis of the primary GHG emitters along the sanitation value chain in Kampala.

Table 2: GHG emissions from Kampala, Uganda due to sanitation

Category	CO_2 kt equivalent / year[22]
Containment	145.00
Treatment	36.00
Embedded carbon, containment	3.00
Operational emissions, treatment	3.00
Embedded carbon, sewers	1.00
Transport	0.50
Embedded carbon, treatment	0.06
Total	**188.56**

From this assessment, the rationale for climate-resilient sanitation mitigation action is to improve containment technologies and practices to limit GHG emissions. Potential activities include improving pit design and/or more frequent desludging as well as opportunities for carbon credits[23].

Some of the key messages from this section include:

- **Climate-resilient sanitation protects the entire service chain.** It is resistant to damage from climate events, enables rapid recovery and reduces GHG emissions.
- **Climate-resilient sanitation encompasses both mitigation and adaptation.** Mitigation involves reducing the emission of GHGs, while adaptation refers to minimizing the impacts of climate events on sanitation service delivery.

21 Johnson, J. et al. 'Whole-system analysis reveals high greenhouse-gas emissions from citywide sanitation in Kampala, Uganda', *Commun Earth Environ* 3, 80 (2022).

22 Adapted from ibid.

23 Carbon credit is a generic term for any tradable certificate or permit representing the right to emit a set amount of carbon dioxide or the equivalent amount of a different greenhouse gas (tCO2e): https://en.wikipedia.org/wiki/Carbon_credit

4. Integrating climate resilience into sanitation programmes

This section provides guidance on integrating resilience and mitigation into sanitation programmes using the Strategic Framework on WASH Climate Resilience (Figure 3).[24] The Global Climate Fund (GCF) recommends the use of this framework when developing WASH-related climate proposals. Note that there is no universal blueprint for creating a climate-resilient sanitation service as climate change manifests itself differently around the globe. As such, countries, regions and communities vary in terms of hazards, preparedness and capacity to respond to climate change and interventions must be planned accordingly.

Understanding the problem

The framework emphasizes understanding the situation at a national or sub-national level before taking action, as well as reviewing historic records, current situations and future scenarios. Carrying out a WASH climate risk assessment is an important first step in understanding the situation and the programme planning process. This evidence is vital, not just to maximize impact, but to form the basis of developing the climate rationale[25] for both advocacy and financing. Other tools, such as the WHO sanitation safety planning approach can be used to assess risk (with a focus on hazards and capacity

Figure 3: Strategic framework for WASH climate-resilient development

24 United Nations Children's Fund and Global Water Partnership, 'WASH Climate Resilient Development Strategic Framework. 2014', New York: UNICEF, 2017.

25 Climate rationale is the established link between climate risks and solutions to reduce these risks.

constraints) and management across the sanitation service chain.

Assessments need to identify the risk to the sanitation system and service. It should also include the calculation of sanitation-related emissions and the future potential for mitigation activities within the programme. Box 4 provides examples of several tools that can be used to calculate emissions across all elements of the sanitation programme.

Box 4: Tools for calculation sanitation-related emissions

- The World Bank has developed a Greenhouse Gas Accounting Tool that can be used to show which elements of a WASH programme contribute the most to emissions, compared to a baseline. This includes emissions from constructed latrines.
- The Climate and Costs in Urban Sanitation project is in the process of developing models to enable an accurate estimation of GHG emissions from a range of sanitation systems. A breakdown of emissions by sanitation storage type can be found here.
- The Energy Performance and Carbon Emissions Assessment and Monitoring Tool is able to provide accurate energy and emissions data sets for each segment of the sanitation service chain.
- The IPCC's Inventory Software implements the simplest Tier 1 methods in the 2006 IPCC Guidelines for National GHG Inventories, and, as such, is useful for calculating emissions under the waste and energy sectors.

Priority interventions and actions include:

- Reviewing existing guidance and tools for risk assessment and adapting or adopting the tools to the local context. Make sure to include the entire sanitation service chain, and not just the infrastructure.
- Conducting risk assessments based on the tools agreed upon by sector stakeholders. Depending on the existing capacity, conduct orientations or training on the use and application of the tools.
- Conduct stakeholders' validation of the risk assessment report.
- Identify potential solutions for addressing adaptation and mitigation needs.
- Develop plan of actions for the implementation of the key findings that should be incorporated into the sectoral workplan and annual workplans of relevant government ministries, departments and agencies.

Identify and appraise options

With a better understanding of the problems through the sanitation climate risk assessment, the framework's next step is to conduct an appraisal of potential programming responses. The identified approaches and solutions should be appropriate to the wide range of current and projected climatic conditions and trends identified in the risk assessment, starting with the known risks, based on the specific needs of a community or region.

In the case of climate-resilient sanitation, this means there usually should be a focus on resilience to storms, floods, drought, water scarcity, fire, temperature extremes, landslides and, in the case of coastal communities, sea-level rise.

Building from a prioritized list of options, at this point programme designers are able to develop an informed intervention. The Linking Risk with Response technical brief provides guidance for countries to identify and prioritize climate-resilient solutions after having conducted risk analysis. When developing a climate-resilient programme, it is important to incorporate climate-resilient sanitation options across all levels: enabling environments, national, sub-national and local levels, as well as behaviour change, demand generation, financing and monitoring.

Deliver solutions

Delivering the identified climate-resilient sanitation solutions at scale requires strong political commitment, an enabling policy environment, institutional and system strengthening, capacity development, mobilization of domestic funding, innovative financing and a functional monitoring and evaluation framework.

Integrating climate-resilient sanitation into national policies, legislation and plans

Integrating climate-resilient sanitation into national policies, legislation and plans is a crucial first step in ensuring these climate-resilient programming and mitigation solutions can be taken to scale. It is vital that the risk posed by climate change is included in sanitation policy and legislation, and similarly, that sanitation is included in climate policy and legislation

at both the national and sub-national levels (and that these are included as national climate priorities).

In recent years, countries have committed to tackle climate change and strengthen resilience through multiple international agreements, the most significant of which, for the sector, are the Sustainable Development Goals (SDGs) and the Paris Agreement. These agreements provide an opportunity for the sanitation sector to engage with climate partners at the international and national levels, and ensures that sanitation has a seat at the climate table.

The implementation phase of the Paris Agreement focuses on parties working to define and enact their NDCs. These, together with other key national and multi-sectoral strategies and plans, such as the NAPs and National Communications provide the framework for defining national priorities for climate action, with the potential to guide both adaptation and mitigation interventions within the WASH sector. Both NDCs and NAPs offer an important opportunity to integrate climate-resilient sanitation and mitigation into the climate agenda.

Including sanitation in a country's NDCs and NAPs are critical prerequisites when applying for major climate financing. Countries that have included a significant number of sanitation-related actions in their NDCs include Angola (see Box 5), Jordan, Morocco, Nepal and Senegal. In several cases, this has allowed countries to secure climate financing for sanitation. Examples of NAPs with a climate-resilient sanitation component include Fiji, Timor Leste, State of Palestinian and Sudan. (Note that while NDCs are revised every five years, NAPs do not have a timescale.)

Other available guidance for integrating sanitation into climate policy include:

- Integrating climate resilience into national WASH strategies and plans (UNICEF-Global Water Partnership (GWP), 2017).
- The Sanitation and Water for All briefing note on adapting to climate change and fostering a low carbon water and sanitation sector.
- Guidance on improving institutional and management arrangements in urban settings, developed by the University of Technology Sydney and SNV.

