Climate resilient and inclusive rural WASH systems and services in practice

Case studies from Nepal, Bhutan, Lao PDR, Mozambique, and Ghana

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UTS Institute for Sustainable Futures

Contents

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ISF is an independent research institute within the University of Technology Sydney. We conduct transdisciplinary, project-based research in line with our vision of creating positive change towards sustainable futures. ISF researchers bring together expertise in a wide range of areas including engineering, architecture, economics, science, social science, international studies and political studies, to deliver practical and holistic solutions to complex problems. We work with a wide range of clients to support them in achieving their sustainability goals and we empower a new generation of changemakers with our Graduate Research Program and suite of short courses.

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Abbreviations

BCC	Behaviour Change Communication
CLTS	Community-Led Total Sanitation
CRRWASH	Climate Resilient Rural WASH
CRWSP	Climate Resilient Water Safety Plan
DNAAS	Mozambique National Directorate of Water Supply and Sanitation
DPOP	Directorate of Public Works and Housing
DPOB	Disabled People's Organisation of Bhutan
FCHV	Female Community Health Volunteer
GEDSI	Gender equality, disability, and social inclusion
IWMI	International Water Management Institute
Lao PDR	Lao People's Democratic Republic
NAP	National Adaptation Plan
NDC	Nationally Determined Contributions
NWASH-MIS	National WASH Management Information System
ODF	Open defecation free
PRONASAR	Mozambique National Rural Water Supply and Sanitation Programme
RM	Rural Municipality
RSPN	Royal Society for Protection of Nature
T-WASH	Transforming Access to WASH and Nutrition Services' programme
UTS-ISF	University of Technology Sydney - Institute for Sustainable Futures
WASH	Water, Sanitation and Hygiene
WASH FIT	WASH Facility Improvement Tool
WUSC	Water Users and Sanitation Committee

1. Introduction

Climate-resilient water, sanitation, and hygiene (WASH) systems and services are essential for addressing the growing challenges posed by climate change. Good WASH access is not only fundamental for health and well-being but also enables broader community resilience. Yet, rural populations, often overlooked in climate discussions, face heightened vulnerabilities due to limited investments in WASH infrastructure and access to services. These communities are at increased risk of service interruptions, infrastructure collapse, and conflicts over water resources, exacerbated by ongoing changes in the hydrological cycle. All these pressures on rural WASH services require a response from the service delivery system; not just at the level of a community, but also at the level of duty-bearers of the human right to water and sanitation.

Thinking and practice on climate-resilient WASH are evolving beyond only addressing the physical risks of climate change to infrastructure. While resilient infrastructure remains critically important, it is now widely recognised that resilience must also be addressed at the scale of users, service providers, the natural environment and governance systems.[1] This is because the climate impacts experienced by WASH users, and the possible range of responses, are powerfully shaped by both environmental and social processes.[2]

Consideration of gender equality, disability and social inclusion (GEDSI) in climate-resilient WASH practice is essential for meeting the needs of all WASH users. Inclusive climate-resilient WASH practice can address climate change's uneven impacts across diverse people, social and institutional discrimination that limit people's capacity to respond to climate impacts, unequal access to climate-resilient technologies, and the skills and knowledge-building that disadvantaged people need to overcome climate impacts on their WASH access.[3] Without consideration of GEDSI, climate-resilient WASH practice is likely to further entrench inequalities.

The climate resilience of WASH systems and services must be built in an existing context of many sustainability challenges. Even without the effects of climate change, WASH systems are not equipped to provide safely managed services for everyone. Novel climate-resilient WASH practices are unlikely to be effective if foundational WASH systems are not in place and working well. Hence, climate-resilient WASH practice must continue to address existing fundamental problems in WASH service delivery in addition to minding climate risk and uncertainty.

SNV's Climate Resilient Rural WASH (CRRWASH) approach operationalises this latest thinking into practice through supporting local governments to ensure sustainable and equitable access to WASH services, for all. The CRRWASH approach integrates climate resilience into WASH activities to ensure that systems and services can withstand climate-related challenges, with a particular emphasis on the experience and voices of women and marginalised groups. By strengthening local government capacity and promoting GEDSI, this work contributes to enhancing fundamental WASH systems and helps all community members benefit from improved WASH services and have a voice in decision-making processes.

Knowledge-sharing and learning are cornerstones of effective climate change adaptation. SNV's experiences and lessons learned from projects in Asia and Africa provide valuable insights into developing innovative solutions for climate-resilient and inclusive WASH services. Fostering knowledge exchange can contribute to building a more resilient and equitable future for all.

This report synthesises the climate resilient and inclusive WASH practices from five countries SNV is working in—Nepal, Bhutan, Lao PDR, Ghana, and Mozambique—and reflects on their contributions to water security in an era of climate change. It presents case studies of activities implemented or in progress by SNV country offices and partners, highlighting the most successful practices and the challenges encountered along the way, all whilst striving to achieve and maintain universal and equitable access to safely managed services which must remain a key priority for the WASH sector in response to climate change.

Through sharing these experiences, the report aims to provide other WASH stakeholders globally with a clear understanding of what CRRWASH can look like and inspire ideas on how to build upon good practices. Further, the report offers reflections on the broader implications for water security to provide strategic insights into the future direction of the WASH sector. These insights help guide efforts to enhance water security and resilience in the face of climate change to support all communities to sustainably access safe and reliable WASH services.

[1] Sanitation and Water for All, *Definition of climate-resilient water sanitation and hygiene services*, New York, Sanitation and Water for All, 2024.
[2] Water for Women, *Learning brief: Integrating risk and resilience for climate-resilient WASH programming*, Canberra, Water for Women, 2025.
[3] Water for Women, *Learning brief: The criticality of GEDSI for climate-resilient WASH*, Canberra, Water for Women, 2025.

2. Approach

This study involved a qualitative analysis of the activities and experiences of SNV WASH programmes across Nepal, Bhutan, Lao PDR, Mozambique, and Ghana. Data sources included:

- A review of country programme documents, including formative research reports, donor reports, and activity case study outputs.
- Interviews with SNV country office staff members about their experiences, reflections, and future plans for working on CRRWASH.
- A synthesis of learnings across the five country contexts to identify themes in relation to water security.

The activities explicitly linked to climate change were then consolidated and grouped into themes.

The main body of this report is structured into three main sections. First, an overview of each of the five case study countries is provided, including country-level information on the climate and WASH context and an outline of the CRRWASH programme recently implemented in that country (or, in the case of Ghana, recently launched). Next, six thematic climate-resilient and inclusive WASH practices are presented with examples from the case study countries of how they were operationalised. The final section relates the climate-resilient and inclusive WASH practices presented in this report to the SNV approach to water security and discusses implications for future practice.

2.1. Climate Resilient Rural WASH (CRRWASH) approach

Each of the SNV country case studies covered in this report have implemented—or are planning to implement—a CRRWASH programme (Figure 1). Although each CRRWASH programme is contextualised to the needs of the people and environment in each location, all programmes have some commonalities.

SNV's approach recognises that local governments are the duty bearers of the human right to water and sanitation within their jurisdictions. Hence, the focus of all CRRWASH programmes is on strengthening the capacity of local governments to integrate climate change resilience within area-wide rural WASH services, systems, plans, and budgets, with greater emphasis on the increasing vulnerabilities of disadvantaged groups.

Programmes also work with rights holder groups, private sector providers and supply chains. Development and sharing of knowledge amongst SNV, its partners and communities, on the potential inequitable impacts of climate change on WASH services and behaviours is prioritised.

SNV's entry point is to consider both inclusion and climate resilience within each of the elements of area-wide service models at the local government level. Types of outcomes that programmes are working towards, therefore, focus on both gender and social inclusion and resilience.