Box 5: Sanitation in Angola's NDC (2021)

Angola explicitly includes sanitation in its 2021 NDCs. Key adaptation priorities include:

- Prioritizing climate-resilient WASH in communities that lack access to basic sanitation and/or are exposed to increasing incidence of floods and soil erosion.
- Ensuring that WASH infrastructure, services and behaviours are sustainable, safe and resilient to climate-related risks.
- Creating WASH systems that connect communities with local authorities to integrate them into response plans.
- Ensuring the use of renewable energy for sanitation operations to lower GHG emissions, and energy generation from waste.

Strengthening institutional systems and capacity for climate-resilient sanitation

A core component of the sanitation climate risk assessment should look at institutional arrangements and capacity needs. This includes understanding the accountabilities within the government for climate-resilient sanitation, coordination mechanisms required to deliver effective climate-resilient sanitation, and whether there is sufficient capacity throughout the sanitation service chain for climate-resilient sanitation.

Different frameworks and tools have been developed to diagnose and address systemic challenges. Sanitation and Water for All and its partners have developed an effective strategy "focused on the development of strong systems and adequate sector capacity to achieve transformational change". It is based on five building blocks that capture the key elements that the sector must have in place to deliver sustainable services: sector policy strategy; institutional arrangements; sector financing; planning, monitoring and review; and capacity development. These building blocks are useful tools in developing a programme targeting institutional systems.[26] In addition, UN-Water developed the SDG 6 Global Acceleration Framework in 2020 to address the slow progress toward SDG 6 and to accelerate coordinated action. The framework is comprised of five pillars: governance; finance; data and information; capacity development; and innovation.

26 Sanitation and Water for All, 'Building Blocks', SWA: https://www.sanitationandwaterforall.org/about/our-work/priority-areas/building-blocks

The WASH Bottleneck Analysis Tool (WASHBAT) has been developed to analyse the complex interplay of institutional structures and processes that determine how effectively human, material and financial inputs are turned into sustainable access to drinking water supply and sanitation.

In cases where institutional arrangements are weak, there should be deliberate efforts at building the capacity of sector professionals and strengthening government systems at national and sub-national levels. This should increase their understanding of the risks posed by climate change and the integration of sanitation into the climate rationale for effective planning, delivery and management of appropriate climate-resilient sanitation solutions.

Delivering climate-resilient sanitation at scale requires sufficient skilled sector professionals. This requires not just training but human resource development, learning exchanges, South-South cooperation, research, innovation and the production and dissemination of appropriate guidance and tools. The plan should ensure that there is adequate capacity targeted at gaps in the service chain to support the resilience of sanitation systems and behaviours in the face of climate-related shocks, chronic stresses and seasonal variabilities. Capacity building at a policy level can also result in a strong national-level climate rationale.

Integrating climate options into sanitation programming

Adaptation: Making sanitation technologies and services resilient

All major sanitation systems can, to varying degrees, be adapted to reduce climate risk. In many cases, the adaptation options available, and the governance arrangements in which they are embedded, are all 'no regret' options. This means that they are desirable and sustainable, regardless of future climate change. Additionally, donors and financing institutions increasingly require that the services they finance be sustainable, climate-resilient and compliant with environmental and social safeguards.

The selection of appropriate sanitation technologies and services should be based on screening their vulnerability and adaptability to different climate scenarios. The selected climate-resilient sanitation technologies and services should have relatively low vulnerability and high adaptability to climate change (as well as follow standard good sanitation design practices).

For flooding, this might involve the following:

- Site latrines, storage and treatment facilities away from areas of known and projected flood risk and down gradient from drinking water sources.
- Adapt or design new sanitation systems (e.g., elevated latrines, non-return valves on septic tanks, separate sewage and stormwater removal and improve drainage).
- Adopt high-quality construction standards, methods and materials (including roofing) in flood-prone areas, and conduct contingency planning in case of severe environmental conditions or service interruption. See Box 6 for a case study on a flood-resilient sanitation system.

Box 6: Flood-resilient containment and capture: Peru's EcoSan Bathroom Systems

In Peru, UNICEF works with rural Amazonian communities to address the regular and severe flooding they face because of climate change.

Dry ecological bathroom systems (Baños Ecológicos Secos, in Spanish) are a new type of climate-resilient latrine. The design integrates three important components: composting latrines; rainwater harvesting; and greywater treatment and retention. Additionally, the design uses durawood to tolerate high humidity levels and connect the sanitation facilities to elevated homes to maintain access during floods.

The systems are elevated, secure, easy to install and use, and rely on affordable, locally available and appropriate materials and technologies.

Photo 3: The Baños Ecológicos Secos in Peru. ©UNICEF

In water-stressed areas, the following sanitation systems could be promoted:

- Low- or no-water use technologies.
- Modified and/or decentralized sewerage systems.
- Water reuse and stormwater management to capture all available water.
- Wastewater treatment processes that can function effectively with reduced dilution.

Integrating climate resilience into community behaviour change programmes

Over the past decade, behaviour change programmes have enabled hundreds of millions of people to gain access to basic sanitation. Few of these programmes have incorporated climate resilience and the facilities provided are often vulnerable to the impacts of climate change, particularly flooding. When non-climate-resilient facilities are damaged, households frequently revert to unsafe sanitation, harming their health, the environment, and adding to GHG emissions.

To tackle this issue, climate-resilience messaging and capacity building must be incorporated into the behaviour change programmes from the planning stage. For example, UNICEF Bangladesh mainstreamed climate change into its sanitation programming through three linked strategies: i) creating demand for climate-resilient sanitation in the ongoing CLTS programme; ii) promoting and expanding the supply and installation of climate-resilient sanitation designs and products through sanitation marketing; and iii) providing climate-resilient sanitation services with a focus on constructing flood-resilient latrines in vulnerable areas. In 2021, UNICEF Bangladesh supported 529,000 people access climate-resilient sanitation services using these three strategies.[27]

Photo 4: © UNICEF/UN0348926

Other available guidance and resources include:

- Linking risk with response: Options for climate-resilient WASH, (GWP and UNICEF, 2017);
- Climate change response for inclusive WASH: A guidance note, (University of Technology, Sydney and Plan International, Indonesia 2020); and
- Rural sanitation and climate change: Putting ideas into practice, (IDS and University of Technology, Sydney 2021).

Mitigation: Integrating options for mitigation into sanitation programmes

Human waste and sanitation systems are important contributors to GHG emissions. While some emissions from the sanitation sector are unavoidable, the sanitation sector can still play an important role in mitigating global emissions. Additionally, the reuse of grey water in sanitation can lessen the strain on water sources. Multiple opportunities exist to reduce emissions across the sanitation service chain.

Capture and containment

Within the sanitation chain, anaerobic containment and treatment are the biggest producers of GHGs, including methane. Several adaptation actions, which are important for climate resilience (for example, ensuring regular pit emptying in flood-prone areas) can be used to reduce emissions by optimizing the emptying rate of pits[28] and transporting and treating the sludge appropriately, minimizing the time that faecal matter spends decomposing in wet, anaerobic pits.

Similarly, incorporating aerobic systems into the sanitation chain provides another opportunity to reduce emissions.[29] An alternative to anaerobic pit latrines is urine-diverting toilets with off-site composting. Recent research has shown that such sanitation systems can reduce emissions by about 126 kg of carbon dioxide

27 *Integrating Climate Resilience into Sanitation Programming in Bangladesh*. UNICEF. 2022

28 Emptying of latrines for treatment on a regular basis can help minimize the time faecal matter spends in such anaerobic environments. The emptying rate for treatment should be aligned with being able to capture as much of the resulting biogas as possible.

29 Reid, MC. et al. 'Global methane emissions from pit latrines', Environmental science & technology, vol. 48,15 (2014): 8727-34.

equivalent per capita per year.[30] If scaled globally, off-site composting could mitigate approximately 336 megatons of carbon dioxide equivalent per year, or 13 to 44 per cent of the sanitation sector's methane emissions.[31]

Ventilated improved pit latrines provide another option, promoting aerobic conditions in the pit by increasing oxygen circulation.

Emptying and transport

Emptying and transporting faecal sludge is critical in the sanitation service chain. Single-pit on-site systems eventually fill up with faecal sludge, creating potential health hazards, especially in the face of climate change. As such, it is vital that these systems are emptied regularly.

The emissions footprint of emptying and transporting sludge can be reduced by integrating more energy- and water-efficient desludging technologies and utilizing greener options for transport. Additionally, environmental and social safeguards standards can improve worker protection.

Photo 5: © UNICEF/UN0139490/Prinsloo

Treatment and reuse

On average, wastewater treated in conventional sewerage plants releases one-third of GHGs compared to the untreated disposal of sludge.[32] The key GHG emissions from such treatment systems are methane, nitrous oxide and carbon dioxide, the latter resulting mostly from the energy consumed during the treatment process.[33] Emissions from treated wastewater vastly outweighs the emissions released from the energy consumed during the construction and day-to-day running of treatment facilities.[34],[35]

There are multiple mitigation strategies for extracting, distributing and treating wastewater. The appropriate solution depends on the local context, projected climate conditions, availability of financing and anticipated operating costs. Potential strategies include:

- Integrating renewable energy options (e.g., solar or wind power). These off-grid solutions can also help improve resilience during grid outages.
- Improving energy efficiency while ensuring these solutions do not compromise the sanitation system's effectiveness.
- Improving water efficiency and recovery.
- Recovering energy (e.g., biogas) and water, and utilizing nature-based solutions.[36]

Box 7: The WASH-energy nexus

Energy is required to extract, transport and treat wastewater. As such, improving the energy efficiency of systems and incorporating renewable energy (e.g., solar) or biogas capture into the sanitation service chain, can help to reduce emissions.

At the same time, improving sanitation systems' water efficiency and/or reusing wastewater can help reduce demand for water, which decreases the amount of energy needed to pump, distribute and treat the water. This both reduces emissions and improves drought resilience across the sanitation service chain.

30 McNicol, G. et al. 'Climate change mitigation potential in sanitation via off-site composting of human waste', Nature Climate Change, 10. 10.1038/s41558-020-0782-4.

31 Ibid.

32 Kim, D. et al. 'Comparing effects of untreated and treated wastewater on riverine greenhouse gas emissions', APN Science Bulletin, 9(1), 88-94. 2019.

33 Environmental Protection Agency, 'Local government climate and energy strategy guides: Energy efficiency in water and wastewater facilities', Washington, DC: EPA, 2013.

34 Ibid.

35 Ibid.

36 Ibid.

Mitigation case studies for sanitation

Sanitation mitigation efforts reduce sanitation's GHG contributions. Through improving collection, transport, treatment and disposal, sanitation has the potential of shifting from contributing to GHG to minimizing GHG emissions.

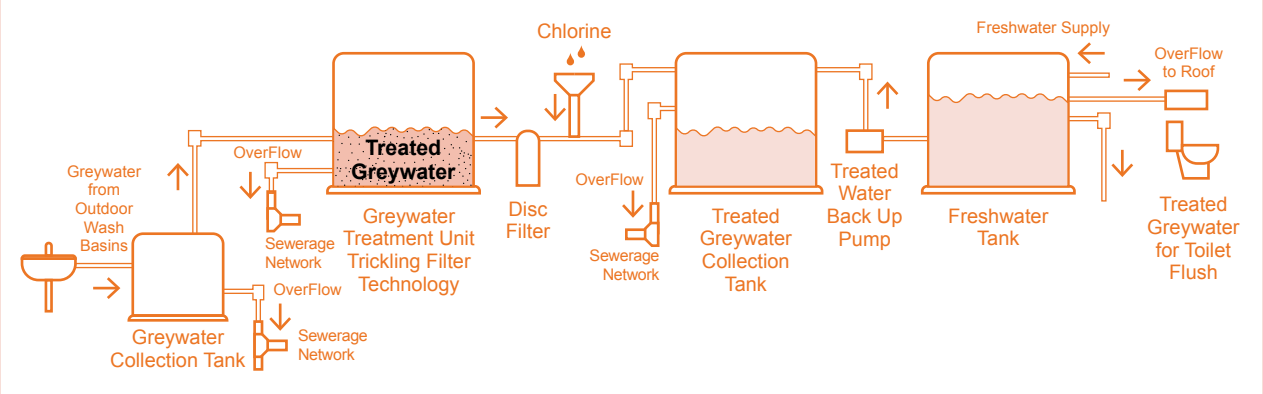
Box 8 provides a brief case study on the use of alternative energy in wastewater treatment and reuse in Jordan, while Annex 1 contains more short mitigation case studies across the sanitation service chain.

Box 8: Solar-powered decentralized wastewater treatment and reuse in Jordan

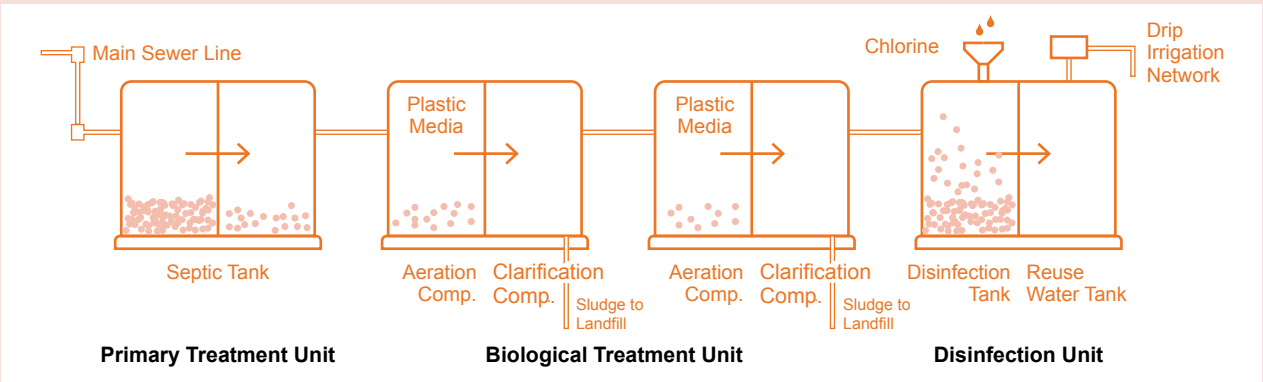
Solar-powered decentralized wastewater treatment and reuse systems are currently being piloted by UNICEF for three schools in Jordan. The project shows promise for future expansion in one of the most water-scarce countries in the world.

The project comprises a '5-in1' approach, including awareness raising, water collection, water saving, reuse and safe sanitation. The systems use modified septic tank systems and greywater treatment equipment and are powered by solar energy to help reduce emissions. They also include a rainwater harvesting system. The main environmental limitation of the system is that the sludge is disposed of in landfills, rather than being used productively.

The systems have increased the volume of water available at the schools, reduced the risk of wastewater contamination, and transformed the schools from being water importers to water exporters. Excess treated wastewater is being used to 'green' the community, allowing trees to be planted, improving water retention and providing an additional opportunity for climate mitigation through the absorption of carbon dioxide by trees. Excess solar power is also sold back to the grid, creating an additional source of income for schools. Finally, students, mosques and the rest of the community are mobilized to support broader water conservation activities.



The greywater treatment and reuse system



The modified septic tank system

Monitor and move forward

As with any other sanitation intervention, monitoring and evaluation (M&E) is an important part of the programming cycle, and must be used to track the progress and impact of climate-resilient sanitation services. These data can then be used to inform future policy development, evidence-based planning and the mobilization of additional investments. The current lack of data on, for example, relative risk and impact on health, livelihoods, education, sanitation services and the economy, is a major challenge to establishing an effective M&E system.