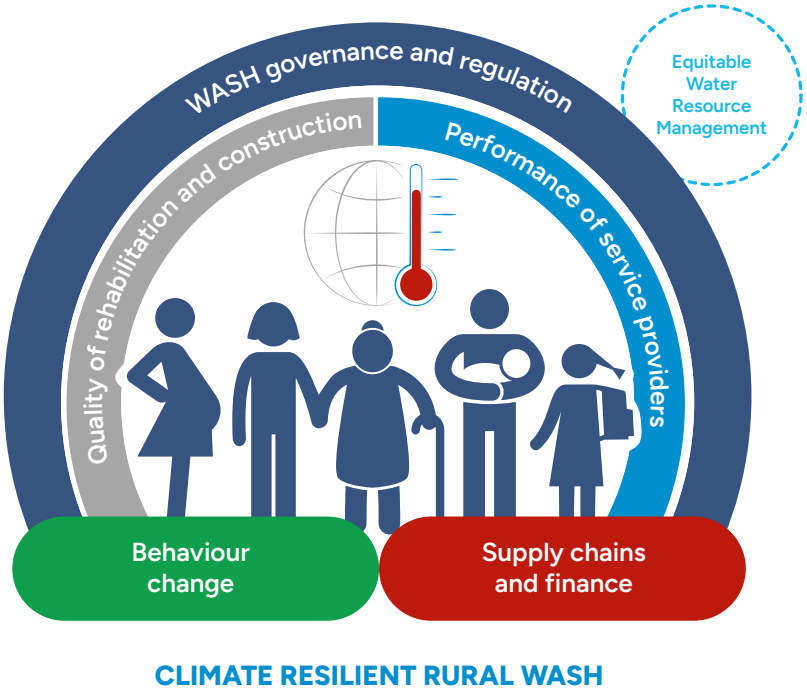

Figure 1. SNV's framework approach to CRRWASH

3. Country overviews

This section provides a brief overview of the countries profiled in this report. For each country, it describes the key climate challenges, climate policy commitments of the national government, and a recently implemented or in progress SNV CRRWASH programme.

3.1 Nepal

OVERVIEW OF THE CONTEXT

Nepal has experienced a significant increase in extreme rainfall events, incidences of droughts, and glacial lake outburst floods since 1960. Both excessive and insufficient water due to climatic extremes affect WASH systems in Nepal. Monsoon disasters such as landslides and floods severely impact WASH systems, while dry seasons lead to unreliable water sources and insufficient supplies in communities throughout the country.[4] Most of the rural population has access to at least basic water services (92%) and basic sanitation services (81%),[5] following steady progress over the last 20 years, but some disadvantaged communities and households have persistently remained underserved. Hence, WASH efforts aim to upgrade existing basic services while closing the gap for underserved people.

Nepal's recent policies, such as the Joint Sector Review 2023, National WASH Policy 2023, Nationally Determined Contributions (NDC) 3.0, and the National Adaptation Plan (NAP) 2021-2050, propose the integration of climate change considerations into WASH service development. The National WASH Policy calls for strengthening local capacity to manage climate impacts, minimising damage to WASH infrastructure from climate events, maintaining pollution-free waterbodies, and managing wastewater. The Joint Sector Review lists key climate risks for WASH, proposed solutions, and gaps in climate-resilient WASH planning across seven provinces. The NDC and NAP further acknowledge the effects of climate change on water availability, quality, and health and sanitation and call for the development of climate resilient WASH infrastructure and services.

PROGRAMME IMPLEMENTATION

SNV partnered with the International Water Management Institute (IWMI), the University of Technology Sydney's Institute for Sustainable Futures (UTS-ISF), CBM Australia and Everest Club Dailekh for the extension of the programme Towards Climate Resilient Inclusive Water Supply Services in Rural Nepal from 2023-24. This climate-financed extension was funded by the Department of Foreign Affairs and Trade and the Australian Government's Water for Women Fund and followed Phase 1, which was operated from 2018-2022, and also focused on inclusive rural water services. Two rural municipalities (RMs) in the mid-hills of Dailekh district of Karnali province, and two in the Terai region of Sarlahi district of Madhesh province, were selected as the implementation area of the programme. Each of these areas represents different ecological zones and types of water supply systems.

In Nepal, the programme focused on strengthening local government capacities to advance climate-resilient and inclusive rural water supply services through:

- Strengthened decentralised WASH sector systems with greater emphasis on climate resilience, sustainability, GEDSI and safety managed WASH and water security.
- Increased equitable universal access to and use of sustainable, climate-resilient WASH services and adoption of hygiene practices, particularly for potentially disadvantaged groups.
- Strengthened climate resilience and GEDSI in local bodies, civil society organisations, communities and households.
- Strengthened use of new evidence, innovation, and practices in climate-resilient inclusive WASH services by subnational and national stakeholders, civil society organisations and international WASH and water sector actors.

3.2 Bhutan

OVERVIEW OF THE CONTEXT

Bhutan's unique geographical features and diverse climatic zones make the country vulnerable to the impacts of climate change. Climate change projections indicate Bhutan may experience increasing seasonal variation of precipitation. Melting glaciers are modifying surface water flows and raising the risk of glacial lake outburst floods. Floods and landslides threaten to destroy sanitation infrastructure while extreme heat and dry spells heighten the risk of water shortages in rural communities.[6] Bhutan achieved nationwide open

[4] SNV and UTS-ISF, Climate change and rural sanitation in Nepal: taking stock, *Learning brief*, The Hague, SNV, 2021.
[5] WHO and UNICEF, *Household WASH Data, Joint Monitoring Programme*, Geneva and New York, WHO and UNICEF, 2025, https://washdata.org/data/household#!/, (accessed 24 July 2025).
[6] UTS-ISF and SNV, Climate change and rural sanitation in Bhutan: taking stock, The Hague, SNV, 2021.

Photo: Installation of a diversion chamber in rural Bhutan. Credit: SNV.

defecation-free status (ODF) in 2022, with 77% of rural households having at least basic sanitation services (with water-based toilets being the norm), and nearly all households (99%) have access to at least basic water services.[7] Consequently, government rural WASH efforts currently have a focus on upgrading services from basic to safely managed and professionalising rural water supply services.

Climate change adaptation and mitigation have become central to the Government of Bhutan's national agenda. The Government is acutely aware of the urgent need to address climate vulnerabilities and implement effective strategies for sustainable development. Bhutan's commitment to maintaining its carbon-negative status, achieved through its extensive forest cover that absorbs more carbon dioxide than the nation emits, highlights the country's dedication to environmental protection.[8] The 2023 NAP prioritises climate-resilient WASH development under its health strategy.

PROGRAMME IMPLEMENTATION

From 2023-24, the extension phase of Towards Climate Resilient Inclusive WASH Services was delivered in collaboration with the Department of Water of the Ministry of Energy and Natural Resources, Department of Infrastructure Development of the Ministry of Infrastructure and Transport, and the Ministry of Health. As in Nepal, this climate financed extension was funded by the Department of Foreign Affairs and Trade and the Australian Government's Water for Women Fund and followed a Phase 1, which was operated from 2018-2022, but represented a transition from a sanitation and hygiene focus, to integrate rural water services following the national ODF declaration. New partnerships were also established with the Royal Society for Protection of Nature (RSPN), alongside ongoing partnerships with the Disabled People's Organisation of Bhutan (DPOB), UTS-ISF as a knowledge partner, and CBM Australia for inclusion expertise. The programme focused on progress in three areas: rural water services, safely managed sanitation and hygiene, and small-town sanitation in Dagana, Zhemgang and Trashigang districts and engaged at the national level.