Developing an M&E system for climate-resilient sanitation requires an appropriate set of indicators that can be used to monitor and evaluate the effectiveness of measures introduced to enhance climate resilience throughout the whole sanitation service chain, and the overall sustainability of these services, systems and associated sanitation and hygiene behaviours.

Climate-resilient sanitation M&E is an evolving area that requires more work and research as there are many uncertainties involved in adapting to, and improving, climate resilience. Hence, forward-looking planning and implementation, and continuous learning and adjustment are needed. The sector also needs strengthened institutional systems and improved capacity for data collection, research and measurement on the impact of climate change on sanitation, for a better, more robust and functional M&E system.

Several organizations have begun to develop M&E guidance for climate-resilient sanitation. These efforts include:

- Technical Brief: Monitoring and evaluation for climate-resilient WASH (GWP-UNICEF 2017): This brief provides a comprehensive overview of examples of typical monitoring indicators that can be used and/or adapted for climate-resilient WASH. The proposed indicators are generic and can be adjusted/adapted to suit the specific hazard, infrastructure or services being considered in the local context.
- Learning Paper: Guidance for monitoring climate-resilient urban sanitation (University of Technology Sydney and SNV 2019): This guidance focuses mainly on urban sanitation and includes resources for measuring climate impacts and subsequent implications for policy and programming.
- The UNICEF-WHO JMP is currently developing a series of climate-resilient sanitation indicators.
- The Sanitation and Climate: Assessing resilience and emissions project in Nepal, Ethiopia, Uganda and Senegal is developing a range of tools, metrics and methods for assessing emissions and resilience.

Some of the key messages from this section include:

- **Climate-resilient sanitation interventions need to be evidence-based.** Climate risk assessments provide a strong data basis for developing climate-resilient sanitation interventions.
- **Interventions should be grounded in national policies and approaches.** Many countries have identified NDCs and NAPs that define the country's approach to climate change. Sanitation is rarely reflected in these plans, and efforts should be made to integrate sanitation interventions within the plans.
- **Most sanitation interventions can be made climate resilient.** Interventions such as improved pit emptying, elevated latrines and wastewater reuse are all climate resilient.

5. Financing guidance

An overview

Scaling up climate-resilient sanitation requires mobilization of domestic resources and leveraging all financing options, including the major climate funds. Securing financing is a challenging, resource-intensive process and is likely to be most successful when targeting co-financing (as opposed to grants). Historically, climate-resilient WASH has attracted less resources than other sectors (water-related funding tends to go to agriculture), and sanitation-specific programmes have received even less. The sanitation sector is rarely at the decision-making table, so its work is deprioritized. Additionally, the sanitation sector lacks compelling climate rationales, which makes it challenging to fund. Finally, there is a self-perpetuating challenge of limited, if any, experience with climate financing. This section provides an overview of some of the key financing opportunities for climate-resilient sanitation and mitigation programmes.

In 2009, wealthy countries pledged US$100 billion per year to support climate resiliency by 2020 (although they have yet to meet this pledge).[37] This commitment was strengthened by the 2016 Paris Agreement, which reaffirmed the need for adaptation and mitigation. Access to these funds is not evenly distributed, either geographically or thematically. Most funding tends to flow towards middle-income countries (e.g., Brazil, China, Egypt, India, Morocco and the Philippines), and they tend to support sectors with well-established links to climate change (e.g., clean technology and energy). Funds also tend to be earmarked for mitigation and less so for adaptation.[38]

Bilateral funding tends to be channelled through existing multilateral agencies (e.g., regional development banks) or to specialized designated mechanisms (e.g., GCF). As Figure 4[39] shows, the World Bank is the largest source of climate financing,[40]

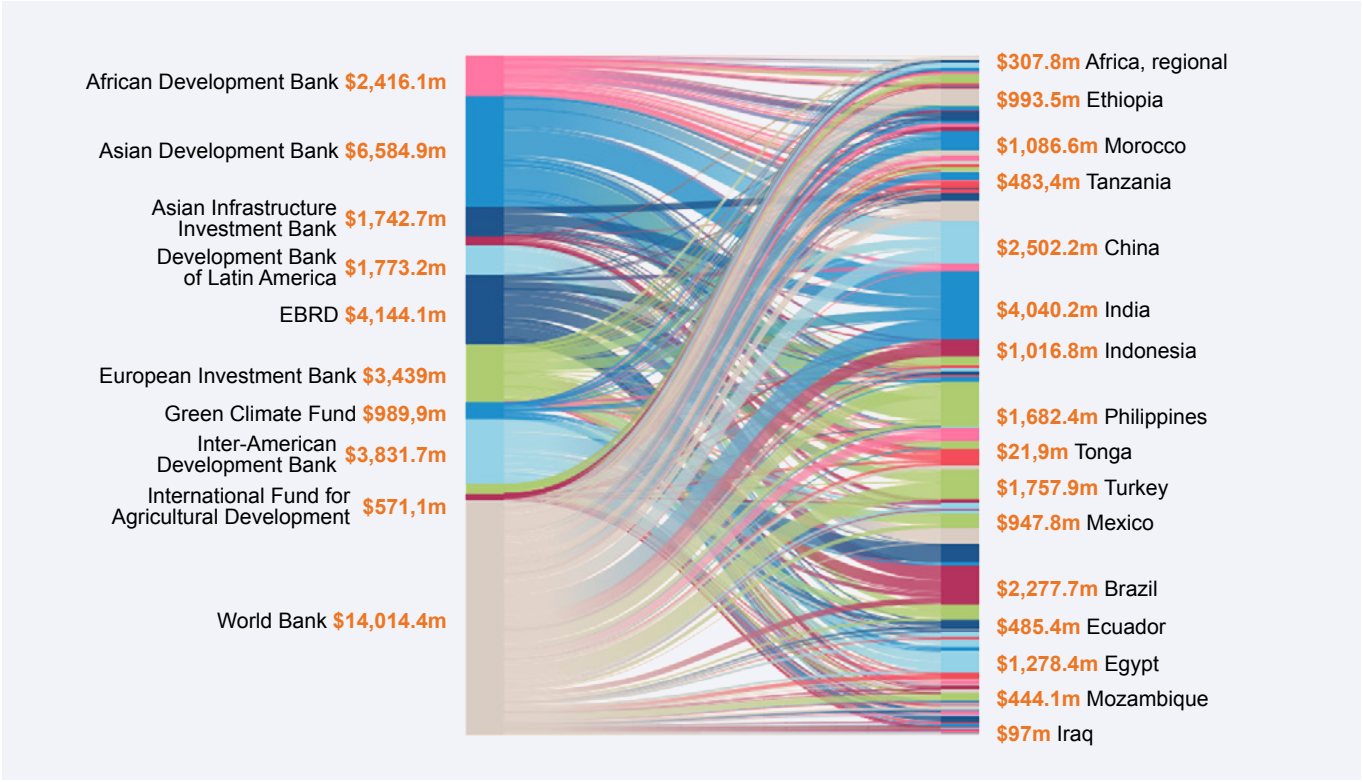


Figure 4: Sources and recipients of climate financing (2019)

37 Hook, L., Kao, S., 'COP26: where does all the climate finance money go?' Financial Times: 3November 2021.

38 Climate Funds Update, January 2022, https://climatefundsupdate.org

39 Financial Times, https://www.ft.com/content/d9e832b7-525b-470b-89db-6275853315dd

40 Financial Times bases their calculations on OECD data. It includes projects where climate is a principal or significant objective.

and India is the primary recipient. Given the variability and specificity of climate financing, organizations seeking funding need to identify the best alignment between the funder and fundee. For example, if a fund is the largest source of WASH financing in a country, but its priorities are misaligned with the country's needs (e.g., suppose the fund only supports energy mitigation and the organization needs funding for water supply adaptation), it is best to seek funding elsewhere. Additionally, projects intending to reduce GHG emissions may provide possibilities for carbon credits. As always, climate financing requires outreach to multiple funders wherever possible.