The programme in Bhutan focused on strengthening climate-resilient WASH services through:

- Improved capacity of national and subnational government agencies in planning, delivering, monitoring and targeting of investments in climate-resilient, inclusive WASH services that adapt to climate risks and water security challenges.
- Increased capacity of national and subnational government agencies in designing, investing, implementing, and monitoring social and behaviour change communications that respond to climate-driven health risks and increase disaster preparedness.
- Improved performance of rural water supply operators (Water Users' Committees) and strengthened adaptive post-construction support services delivering climate-resilient, inclusive WASH services.
- Strengthened consumer supply chains and finance to deliver affordable market-based solutions for changing consumer needs, climate resilience and service levels, including for potentially disadvantaged groups.

[7] WHO and UNICEF, 'Household WASH Data', The JMP, Geneva and New York, WHO and UNICEF, 2025, https://washdata.org/data/household#!/, (accessed 24 July 2025).
[8] National Environment Commission, Climate change policy of the Kingdom of Bhutan 2020, Thimphu, Royal Government of Bhutan, 2020.

- Strengthened leadership, agency and voice of women, people with disabilities, potentially disadvantaged groups and civil society actors.
- Documenting and sharing of climate-resilient and gender, disability and socially inclusive evidence and practices with other civil society organisations, national/subnational sectors and international WASH and water sector actors.

3.3. Lao PDR

OVERVIEW OF THE CONTEXT

Lao PDR, currently categorised as a Least Developed Country but expected to graduate from this status in 2026, relies heavily on agriculture, hydropower, and mining for its economic stability. By the 2030s, the annual population exposed to flooding is expected to double to over 80,000, and the country will experience longer dry seasons. In Savannakhet province, the country's most populous province, approximately 46,000 people along the Xe Champhone River face significant flood risks, with regular flooding occurring in Champhone and Atsaphone Districts. Flooding events frequently destroy sanitation and water infrastructure and contribute to the contamination of drinking water sources. Although the effects of climate change on the frequency of droughts in Lao PDR are uncertain, local scarcity of safe drinking water sources already afflicts many communities in the dry season. A relatively high proportion of people living in rural areas (26%) practice open defecation, and 69% of households have at least basic sanitation services. Hence, resilience-building efforts for sanitation occur in a context where significant portions of the rural population have no sanitation access at all. Approximately 78% of the rural population has access to at least basic water services.

The Government of Lao PDR enacted a decree on climate change in 2019 to set general rules for enabling adaptation actions in the country. The National Strategy on Climate Change and Health Adaptation 2018-2025 prioritise the use of research and climate information to inform WASH planning in the country.

PROGRAMME IMPLEMENTATION

SNV led the Towards Climate-Resilient Inclusive WASH Services in Rural Lao PDR (2023-24) programme to support local government and rural communities to improve the use of inclusive, sustainable and climate-resilient WASH services and achieve climate-resilient ODF in the districts of Atsaphone, Champhone and Phalanxay in Savannakhet province. As in Nepal and Bhutan, this climate financed extension funded by the Department of Foreign Affairs and Trade and the Australian Government's Water for Women Fund followed a Phase 1, which was operated from 2018-2022 but in Lao PDR maintained its focused on ODF given the high levels of open defecation and inequities in service particularly prevalent across different ethnic groups. SNV engaged at both the province and district levels (e.g., building capacity among local government, private sector, civil society, and sub-national government) and at the national level (National Nam Saat, Ministry of Health). The programme was in partnership with UTS-ISF as a knowledge partner, and CBM Australia for inclusion expertise and engaged with the Lao Women's Union to increase women's participation in WASH activities.

In Lao PDR, the programme aimed to deliver impact through:

- Targeted support to government health officers, health care facilities and schools to improve access to basic water supplies, basic sanitation, including menstrual hygiene management, and improve hand hygiene behaviour.
- Verification of the three project districts ODF, with strategies in place to sustain this outcome.
- Delivery of meaningful and scalable interventions for climate-resilient adaptation processes, including facilitation of government learning, budgeting and planning, and development of climate-resilient water safety plans, learning and capacity-building for inclusive community WASH committees.
- Research and development of climate-resilient support options for households living in poverty to ensure WASH access for all and leave no one behind.
- Strengthened decentralised WASH systems that are responsive to local climate risks, adaptation and security challenges, capacities and priorities.
- Strengthened private sector engagement in the delivery of climate-resilient, inclusive WASH services.
- Strengthened GEDSI in the WASH sector, including increased female leadership among local WASH provisioners, civil society organisations, communities and households.
- Strengthened use of evidence-based practice and innovation in climate-resilient, safely managed and GEDSI WASH delivery by subnational and national stakeholders, civil society organisations and WASH sector actors.

[9] The World Bank Group and the Asian Development Bank, Climate risk country profile: Lao PDR, Washington DC, The World Bank Group, 2021.
[10] WHO and UNICEF, 'Household WASH Data', The JMP, Geneva and New York, WHO and UNICEF, 2025, https://washdata.org/data/household#!/, (accessed 24 July 2025).

Photo: Water tank construction in rural Mozambique. Credit: Pronasar and SNV.

3.4. Mozambique

OVERVIEW OF THE CONTEXT

Mozambique is a climate-vulnerable country, facing recurring extreme weather events, including cyclones, floods, and droughts that impact its water and sanitation infrastructure and services. Coastal areas, where approximately 60% of the population lives, are particularly vulnerable to tropical cyclones and sea-level rise. The impacts of Cyclones Idai and Kenneth in 2019 highlighted these vulnerabilities, damaging water supply systems and contaminating water sources across multiple provinces. Steady progress has been made in eliminating open defecation, but it is still practised by 28% of the rural population. Less than half (48%) of the rural population has access to at least a basic water service. Thus, there is an urgent need to establish foundational basic services while also planning for future climate change.

Mozambique has a national WASH plan approved by all WASH sub-sectors. The Government of Mozambique is implementing comprehensive water supply and sanitation improvements across rural, peri-urban, and urban areas, aligned with both the Government's Five-Year Plan (Programa Quinquenal do Governo) and the broader Sustainable Development Goals. These efforts span institutional reforms and infrastructure development, with a particular focus on dispersed rural water supply systems and inclusive school sanitation.

PROGRAMME IMPLEMENTATION

In 2021, the Mozambique National Directorate of Water Supply and Sanitation (DNAAS) established a Memorandum of Understanding with the UK Government for the Transforming Access to WASH and Nutrition Services II (T-WASH II) programme, focusing on improving rural WASH services under the National Rural Water Supply and Sanitation Programme (PRONASAR). A significant portion of this funding was dedicated to improving climate resilience for beneficiary communities. As PRONASAR's Capacity Building Agent, SNV has collaborated with DNAAS and Provincial Directorates of Public Works and Housing (DPOP) to conduct climate resilience training, develop assessment tools and undertake assessments of water supply systems nationwide.

SNV has sought to integrate climate resilience into WASH in the T-WASH II programme through four main areas:

1. Capacity building and support to the government to deliver their climate-resilient WASH programming.
2. Sanitation improvement through Behaviour Centred Design and Behaviour Change Communication (BCC).
3. Developing feedback mechanisms for the quality of WASH service provided.
4. Working with the government to develop an early warning system specific to water supply.

[11] Sanitation and Water for All, Mozambique: Collaborative behaviour profile, Sanitation and Water for All, 2020 (revised 2021).

3.5. Ghana

OVERVIEW OF THE CONTEXT

Ghana experiences a diverse array of climate hazards. The country is being exposed to more frequent very hot days and nights, as well as erratic rainfall patterns. Annual average rainfall is reducing, punctuated by intense rainfall events and prolonged dry spells. During the dry season, winds from the Sahara bring arid conditions and dust. Rising sea levels exacerbate flooding risks, particularly in densely populated coastal urban areas like Accra.[12] Reduced rainfall threatens the sustainability of water supplies throughout the country, while intense rainfall events pose water contamination risks. The proportion of the rural population practising open defecation has remained stubbornly high over the past 20 years and currently sits at approximately 30%. About 74% of the rural population has access to at least a basic water service. Hence, climate-resilience building efforts, especially for sanitation, exist in a context where large segments of the rural population have little or no service.

The Government of Ghana recently launched a revised National Water Policy in April 2024, which provides a framework guiding the sustainable use, management and planning of water resources for drinking and other domestic uses. It specifies the Community Water and Sanitation Agency as the government agency to provide support to District Assemblies to promote safe drinking water supply and sanitation services to rural communities and small towns. Moreover, the Ghana Water Supply, Sanitation and Hygiene Sector Development Programme 2021-2030 is the national WASH programme that provides a guiding framework for all WASH activities, projects, and programmes in the country.

PROGRAMME PLANNING

The Healthy Future for All – Phase 2: WASH in Nandom and Lambussie programme is the second phase of a WASH intervention in two districts of Ghana, aiming to "increase the number of children under 15 growing up in a hygienic environment at home, in schools and in health care facilities". Building on the first phase (which ran for three years), it is currently working to scale and institutionalise successful approaches and deepen work on WASH service functionality and behavioural change.

The three-year programme aligns with Ghana's national approach and is particularly focused on strengthening the roles of local authorities, education and health units, the private sector, traditional leadership and community groups. It has four main components:

1. Developing effective, evidence-based behavioural change interventions focusing on water, sanitation, and hygiene.
2. Strengthening supply chains, services, and finance for water and sanitation, including consolidating a revolving fund and supporting local entrepreneurs.
3. Improving the functionality of water and sanitation infrastructure in households, schools, and healthcare facilities through rehabilitation and new construction.
4. Strengthening climate-resilient WASH governance through by-law implementation, developing CRRWASH strategies and local investment plans, and enhancing stakeholder coordination.

[12] The World Bank Group, Climate risk country profile: Ghana, Washington DC, The World Bank Group, 2021.

4. Climate resilient inclusive WASH practices

The threats of climate change to WASH access and the potential responses are often contextual, hence climate-resilient, inclusive WASH practices are diverse. Each of the five SNV country offices profiled in this report have taken a tailored approach, but there are some commonalities. The climate-resilient inclusive WASH practices presented here are categorised into six themes:

1. **Assessing climate risks to inform resilient and inclusive WASH solutions:** Gathering and using current and historical climate data, future climate scenarios, and information about system vulnerability to inform the design and implementation of WASH solutions.
2. **Mainstreaming climate change into WASH strategies and plans:** Strategically planning for climate-resilient and inclusive WASH through integrating explicit consideration of climate change into key WASH guidance documents and processes.
3. **Building the capacity of service providers and authorities to implement resilient and inclusive WASH solutions:** Providing training, knowledge and skill development, and awareness raising to WASH service providers and authorities to enable them to implement solutions.
4. **Engaging WASH users and communities on inclusive responses to climate change:** Empowering, context-specific messaging that uses inclusive approaches to engage all users, including vulnerable groups, to understand climate risks to WASH and possible solutions.
5. **Enhancing the resilience and accessibility of WASH infrastructure:** Designing or adjusting WASH infrastructure with the intent of offsetting expected climate impacts while ensuring the infrastructure remains physically accessible and usable for all.
6. **Promoting learning on resilient and inclusive WASH through research and knowledge exchange:** Bringing diverse WASH stakeholders together to share ideas and knowledge on climate resilience and inclusion and making use of rigorous research to fill knowledge gaps.

4.1. Assessing climate risks to inform resilient and inclusive WASH solutions

In Nepal, SNV and IWMI worked with local governments in Dailekh and Sarlahi and other local stakeholders to assess climate risks at different scales. At the landscape scale, IWMI applied multi-hazard susceptibility and exposure analyses to four rural municipalities (RMs) using transboundary models that predict exposure and susceptibility of populations to floods, landslides and wildfires. These models were created from historical remotely sensed data and machine learning techniques. The analyses provided data on the percentage area in each of the four target RMs that are susceptible to flood, landslides and wildfires at a resolution of 500m2. Further, climate model data for future projections of hydro-climatic patterns were collected from the sixth coupled model inter-comparison project and refined for local conditions in the four RMs to calculate local indices of future climate extremes, heavy rains, droughts and heat waves. Finally, a hydrological model for the Dailekh district was created using historical observed data of precipitation and surface water discharge. This model is being used to project future water availability on

Photo: Beyond access, inclusive sanitation also entails meaningfully engaging with diverse groups to enhance the quality and reach of services. Credit: SNV.

monthly, seasonal, and annual timescales under different climate change scenarios.

At the water supply level, risk assessments were carried out following the climate, environment, and disaster risk reduction integration guidance. These assessments involved identifying climate impacts on piped water schemes in Dailekh and point sources in Sarlahi, including their consequences for water users with a disability, using the tacit knowledge of representatives from local governments and organisations for persons with disabilities. With support from IWMI, these participatory assessments of water supply schemes identified climate, environmental, and disaster-related risks and risk reduction measures. The process began with a transect walk, where participants moved from household water points to the source, discussing risks along the way. This was followed by a group discussion to share observations and potential responses. Hazards were then assessed using pairwise ranking, where participants compared hazards by severity.

At a household level, climate risks were assessed through research studies in partnership with UTS-ISF, CBM Australia and Upward Spiral. SNV, UTS-ISF and CBM Australia carried out research focusing on household coping mechanisms for dealing with climate impacts that involved the identification of risks by households themselves that seasonally threatened their access to water and sanitation. With Upward Spiral, SNV researched climate risks related to the availability and quality of water that affected how households collect and treat drinking water.

Other risk assessment methods included assessing data collected on climate and disaster impacts on water supplies for a National WASH Management Information System (see section 4.2) and as part of climate-resilient Water Safety Plan processes for individual water supplies (see section 4.3).

In Bhutan, SNV worked with the local organisation Selme Consulting to gather information on current and projected climate hazards, the sensitivity of WASH services to climate hazards, and the capacity of communities and local governments to respond. Information was gathered through a desk review of existing documentation on climate change impacts, focus group discussions and interviews with local government staff members and diverse community members, and through a survey that was sent to 168 people living in urban and rural areas. The information was used to identify and rank the most significant climate risks and to understand who the most vulnerable populations are. At a national workshop, WASH stakeholders considered a variety of adaptation options based on what was learned and used a multi-criteria analysis approach to prioritise WASH solutions.

In Lao PDR, a climate vulnerability assessment was carried out to understand how WASH users were at risk from climate change in rural areas of Savannakhet Province. Information-gathering for the assessment included a desk review on climate impacts in Lao PDR, existing SNV WASH project survey data, interviews with 36 households, including 12 households of people with disabilities and their carers, 30 government stakeholders, 20 private sector actors, and 24 gender disaggregated focus group discussions with community members. The assessment identified the most prominent hazards in the areas (flooding and water shortages) and how they affected the common types of water and sanitation systems. It also considered the direct and indirect outcomes for WASH users when hazards affected water and sanitation systems. Through the interviews, community members scored the severity of different impacts and described their coping mechanisms. All this information was used to develop recommendations for building more resilient and inclusive WASH services.

In Mozambique, the programme developed an assessment tool with the government, based on the University of Bristol's *How Tough is WASH* framework,[13] to assess the climate resilience of existing water supply infrastructure and identify vulnerabilities. The assessment involves quantitative and qualitative measurements of infrastructure, environment, and management factors. Government stakeholders use the tool to inform plans for reducing climate vulnerabilities in water supply systems. There are plans to now extend its application to WASH infrastructure in schools.