Sanitation and climate financing

The WASH sector in general–and sanitation in particular–has been unsuccessful in leveraging large-scale climate finance. The reasons for this include:

- The risks posed by the sanitation sector were not reflected as key national priorities via NDCs and NAPs, a requirement for many of the large climate funds. This is because the sanitation sector has not been present in key national climate discussions.
- The sanitation sector has not fully embraced the concept of the climate rationale and additionality and instead, develops and submits sanitation projects that are 'business as usual' approaches, with no clear link between the proposed activities and climate risks.
- The sanitation sector has not fully engaged with the climate sector to learn the 'appropriate language' of the climate sector, including the new terms, partnerships and ways of analysis.
- The sanitation sector does not fully understand, and lacks capacity to make, the level of investment required to develop full proposals (with no guarantee of funding).

Prerequisites for applying for major climate financing

Securing large-scale financing from major climate investors requires dedicating sufficient time and resources to secure the key prerequisites for applications. Climate financing should be secured by governments, with development sector partners supporting the government's efforts to develop successful proposals.

The Climate Rationale

The first step is developing the climate rationale, which is foundational to securing funding from climate funds. It refers to the scientific basis for an intervention. Importantly, it describes how sanitation impacts climate change and vice versa, but not why sanitation is important generally (e.g., the health, dignity, education and economic impacts). It provides the foundation to guarantee a project responds directly to climate-change challenges. The climate rationale supplies the scientific basis for evidence-based climate decision-making and relies on past and current data on the climate system as well as projections. It is designed to assist proposal assessors understand how the activities align with the aims of the funder. Successful proposals have an evidence-based description of climate impacts and risks.[41]

Box 9: Climate rationale versus rationale for climate-resilient sanitation

The 'climate rationale' (also known as the 'climate impact potential') is the established link between climate risks and solutions to reduce these risks.

The process to develop the climate impact potential involves an understanding of the current and projected changes in climate, including the impacts on services and identifying solutions to reduce the impact of climate change on the services. The rationale for climate-resilient sanitation is the justification for why sanitation services (and not just the infrastructure) must withstand the risks posed by climate change.

41 Impact, 'Enhancing the Climate Rationale for GCF Proposals' Impact: March 2020. https://climateanalytics.org/media/enhancing_the_climate_rationale_in_gcf_proposals_final_03.30.2020.pdf

Descriptions should differentiate between mitigation (e.g., reducing GHG emissions) and/or adaptation (e.g., climate hazards and related risks, impacts, exposure and vulnerabilities) that the proposed interventions are expected to address.[42]

Ultimately, the climate rationale describes the following key elements:

- Climate impacts to be addressed;
- Vulnerabilities and risks of the climate impacts to human well-being;
- Emission trajectories for mitigation projects;
- Pathways to shift the emission trajectories for mitigation projects;
- Assessment of adaptation options based on priorities; and
- How the proposed intervention fits into broader domestic and international policies and decision-making processes.[43]

The sanitation climate rationale needs to be defined (with strong data) within each specific context. It is important to develop the climate rationale by identifying solutions that: i) reduce the impact of sanitation on climate change; or ii) reduce the impact of climate change on sanitation. These solutions need to have been developed through a climate risk analysis.

Prior to developing a proposal

- Research alignment with the funder: As noted above, identifying clear alignment with a funder greatly improves the likelihood of success in securing funding.
- Engage with the National Designated Authorities (NDAs): NDAs are government agencies, usually finance or environment ministries, with accountability for developing national strategies and engagement with many (though not all) global funds, including GCF. However, given their sector focus, they may not have much knowledge on climate-resilient sanitation. It is, therefore, important that sector partners work closely with them and advocate for climate-resilient sanitation whenever possible. The NDA for each country can be found here.
- Sanitation sector partners should work with the NDA to support government leadership in including climate-resilient sanitation in their NDCs and NAPs. In many cases, sanitation's inclusion in the NDCs, NAPs and other national policies are a prerequisite for climate financing. The role of sanitation sector partners is to support governments in articulating the importance of climate-resilient sanitation in their NDCs and NAPs. Sector partners can raise awareness among the NDA of the risk of not addressing sanitation in national strategies. Once a relationship has been developed with the NDA, partners can support the development of their updated NAPs and NDCs.
- Advocating for equity: Very little climate financing is currently reaching the poorest households in lower-income countries, despite them being the most affected by climate change. The major climate financing institutions are conscious of this and wish to address the issue, but they still lack 'fundable' projects. The sector must demonstrate the investability of climate-resilient sanitation projects that serve the poorest and most vulnerable. Box 10 describes some investible sanitation programmes. Additionally, there is a strong need to raise awareness of the impacts of non-investment on the poorest households and communities.
- NDAs should engage with fund board members and familiarize them with existing projects: NDAs, as the designated government representative, should engage with fund leadership. Development agencies' role, then, is to support NDAs in their advocacy towards funders. It is important to take advantage of events, such as the Conference of Parties (COPs) and board meetings, to promote potential projects.

Box 10: Examples of fundable climate-related sanitation programmes

The following sanitation programming options are considered 'highly fundable' according to the main criteria established by the major climate funds.

Adaptation

- Climate-resilient sanitation systems.
- Sanitation for people displaced in the context of climate change.
- The reuse of wastewater in areas affected by droughts linked to climate change.

Mitigation

- Reducing the carbon footprint of wastewater infrastructure.
- Renewable energy use (e.g., solar power) or capture (biogas).

42 Ibid.

43 Ibid.

- Establish new partnerships: To develop a strong climate proposal, sanitation sector stakeholders should expand partnerships beyond existing networks. A strong proposal requires strong partnerships and proven technical expertise for implementation. It is important to ask:

  - What is the comparative advantage of each organization?
  - Which key skill gaps need to be filled?
  - Which partner could potentially help fill these gaps?

  Addressing gaps in expertise and implementation is critical to improving the chances of receiving funding. Central to a partnership strategy is engaging with an Accredited Entity (AE). AEs partner with funds to implement projects; they collaborate with governments to develop project ideas and submit proposals to funds for review.

  Direct Access Entities (DAE) are a type of AE. They are sub-national, national or regional organizations nominated by NDAs or focal points and may be eligible to receive readiness support (e.g., funding designed to help organizations become AE, as well as strengthen organizational capacities). International Access Entities are the second type of AE. They include United Nations agencies, multilateral development banks, international financial institutions and regional institutions. Accreditation of entities varies by fund, but include the United Nations Development Programme (UNDP), the Development Bank of Southern Africa (DBSA), the West African Development Bank (BOAD), the African Development Bank (AfDB), the French Development Agency (AFD), the Japan International Cooperation Agency (JICA), the German Development Agency (GIZ) and others. Note that some agencies are accredited to one or more funds (and some are not accredited to all of them).