4.2. Mainstreaming climate change into WASH strategies and plans

In Nepal, SNV and local government partners reviewed the existing water supply strategies for Mahabu and Dungeshwor RMs in Dailekh and Ramnagar and Parsa RMs in Sarlahi. This review identified that the strategies at the time lacked explicit actions to address climate change risks. Numerous entry points for strengthening climate resilience were identified which formed a basis for many of the climate resilient and inclusive WASH practices included in this report for Nepal. In Mahabu and Dungeshwor RMs, standard operating procedures were revised to enhance the climate resilience of water supply

[13] G. Howard, et al., 'The how tough is WASH framework for assessing the climate resilience of water and sanitation', *npj Clean Water*, 4, 39, 2021.

services, including integrating emergency-related costs into tariff calculations and strengthening the climate-resilient Water Safety Planning process. These updates support better preparedness for climate risks through measures such as funding provisions for major repairs, improved coordination with local disaster risk reduction mechanisms, and promotion of household-level water storage and safe handling practices.

Processes for costing resilient and inclusive water supply systems were also improved. The project carried out capacity building of the four local governments on the National WASH Management Information System (NWASH-MIS), the government's platform for digital WASH data collection, analysis, and visualisation. The system allowed for the calculation of construction costs at the pre-feasibility level for upgrading existing water supply systems to safely managed service levels. The programme further developed a framework for using NWASH-MIS data for costing climate resilience enhancement activities, including spring enhancement, source protection, and drainage water management. The application of NWASH-MIS data supported RMs in Dailekh District in calculating the additional costs specifically for strengthening the climate resilience of existing water supply systems, as well as supported prioritisation of water supply investments based on climate and inclusion parameters. The local governments then reflected the revised water supply strategies, entry points for resilient services, investment priorities, and associated costs in their ten-year LG WASH Plans, and used these Plans to guide the activities and budgets of their annual plans.

In Bhutan, programme partners, including government agencies, reviewed and updated multiple national guidelines and documents, including the Guidelines for Inclusive and Climate Resilient Rural Water Supply Services, Climate Resilient Water Safety Plan (CRWSP) Facilitation Guide, Climate Resilient Inclusive Water Caretakers Trainer's Manual, Bhutan Standard for WASH in Healthcare Facilities, and Water and Sanitation Information System. Training and capacity building initiatives were also undertaken through the programme to ensure that all stakeholders, including engineers, healthcare workers, and government officials, were well-equipped to implement these guidelines effectively. Further, in collaboration with the Water and Sanitation Division of the Ministry of Infrastructure and Transport, the programme supported the development of guidelines on climate-resilient water supply designs that ensure accessibility for people with disabilities.

In Lao PDR, SNV worked with local government teams to build their capacity in integrating climate resilience into their existing sanitation practices. This involved revising existing tools like the national Water Safety Plan guidelines and the WASH Facility Improvement Tool (FIT) and embedding climate resilience into these processes. There was a focus on mainstreaming climate resilience into existing processes rather than treating it as an additional component. This approach included learning by doing, where government partners were involved in the practical application and reflection of these tools. Finally, in partnership with UTS-ISF, a climate-resilient sanitation costing study was carried out to inform the government of the investment needs to achieve area-wide climate-resilient sanitation services.

In Ghana, governance is being improved through better financial planning that accounts for the funding needs of CRRWASH services. The programme focuses on developing, improving, and consolidating Local Investment Plans for CRRWASH, which includes new developments, rehabilitation, and major maintenance beyond the financial capacity of Water and Sanitation Management Teams. This aims to increase the allocation of Internally Generated Funds for sustaining WASH services, as well as create clarity on increased costs required due to climate change, including capital and maintenance expenditures. Learning from the first phase of the programme, Local Investment Plans work more strategically with the area councils under the district and make use of private sector financing through proven mechanisms like low-interest loans from a local bank.

4.3. Strengthening the capacity of service providers and authorities to implement resilient and inclusive WASH solutions

In Nepal, SNV worked with local governments and service providers to build their capacity to implement climate-resilient and inclusive solutions through a variety of trainings. Local government officials and service providers in Dailekh were supported with training on the application of standard operating procedures that were revised to consider the effects of climate change. For example, the standard operating procedure on Climate-resilient Water Safety Planning strengthened the resilience of their water supply systems through measures such as spring enhancement, source protection, and drainage water management and their capacity to operate piped water supply systems under different climatic conditions. Local government officials were also trained on planning for and providing post-construction support for water supply service providers throughout their rural municipalities and the use of the NWASH MIS to inform data-driven planning and decision-making. Elected representatives, WASH coordination committees, and RM staff were also

supported in integrating climate risk-informed actions for WASH into annual planning and budgeting processes using their local government WASH Plans for strategic guidance.

Inclusive approaches were embedded throughout capacity-building activities. For example, Female Community Health Volunteers (FCHVs), who conduct outreach activities for the community-level health facilities, were trained and mobilised to lead household-level behaviour change campaigns on safe drinking water, reaching over 44,000 people. The FCHVs engaged all households but especially focused on those lagging behind, households in poverty, Dalit households, and households having persons with disabilities. Surveys carried out by SNV showed a significant increase in the proportion of people reporting that they treated water before drinking, which is crucial given contamination risks from increased flooding events.

Throughout the programme, there has been active participation of women, households in poverty, and representatives from organisations of people with disabilities in the WASH Coordination Committees, who received capacity-building support on climate resilience. Women were encouraged to be members of Water Users and Sanitation Committees (WUSC) as well as take leadership roles. By the end of the extension phase of the programme, a significant number of women were chairing the WUSCs, and more than 50% of the WUSC members in the programme districts were women. One Chairperson of a WUSC is also a woman with a disability. The active participation of diverse groups in community decision-making platforms helps more comprehensive consideration of climate risks and possible solutions that support WASH access for all.

In Bhutan, the programme supported the training of 72 government Health Assistants on a Climate Resilient WASH FIT to assess and improve WASH services in healthcare facilities. In partnership with the RSPN and the Department of Water, 252 participants (including 120 women) representing six water schemes received training on spring shed and water resource management and protection. This training equipped WUSC members with the knowledge and skills needed to manage and protect their water resources effectively. Additionally, 11 female caretakers received refresher training to enhance their skills, confidence, and technical knowledge.

The programme further provided training and capacity building for 18 district engineers and technicians from national and project districts. Engineers and technicians were trained through a 6-day programme on climate-resilient rural water supply design. These participants subsequently applied their training to support the implementation of CRWSPs in 30 rural communities across six sub-districts, spanning three climatic zones. The training also capacitated engineers to mainstream GEDSI considerations into water scheme design and planning. This reduced dependency on central government agencies. In turn, engineers facilitated community-based CRWSP workshops that trained water caretakers and health assistants and promoted safe drinking water practices at health facilities. Water supply infrastructure designs were revisited to improve accessibility, and nature-based solutions were explored to reduce climate risks.

In Lao PDR, responding to the context of high rates of open defecation, which is a government priority for addressing, the programme included a focus on adapting CLTS for climate change, particularly in flood-prone areas. This involved practical measures such as encouraging households to construct more resilient toilets through participatory activities such as mapping the impacts of floods in villages and role-playing different community members affected by flooding. The programme also raised awareness with private sector actors and local governments to emphasise the importance of building better quality toilets that could withstand flooding conditions. This involved creating frequent community-level touchpoints and coordinating with suppliers to accelerate the purchase and construction of good-quality toilets in targeted communities. It also involved building the understanding of suppliers of GEDSI-sensitive and climate-resilient technology designs. The programme also supported the dissemination of technology options and locally developed solutions to ensure that households could integrate technologies into the design of their homes (e.g., those raised on stilts).

At the government level, active participatory processes in stakeholder workshops fostered local ownership and shared understanding of WASH-related challenges. The programme focused on building the capacity of the Women's Union and the Laos Disability People's Association and ensuring their participation in CRRWASH activities alongside government officials. CBM trained SNV and local government staff on addressing institutional, attitudinal, physical, and communication barriers for people with disabilities. Finally, a disability working group was established that was instrumental in driving tangible changes in WASH infrastructure design and increasing recognition of the need to include people with disabilities, children, and elders in discussions on design and implementation.

Photo: Persona of a climate champion in Lao PDR generated by AI based on participants' insights and feedback during the development of the Climate Hero Toolkit.

The programme also conducted a CRWSP pilot that involved training government officials on integrating climate considerations into water supply management and supporting water quality monitoring. E. coli tests were also conducted to raise awareness about water contamination risks. The work highlighted the need for more regulation on water quality. The potential for domestic rainwater harvesting to be implemented as a safe drinking water source where groundwater is contaminated was researched but found that such systems are often unaffordable for the lowest-income families. Findings from the pilots and research were used to update the national WSP guidelines and broaden government perspectives on sanitation and its impact on water quality, especially when flooding occurs.

In Nepal, Bhutan, and Lao PDR, SNV worked with UTS-ISF to implement the *Climate Hero Toolkit*,[14] which strengthened local government and community leadership for initiating climate action for inclusive WASH. Implementation of the Toolkit involved facilitated mentoring of present and future leaders to understand what leadership on climate action looks like and reflect on their progress towards becoming champions of climate action for inclusive WASH.

In Mozambique, the programme provided training on climate resilience to technical staff from the DPOP, DNAAS, and the Provincial Directorate of Land and Environment of each province. The training was conducted in three regions, namely Nampula in the Northern Region, Manica in the Central Region, and Gaza in the Southern Region. This training covered the concept of climate change and its impacts on WASH, as well as practical ways of integrating climate resilience into WASH systems strengthening.

Tiered training and support structures were used to build capacity at multiple levels. The programme sought to build capacity on climate-resilient water services at the provincial government, district government and water operator levels. Iterative feedback and follow-ups also helped to ensure that stakeholders were set up for success. For example, the programme supported evaluations of new water supplies to be carried out 6 to 12 months after construction to check if the water supply operators can manage the new infrastructure and its climate resilience design features.

The government was engaged and took leadership of tool development (see the Enhancing the resilience and accessibility of WASH infrastructure section) and assessment processes. Government interest generated through the need to report on the climate resilience of services and the possibility of accessing climate finance. WASH sector government leaders were also proactive in leading the application of the newly developed climate resilience tool and in national contracting processes. Further effort is being undertaken to document and report on the climate resilience of WASH services to possibly support applications for climate financing.

In Ghana, WASH governance is being strengthened through improved coordination between key WASH and water resource stakeholders in addressing climate risks. In particular, the programme is working with local governments, the Community Water and Sanitation Agency, and the Water Resources Commission on multi-

[14] D. Gonzalez et al., Climate hero toolkit: Strengthening local government leadership for climate resilient inclusive WASH. SNV & UTS-ISF, Sydney, 2024.
[15] SNV and Upward Spiral, Formative research report; Safe drinking water, Bhutan and Mumbai, SNV, 2024.

stakeholder alignment and joint planning. Linking WASH stakeholders with the Water Resources Commission, which operates at the water basin level, promotes a more holistic approach to addressing climate risks to water security. A key ambition is to also work with the Water Resources Commission to build the capacity of local staff and highlight key issues relating to water resource management and how best to enforce regulations (e.g., relating to water quality testing). The programme uses established district-level platforms to facilitate these cross-agency collaborations. Finally, the programme is supporting local voices in WASH governance through public forums to facilitate dialogue between communities and local government.

4.4. Engaging WASH users and communities on inclusive responses to climate change

In Nepal, a significant capacity-building activity involved institutionalising evidence-based BCC. This activity was informed by a formative research study carried out by SNV and Upward Spiral.[15] This study found that women were primarily responsible for water collection and treatment, people with disabilities were not able to access clean drinking water at home, and community members sought out alternative water sources with high risk of contamination when their preferred water source was disrupted by climate events. Drawing on the study's findings, local governments were trained on making BCC campaigns inclusive and climate-sensitive, for example, ensuring that households treated their drinking water consistently throughout the year, irrespective of the water source they used, especially during climate events. Campaigns also encouraged men to contribute to household WASH activities to manage climate risks; deliberately engaged marginalised groups, such as an organisation of people with disabilities, to ensure households adopted drinking water treatment and storage technologies that persons with disabilities could readily access (e.g., filters); and linked local women entrepreneurs to households for providing these technologies.

In Bhutan, during the development of the CR-WSPs, programme partners sought to draw on the experiences of diverse people to understand climate-related issues. One method for gathering these experiences was the water scheme walk. This involved inviting women, men, people with disabilities and caregivers from the community, and health and engineering personnel from the government, to inspect or map out the entire water service from source to consumption. This enabled the participants to discuss and learn from one another's different experiences and viewpoints on water supply issues and possible solutions. The programme also engaged the DPOB as a key partner in planning, designing and implementing climate-resilient water supply solutions. The water scheme walk also involved water quality testing and discussion of the importance of sharing water quality results with local leaders and the community.

Further, formative research in Bhutan revealed that secondary water sources used during the dry season are often unsafe, with water treatment practices varying by region and climate. In response, SNV worked with governments to tailor water treatment campaigns to promote safe boiling practices adapted to both cold and warm climates.

In Lao PDR, at the community level, initiatives aimed at supporting community members to manage climate risks also aimed to challenge restrictive social norms, particularly around women's participation in decision-making. Efforts were made to include marginalised groups, such as people with disabilities, in discussions and decision-making processes. Campaigns and materials were designed to reach all groups within the target communities, especially women and people with disabilities. These activities also aimed to help men understand how they could support their families and neighbours in climate risk situations.

4.5. Enhancing the resilience and accessibility of WASH infrastructure

In Nepal, enhancements to the resilience and accessibility of WASH infrastructure were made to suit the local environmental conditions. In the hilly district of Dailekh, the programme supported climate-resilient piped services by first strengthening local capacity and planning. Local governments and WUSCs were trained to use NWASH-MIS data, climate-resilient standard operating procedures, and the CRWSP process to prioritise, cost and design upgrades. Amongst other aspects, the CRWSP process emphasised addressing the wider sub-catchment beyond the source, spring source protection, linking between the CRWSP team and the RM technical staff to disaster risk reduction mechanisms, risks from leakages on the surrounding environment, the management of surface water and drainage runoff to promote recharge of groundwater, erosion, reuse water of water, and household level water storage techniques. The programme also followed best practice in installing flow regulation chambers in distribution lines and water meters. Six demonstration upgrades to water supply schemes were supported using robust materials and construction techniques to withstand climate hazards.

In the flatlands district of Sarlahi, the programme

demonstrated an alternative to the ad-hoc, inequitable tubewell response used during a drought. When a drought caused traditional wells to run dry, numerous deep tubewells fitted with electric submersible pumps were haphazardly installed by local stakeholders with little consideration of equitable distribution or sustainable management of the water resource. SNV took the opportunity to demonstrate an appropriate climate-resilient water supply by supporting the local government to overhaul some of the tubewells with a communal piped scheme that includes features such as an overhead tank, chlorination, and underground distribution pipes feeding one tapstand per household. This network, built as a model system of how to respond to a drought, provided a reliable source of safe drinking water during a time of water scarcity. Following the construction, an operation and management fund and an agreement on tariff levies were established to cover operation and minor repair costs. The programme also supported a community-managed service delivery model that empowered women to actively participate in water committees to ensure the sustainability and continued operation of the infrastructure.