When developing a proposal

- Highlight the strong links among other sectors (e.g., climate change): Currently there is limited understanding within the climate sector of the interconnectedness of sanitation, public health, the environment and climate change (see Figure 2). Refer back to the climate rationale for sanitation to clarify the specific– and data-driven –links between climate change and sanitation: e.g., reduction in GHGs, improved ecosystems, improved health, reduced poverty, improved education performance, etc. For example, the Least Developed Countries Fund is a US$1.8 billion fund targeting **adaptation**, while the Clean Technology Fund is a US$5.3 billion fund targeting **mitigation**. GCF is a US$10 billion fund, and includes a health component.[44]
- Utilize the climate rationale to ensure that interventions respond to the actual climate risks identified: If the feasibility studies and climate risk assessments indicate, for example, that flooding is the main risk to a vulnerable community, and climate projections indicate drought is unlikely, then the intervention should help them manage flooding, rather than drought.
- Provide strong climate evidence in the proposal: Integrate climate data into the proposal, supported by a comprehensive WASH climate risk assessment. Climate projects should be based on stakeholder priorities (i.e., bottom-up project design); community voices and needs should be streamlined throughout the proposal.
- Use climate resilience language as opposed to the usual sanitation sector language: The major climate funds do not finance non-climate-related sanitation interventions. As such, partners must avoid using some of the traditional language used in development proposals and instead focus on utilizing climate-related evidence, data and language. It is also important to document additionality (e.g., how interventions have a multiplying impact beyond the sanitation sector) to be successful in applying for financing.

Financing opportunities

The sanitation sector has had limited success in securing funding from large climate funds. This has been caused by a lack of quality proposals for sanitation projects from AEs and NDAs, possibly due to a lack of knowledge and/or prioritization of climate-related sanitation activities. Among the proposals that have been submitted, many do not have a clear 'climate rationale', lack a strong enough climate adaptation or mitigation component, or are simply 'business as usual', do not contribute to any of the G8 Strategic Impact Goals and areas (for GCF), or meet their investment criteria, and/or do not align as a national climate priority. Only DAEs or AEs can access climate funding for projects (with the exception of Readiness Delivery Partners).

44 Climate Funds Update, January 2022. https://climatefundsupdate.org/

- GCF is the largest international public climate fund. It considers a range of different financial instruments (not just grants), and has different levels of accreditation. The fund aims to split its funding 50-50 between adaptation and mitigation, with a focus on African countries and Small Island Developing States. In 2017, the GCF provided a significant funding boost for the water sector. However, very little (less than 1 per cent) of this has so far been dedicated to sanitation.[45] More information on how to apply for GCF funding is available here.
- AF was created in 2001 under the Kyoto Protocol with the mandate to finance adaptation projects in the low-income countries most vulnerable to the impacts of climate change. The AF has grown to a US$1 billion fund and committed about US$850 million for over 120 adaptation projects and programmes to date. Half of the AF's projects are in low-income countries. The AF has pioneered 'direct access' implementation by organizations based in the beneficiary country, a modality that other funds such as GCF are now also keen to follow. The AF additionally received a significant boost to its funding during the 2021 COP26 and provides an option to apply for climate-related sanitation funding. More information about the AF application process can be found here.
- The GEF was established in 1990 to tackle a range of urgent global environmental issues (not just climate change), including biodiversity loss, ozone depletion and international water disputes. It has programmed US$21.5 billion for more than 5,000 projects in developing countries. Eighteen institutions act as GEF Agencies, designing and delivering the projects. GEF has a broader mandate than GCF, and could be of particular interest for projects that tackle environmental issues, such as pollution of water courses, but which do not necessarily have a climate change adaptation or mitigation rationale. More information is available online on how to apply for the Small Grants Programme.
- At COP 26 in November 2021, the United States of America, European Union and other partners announced the Global Methane Pledge. Over 100 countries have signed the pledge to reduce methane emissions globally by 30 per cent by 2030 (from 2020 levels). Additionally, a host of donors have pledged US$328 million to support methane mitigation strategies as part of the pledge. This pledge could be of particular interest to countries wishing to pursue increased sanitation mitigation efforts. While limited information is available for now on how to access this fund, updates can be found here.
- Several private sector foundations prioritize climate change adaptation and sanitation projects, but not necessarily at the same time. With a strong proposal, however, these foundations may provide a potential option for climate-related sanitation funding. For example, the Bill & Melinda Gates Foundation finances urban sanitation innovations in Africa and South Asia and advocates for investment in Citywide Inclusive Sanitation (CWIS).
- WASH and climate change are priority sectors for many bilateral donors. The largest bilateral donors for climate financing can be found in Figure 4. The targeting of this financing varies from donor to donor. However, in many cases, there are clear links between their climate-change adaptation programmes and WASH projects. Many of the major donors represent their respective countries in United Nations Framework Convention on Climate Change (UNFCCC) processes and are also international finance institutions, GCF and GEF board members. As such, they are well placed to influence investment policy in climate and to prioritize sectors and regions they are most interested in, and should be a key focus of major advocacy efforts by the sector moving forward.
- International financial institutions are currently some of the largest investors in WASH programmes internationally. Furthermore, most are now striving to increase the proportion of their investments that are climate resilient and contribute to GHG reductions. Many of these institutions and development banks are accredited with the GCF and GEF. Regional international financial institutions, in particular, such as BOAD and DBSA, are likely to be interested in partnering with sanitation sector partners to develop new sanitation proposals.
- The private sector encompasses a variety of actors involved in wastewater and sanitation activities, from local builders and masons to international companies (such as Suez and Veolia) managing concessions. They also play a critical role in marketing climate-resilient sanitation products and services and building demand. Many funds (such as GCF) encourage partnerships with the private sector to ensure ownership, create new livelihoods and leverage further investments.

45 Hedger, M., 'Climate change and water: Finance needs to flood not drip', ODI, October 2018. https://cdn.odi.org/media/documents/12481.pdf

Opportunities to use different financial instruments may be viable through these partnerships, but the political acceptance of the private sector in sanitation may vary from country to country.

Some of the key messages from this section include:

- **Most public financing for climate change has so far been spent in middle-income countries.** Additionally, of the funding that does flow to low-income countries, the majority has so far been spent on mitigation.[46] This leaves a significant opportunity for climate-resilient sanitation (adaptation) in particular.
- **The lack of good quality projects** for both mitigation and adaptation, which include a clear climate rationale, is a key reason why so few sanitation projects have received climate funding.
- **The sector is failing to fully engage with key climate actors at the country level** (including NDAs), meaning sanitation is omitted from the NAPs or NDCs, a key prerequisite for climate financing.
- **The sector must expand beyond its traditional, bilateral donor base** and explore other financing options and partnerships to take climate-resilient sanitation to scale.

Photo 6: © UNICEF/UN0644173

46 Timperley, J., 'The broken $100-billion promise of climate finance — and how to fix it', Nature, October 2021. https://www.nature.com/articles/d41586-021-02846-3

6. Conclusion

Climate change is already undermining decades of progress in the sanitation sector, leaving many people, again, without access to safe sanitation and threatening the achievement of SDG Targets 6.2 and 6.3 (and impacting other SDGs). Multiple climate-resilient sanitation and mitigation options exist across the sanitation sector, from small rural communities to large urban centres. Several examples of these have been included in this technical brief. However, many of these pilot projects have yet to be taken to scale.

As such, it is imperative that the sanitation sector unites in actively addressing climate change, advocating for urgent and immediate action from governments, donors, the private sector and civil society.

As identified under the UN-Water SDG 6 Global Acceleration Framework, and UNICEF's Game plan on safely managed sanitation, overcoming the challenges of inadequate access to safe and resilient sanitation services calls for more investment in five key accelerators: governance; financing; capacity development; data and information (especially climate change risk analysis); and innovation. This can be an effective pathway for accelerating progress and mobilizing coordinated support from all relevant partners on climate-resilient sanitation.

Governance

Strong political leadership and institutional arrangements are critical for providing the required enabling environment and resources to integrate climate resilience in sanitation programming, and recognize it as a national climate change priority. Some key interventions and actions that could support the enabling policy environment for climate-resilient sanitation include:

- Building consensus on institutional roles and responsibilities, with a lead agency (with accountability measures) identified.
- Identifying and enabling relevant institutional climate champions for the sanitation sector.
- Establishing effective coordination mechanisms across multiple sectors, with active participation of all major stakeholders.
- Sustaining advocacy for increased political commitments and prioritization of sanitation in the climate agenda of the country.
- Identifying and working with all relevant stakeholders to ensure that all components of the sanitation service chain are climate resilient.
- Promoting the scale-up of climate-resilient sanitation services for low-income and climate-impacted communities.
- Engaging NDAs and ensuring WASH sector participation in key national and sub-national climate discussions/processes (e.g., NAP and NDC).