In Bhutan, following the training of 252 community and Water User Association members on springshed and water resource management and protection, the programme supported source protection and rehabilitation work in five water schemes. This work lessened the risk of contamination from heavy rainfall events, which are expected to increase in frequency in Bhutan. Interventions were also supported by SNV to address specific risks, such as strengthening supports for suspended pipe crossings and relocating water supply intakes to avoid landslide damage, and expanding a water supply reservoir to account for longer dry periods. Additionally, as a result of 18 district engineers and technicians being trained on CRWSP processes, knowledge on climate-resilient rural water supply designs is being applied as part of the contracting and procurement cycle in their districts.

In Lao PDR, the programme has supported the development of flood-resilient sanitation superstructures that consider existing and future flood risks. Community-level planning supported by Water Safety Planning and post-ODF priority setting has led to practical infrastructure improvements, including raised borehole platforms, designated waste disposal areas, and fencing to protect backup water sources from contamination during droughts or floods. Locally developed solutions and technology options have been widely disseminated to further promote these practices.

In Mozambique, a key initiative of the programme was the development of a 'resilience matrix' to inform the construction, design and governance of water systems. This matrix facilitates water system implementers and managers to consider the likely climate events for specific regions of Mozambique.

Photo: Water User Association and community members examining the impact of climate-induced landslide on drinking water supply. Credit: SNV

The matrix was developed collaboratively by the SNV team and provincial government officials, with input from consultants with expertise in hydraulic engineering and climate resilience. It is planned that this matrix will be mandated in tender documents and adopted as a national guideline.

In Ghana, the programme is piloting innovative construction practices that incorporate resilient design elements. For example, the construction of water facilities, like boreholes and small water supply schemes, that are engineered to cope with low groundwater levels and extreme flood events. A solar-powered water system that will be managed by a Small Water Enterprise is also being piloted. This pilot, which builds upon a social enterprise model tested in communities in the Nandom district, aims for efficient water management and professionalisation of local water services.

4.6. Promoting learning on resilient and inclusive WASH through research and knowledge exchange

In Nepal, research organisations were engaged in numerous aspects of programming to create an evidence base for action. Research in partnership with IWMI was carried out to gather scientific data to inform risk assessments and to gather local knowledge on risks (see section 4.1). Research with UTS-ISF also informed the development of the Climate Hero Toolkit that facilitates motivated local government officials to reflect on their own values and leadership styles and identify practical actions they can take to support climate-resilient WASH services. SNV also carried out formative research with Upward Spiral inform BCC interventions related to water collection and treatment (see section 4.4). Additionally, the programme shared its learnings at various knowledge exchange events, including at international and national conferences, government-led events, and online webinars.

In Bhutan, through a transformative leadership initiative, UTS-ISF and SNV developed guidelines to help 28 local leaders understand their roles and responsibilities and foster a rights-based approach regarding the delivery of climate-resilient water services. The increased awareness among local government leaders about the needs of different community sections and the climate impacts on water schemes led to budget allocations for making services more accessible and encouraging women's participation.

Knowledge-sharing resources were also developed to better prepare healthcare facilities for climate change challenges. With support from Upward Spiral, SNV's Bhutan team collaborated with SNV's teams in Nepal and Lao PDR to carry out formative research to inform the design of interventions promoting safe drinking water practices, such as boiling and safe handling, when contamination risks are heightened due to heavy rainfall. Posters and testimonial videos were designed and integrated into the CRWSP process. These resources were then rolled out by local health assistants and engineers at primary health centres and outreach clinics.

In Nepal and Bhutan, UTS-ISF, CBM Australia and SNV carried out research to understand household coping mechanisms for responding to climate impacts on WASH services. This research led to the development of recommendations for local government water and sanitation authorities, rights-holder organisations, and service providers on how to better support communities to cope with climate impacts in the near term.

In Lao PDR, a learning exchange visit to Cambodia gave the Government of Lao PDR decision-makers an opportunity to see new ways of integrating climate considerations into WASH programming. This experience inspired fresh ideas for technologies, BCC, and governance approaches amongst the participants.

Additionally, in collaboration with UTS-ISF, the programme undertook research on costing for safely managed sanitation, focusing on high-risk flooding areas like Champhone. This research detailed the full life-cycle costs of resilient and safely managed sanitation, providing a breakdown of cost burdens and necessary investments.

In Mozambique, the programme introduced Behaviour Centred Design and BCC methodologies to promote the construction of more durable and inclusive latrines, improving upon national rural sanitation approaches like CLTS. This involved formative research to understand factors influencing the construction of durable latrines and an implementation phase in two pilot districts. The approach has raised community demand for durable latrines that are more likely to withstand climate hazards.

All country teams and their government partners participated in an SNV Global Learning Event on 'professionalising management and accountability in rural water supply' in Mozambique. SNV teams also joined Water for Women Fund learning events in Australia and Cambodia, and a conference in Thailand. Each of these events enabled learning on resilient and inclusive WASH practices from other countries, training through event workshops, and discussion of emerging ideas on delivering resilient WASH service to all.

Photo: Water is not just a resource. It is a multiplier of resilience, rights, and development opportunities. Credit: SNV/Bart Verweij.

5. Water security

This section situates activities progressing climate-resilient WASH within SNV's water security framework, reflecting on the benefits and priorities for approaching climate-resilient rural WASH within a water security framing.

5.1. Connecting climate-resilient and inclusive rural WASH to water security

WASH AND WATER SECURITY: OPPORTUNITIES FOR STRONGER INTEGRATION

Water security concepts have long included a focus on human water needs as well as ecosystem needs.[16,17] However, the WASH sector has been more strongly associated with public health and human rights issues,[18] with limited engagement on how water security ideas might benefit and be enriched by deeper connections with WASH. Exceptions are the body of work focusing on the measurement of household water insecurity,[19] and pre-Sustainable Development Goal work proposing water security as helpful for conceptualising domestic water supply.[20] Yet a divide has persisted, with parallel institutions for WASH and wider water management, separate policy discussions, and distinct professional communities.

A particular gap is the lack of connection between water security and sanitation, with issues of sanitation-related pollution not well discussed in water security literature.[21] This separation is challenged by the lived reality of communities, where access to clean water and safely managed sanitation is inseparable from questions of water resource availability, quality, and management.

SNV'S LOCATION OF WASH WITHIN A WIDER WATER SECURITY FRAMEWORK AND STRATEGY

Since 2023, SNV has been challenging the artificial separation between WASH and water security, pursuing an integrated Water Security for All strategy in which CRRWASH is one of four core priorities.[22]

In their water strategy, SNV defines water security as the reliable availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks. Translating this definition into a practical framework, SNV's water sector strategy identifies four dimensions of water security to guide programming: water use, pollution, water resource security, and hazards and risk (Figure 3, on next page).

[16] Cook, C. and Bakker, K., 'Water security: debating an emerging paradigm', *Global Environmental Change*, 22, 1, 2012.
[17] Cook, C. and Bakker, K., 'Chapter 2 Water security: critical analysis of emerging trends and definitions', *Handbook on Water Security*, 2016, p. 19–37.
[18] S. de Wit et al., 'Water, sanitation and hygiene (WASH): the evolution of a global health and development sector'. *BMJ Glob Health*, 9, 10, 2024.
[19] J. Stoler, et al., 'Frontiers of household water insecurity metrics: severity, adaptation and resilience', *BMJ Global Health*, 8, 5, 2023.
[20] D. Bradley and J. Bartram, 'Domestic water and sanitation as water security: monitoring, concepts and strategy'. *Philos Trans A Math Phys Eng Sci*, 371, 2002, 2013
[21] Carrard, N. and Willetts, J., 'Environmentally sustainable WASH? Current discourse, planetary boundaries and future directions', *Journal of Water, Sanitation and Hygiene for Development*, 7, 2, 2017.
[22] The three other core priorities are equitable water resource management, sustainable inclusive irrigation, and sustainable urban water cycles.