Financing

Attracting sufficient and sustainable financing is critical for successfully scaling up climate-resilient solutions. Some priority interventions and actions include:

- Conducting sustained advocacy for increased government funding for climate-resilient sanitation and allocation at national and sub-national levels by incorporating climate-resilient sanitation in the annual budget plan.
- Conducting global advocacy and dialogue with major climate funds, international financial institutions and bilateral donors to increase investments for climate-resilient sanitation.
- Developing a national WASH financing strategy that includes how to access major climate funds and other innovative financing opportunities for climate-resilient sanitation.
- Developing a financing model that enables the poorest families in the most climate-vulnerable communities to gain access to climate-resilient sanitation services.
- Developing simple guides on how to develop bankable climate-resilient sanitation projects for investment by major climate funds and other financial institutions.
- Promoting the development of investment cases and cost of inaction studies.
- Strengthening the creditworthiness of utilities to facilitate their access to finance.
- Working with local markets and engaging the private sector to establish affordable and resilient sanitation services for the poorest households, creating demand and supporting targeted subsidies as needed
- Identifying opportunities to explore the use of carbon credits as a rotating fund.

Capacity development

Some priority interventions and actions that could support systems strengthening and capacity-building efforts on climate-resilient sanitation include:

- Based on the capacity gap identified as part of the risk assessment, supporting the development of institutional capacity development plans on the risks posed by climate change on sanitation and the identification and design of solutions.
- Establishing partnerships with research and academic institutions for research on links between sanitation and climate change, training sector professionals on climate-resilient sanitation, and developing, implementing and measuring climate-resilient sanitation solutions.
- Building the capacity of government and other sector partners, including the private sector, on developing the rationale for climate-resilient sanitation, mainstreaming climate resilience in sanitation programming, accessing major climate finance for sanitation and innovative and appropriate climate-resilient sanitation solutions and approaches.
- Supporting peer-to-peer and learning exchanges among partners and countries.
- Strengthening capacity approaches for mitigation components.
- Implementing sanitation safety planning protocols.
- Supporting the mapping and documentation of experiences for dissemination to all relevant stakeholders.
- Mobilizing and strengthening the capacity of private service providers to integrate climate resilience across the whole sanitation service chain to ensure continuity of services in the face of climate-related shocks and seasonal variabilities.
- Introducing climate resiliency within demand creation programmes (e.g., inclusion of climate-resilient sanitation in CLTS programmes).
- Developing and disseminating more programmatic guidance on the implementation of climate-resilient sanitation approaches for different contexts.

Data and information

There is a need to strengthen data and information to support the establishment of effective M&E systems for climate-resilient sanitation. Some of the priority interventions and actions include:

- Supporting the development of a climate-resilient sanitation M&E framework.
- Developing measurement, reporting, and verification systems for GHG emission reductions to access results-based climate finance.
- Strengthening national sanitation management information systems to incorporate climate-resilient sanitation.
- Developing indicators for national household surveys (in conjunction with the JMP) to set targets for (and monitoring progress towards) climate-resilient sanitation
- Developing national capacity to establish and operate early warning systems that provide real-time data on climate events and how they relate to climate-resilient sanitation services, and vice versa.
- Prioritizing resources (human and financial) for the establishment and sustainability of the M&E system.

Innovation

Some of the innovation-related priority interventions and actions that could support scaling up of climate-resilient sanitation programme include:

- Supporting the development of more innovative approaches for integrating mitigation and adaptation options into sanitation programmes, including the use of green infrastructure and nature-based solutions for sanitation.
- Supporting more pilots of appropriate and replicable service delivery models that cover the whole sanitation service chain for scaling up climate-resilient sanitation services.
- Supporting the development of innovative social and behaviour change approaches, targeting communities, governments and service providers to promote the shift to climate-resilient systems and services across the sanitation service chain.

More information is available in the **Call to Action** developed by key actors, urging **the sector to unite in ensuring safe access to climate-resilient services for 3.6 billion people by 2030**.

Annex 1: Climate-resilient sanitation case studies

Collection, transport, treatment and reuse: Resilient, container-based sanitation in Nairobi, Kenya

The container-based sanitation system is supporting increased access to safe sanitation in densely populated urban areas, informal settlements and areas with high risk of frequent flooding. It aims to shift the paradigm around urban sanitation approaches, by providing an end-to-end service, which covers the whole sanitation service chain. Excreta is collected hygienically via sealed, flood-proof toilets, which use minimal water. The latrines are also safely anchored to the ground (to protect them against storms). Both factors contribute to their climate resilience. The excreta are then safely collected and reused, being sold to local agricultural markets.

See the links below for more information on container-based sanitation:

- Evaluating the potential of container-based sanitation
- Taking container-based sanitation to scale: Opportunities and challenges
- Container-based sanitation: One way to reach the last mile for sanitation services

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Biogas collection in Nepal (Mitigation)

Biogas in Nepal started in the 1980s as a technological research project, and the approach was expanded during the 1990s through the Biogas Support Programme into a highly successful market development programme with active involvement from the business community. Over the last 13 years, more than 140,000 biogas installations have been built in Nepal and the sector comprises 62 local companies, creating more than 13,000 jobs. Each biogas toilet is estimated to reduce GHG emissions by 6.98 tons of carbon dioxide per year.

Most of Nepal's villages (2,800 out of 3,915) in all 75 districts of Nepal now have biogas systems installed. Toilets are attached to 72 per cent of all systems constructed, allowing households to make use of the methane produced through anaerobic digestion processes to provide electricity and heating. The net result is a cleaner environment, reduced disease spread and increased availability of low-cost energy for communities, many of whom remain off-grid. More information on Nepal's biogas programme is available here.

Urine diverting biogas toilet in Gundu, Nepal. ©ENPHO

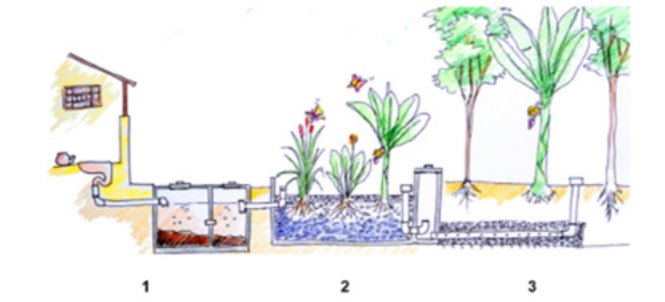
Constructed wetlands treat wastewater in Pakistan (Mitigation)

In Pakistan, 'end-pipe' solutions have always been a challenge, especially in rural communities where latrines are often not connected to public sewers. Constructed wetlands are one way of helping to overcome this challenge. They provide a low-cost option that uses natural processes, instead of fossil fuels, to treat wastewater. They also encourage water conservation and recycling in water-scarce communities, while increasing biodiversity and beautifying the environment. The trees and other vegetation also contribute to carbon capture.
The constructed wetland contains three steps for wastewater treatment:

Step 1. The septic tank: Wastewater (blackwater from toilets, greywater from sinks, showers, kitchens and laundry rooms) enters a water-tight septic tank, settling out solids, which are then digested by bacteria. A final filter prevents the passage of solids, with only nutrient-rich water being released from the septic tank.

Step 2. The constructed wetland (plantation tank): The effluent then enters the water-tight wetland, which is filled with gravel, which has one or more compartments depending on the size of system. In the plantation tank, green plants and microbes use and purify the wastewater of organic compounds, improving water quality.

Step 3. Subsoil irrigation (leach drain): Discharged water from the wastewater garden is sent to subsoil irrigation trenches or to a leach drain where plants and soil further purify the water and use up any remaining nutrients. The resulting water is then used to support the further irrigation of gardens and farms.



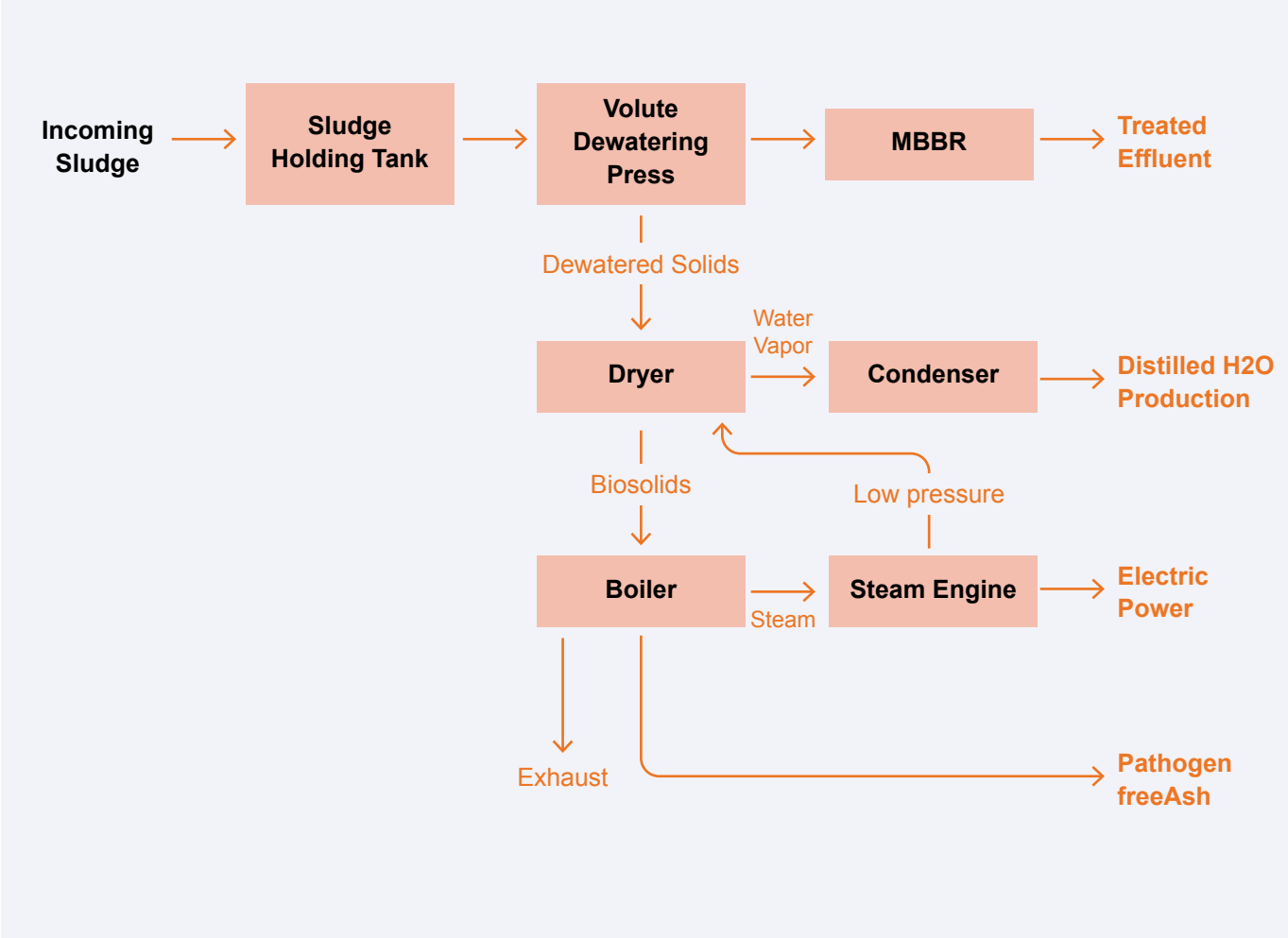
Constructed wetland wastewater systems. ©UNICEF Pakistan

Faecal sludge treatment plant produces renewable energy and nutrient-rich soil for agriculture (Mitigation)

By 2030, India's urban population is expected to rise to 590 million, placing major pressure on water and sanitation systems. Additionally, more than 75 per cent of sewage generated in India is untreated and discharged into water bodies, with major environmental health impacts.

Omni Processor technology offers a solution to this urban WASH crisis. In Vadodara, India, the faecal sludge treatment plant uses the technology to treat faecal sludge and municipal solid waste. The technology kills all pathogens and generates renewable electricity, distilled water and nutrient-rich soil.

The faecal sludge treatment plant in Vadodara. ©AnkurScientific.



The Omni Processor system. ©AnkurScientific

Methane emissions produced are dramatically lower than traditional waste lagoons and standard treatment plants, offering an opportunity for emission mitigation. The water and nutrient-rich soil produced are also of high enough quality to sell.

Additionally, the system uses just 40 per cent of the land than other treatment approaches, so siting can also be optimized for resilience in densely populated urban areas. It is also an effective solution for non-sewered locations, as waste can be brought in vacuum trucks, then treated. Finally, a city could have multiple of such treatment plants, creating additional resilience benefits from decentralization.

Annex 2: Additional resources

Organization	Year of publication	Resource
GCF	2021	Country readiness resources
	2021	GCF Simplified Approval Process
	2021	GCF Water Project Design Guidelines
	2021	Programming Manual
Global Green Growth Institute	2021	What do 'Paradigm Shift' and 'Climate Rationale' Mean for the Green Climate Fund (GCF) Project Concept Notes
GIZ	2021	Resilient Urban Sanitation – Accelerating the Convergence of Sanitation and Climate Action
Global Water Centre	undated	Solar Powered Water Systems Design and Installation Guide
UNICEF	2020	Call to Action: Why water, sanitation and hygiene must be top of your climate agenda
	2021	Children's Climate Risk Index
	2020	Guidance Note on Shift to Climate Resilient WASH Programming
	2021	Guidance Note: Programmatic Approaches to Water Scarcity
	2021	Guidance Note: Urban Water Scarcity - Preventing Day Zero
	2020	How UNICEF Regional and Country Offices can Shift to Climate Resilient WASH Programming
	2021	Impact of Water Scarcity on Children in the Middle East and North Africa Region
	2021	Water Security for All
	2022	UNICEF's Game plan on safely managed sanitation

Organization	Year of publication	Resource
UNICEF and GWP	2017	Guidance Note: Risk Assessments for WASH and Spreadsheet Tool
	undated	Learning Modules: Implementing WASH climate resilience programming - Introduction; WASH Climate Risk Assessments; Options to improve Climate Resilience; Integrating Options into Strategies and Plans; Monitoring Programmes and Systems
	2017	Technical Brief: Appraising and prioritising options for climate resilient WASH
	2015	Technical Brief: Integrating climate resilience into national WASH strategies and plans
	2017	Technical Brief: Local participatory water supply and climate change risk assessment: modified water safety plans
	2017	Technical Brief: Monitoring and evaluation for climate resilient WASH
	2017	The Strategic Framework for WASH Climate Resilience; English, Spanish, French, Portuguese
	2017	WASH Climate Resilient Development: English, Spanish, French
Water Finance Coalition	2022	Water Climate Finance Toolkit to Public Development Banks
WHO	2018	Climate, Sanitation and Health
	2022	Sanitation safety planning
World Bank	2020	Resilient Water Infrastructure Design Brief

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