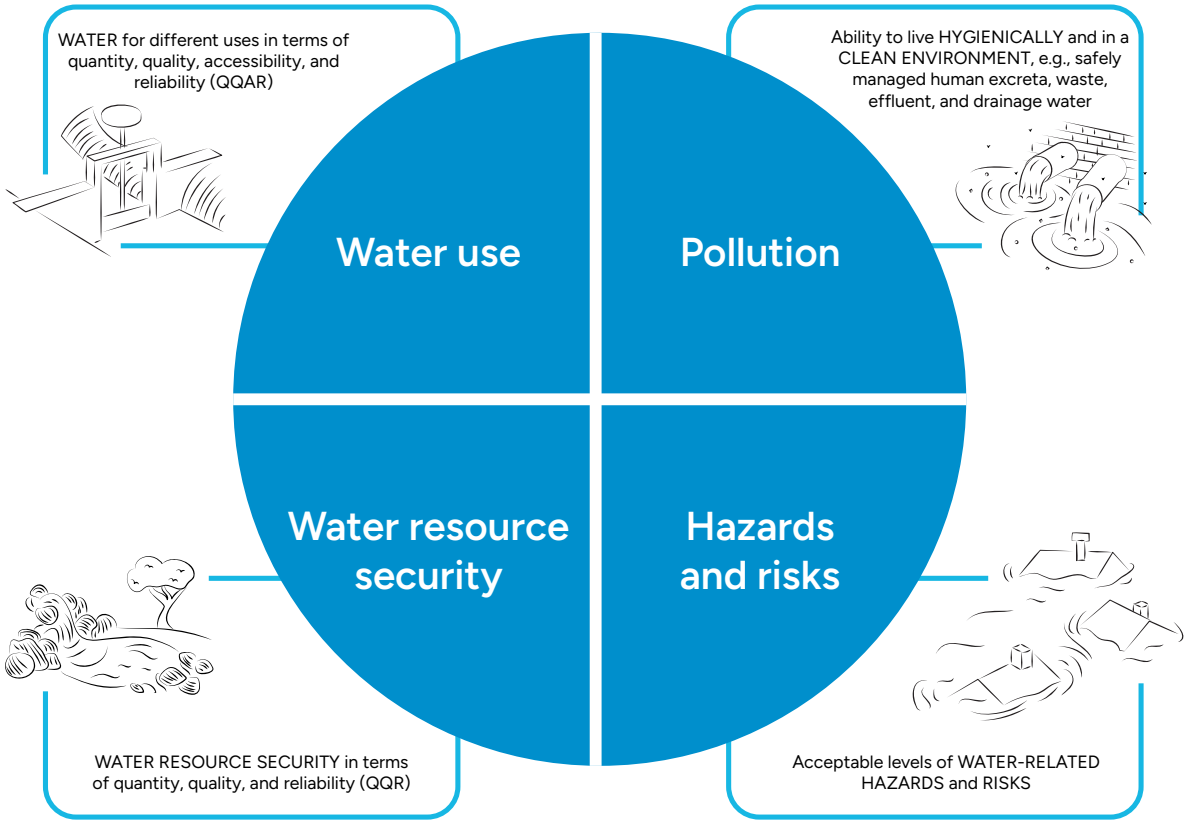

Figure 2. SNV water security dimensions

In this framing, SNV's WASH programmes directly address the availability, quality, safety, and reliability of water and sanitation services for individuals and communities, thereby contributing to overall water security. SNV also recognises climate change as a fundamental threat to water security generally, with specific connections made to WASH in two directions - both recognising climate change impacts on WASH infrastructure and services (including hazards and risks), and seeing WASH as a cornerstone of climate resilience, particularly for vulnerable populations.

As such, SNV's approach warrants particular focus in this report as illustrative of how WASH, climate resilience and water security can be pursued as integrated objectives in practice.

HOW SNV CRRWASH PROGRAMMES RELATE TO WATER SECURITY

The programme activities documented in this report demonstrate how SNV's climate resilient and inclusive WASH practices are directly contributing to water security. Many other practices, such as those that build the capacity of service authorities and service providers, indirectly contribute to water security through strengthening systems that make improvements possible. Illustrative activities shown in Table 1 (on next page) reveal that all country programmes contributed to at least three of the four SNV water security dimensions, with particular focus on 'water use' and 'risk and hazard' dimensions.

A key point in this narrative is emphasising sanitation as central to water security. Water security discussions often focus on water supply and resource management, inadvertently sidelining sanitation despite its fundamental role in protecting water quality. The climate-resilient sanitation approaches documented in this report represent water security interventions that protect source waters from contamination.

Table 1. Mapping illustrative CRRWASH activities to SNV's four dimensions of water security

	Nepal	Bhutan	Lao PDR	Mozambique	Ghana
Water use: the quantity, quality, accessibility, and reliability of water for different uses	Enhanced planning of climate resilient rural water supplies through supporting local governments to make data-driven decisions using NWASH-MIS and updated technical guidelines Supported the construction of robust and accessible piped schemes in Dailekh and accessible communal water points and a model deep tubewell-fed piped network with chlorination in Sarlahi to counteract climate effects Implemented BCC on equitable water collection and treatment practices in times of climate stress	Updated WASH technical and planning guidelines to integrate climate resilience and inclusion aspects Trained WASH stakeholders on CRWSPs and Climate Resilient WASH FIT Protected and rehabilitated springfed schemes to counteract climate effects Implemented water treatment promotion campaigns tailored for different regions and climatic zones	Updated Water Safety Planning and WASH FIT guidelines to incorporate climate resilience, and piloting of a CRWSP Raised awareness of government and community on water quality issues through E. coli testing	Tiered capacity-building for government staff at different levels on planning and implementation of climate-resilient water supplies	Planning construction of solar-powered water systems managed by small water enterprises to ensure reliable access despite power disruptions Supporting the development of Local Investment Plans that account for increased costs on water systems due to climate change impacts
Water pollution: the ability of people to live hygienically and in clean living environment (free from pollution), e.g., from human excreta, wastewater, drainage, septic effluent	Worked with local governments and service providers on water source protection as part of climate resilient WSP processes	Trained 252 community and Water User Association members on springshed protection and management	Worked with private sector to offer disability-inclusive, resilient sanitation options Studied the life-cycle costs of climate resilient rural sanitation, building an evidence base for required investment and additional costs associated with climate resilience Integrated consideration of flood risks into CLTS triggering activities	Implemented a Behaviour Centred Design approach to promote more durable and inclusive latrines that can withstand climate hazards Focus on raising community demand for durable sanitation able to continue containment during extreme weather events	Planning collaboration with the Water Resources Commission, which has a mandate for water quality protection

	Nepal	Bhutan	Lao PDR	Mozambique	Ghana
Hazards and risks: protection of people to the most severe nacceptable") water-related risks	Conducted participatory climate-risk assessments to identify and rank flood, landslide and drought threats to water schemes Researched present and future climate risks to water systems using environmental data and flood, landslide, and drought models Undertook assessment of community coping mechanisms to build evidence about responses to climate hazards and support needs	Facilitated a national assessment of climate risks with key stakeholders based on interview, focus group, and household survey data Undertook assessment of community coping mechanisms to build evidence about responses to climate hazards and support needs	Carried out a detailed climate-vulnerability assessment with households, government and private actors to inform WASH resilience measures for flooding and drought	Developed a 'resilience matrix' to inform construction and governance of water systems that consider reliable access during climate events	Using established district-level platforms to facilitate cross-agency collaboration during hazard events
Water resource security: in terms of quantity, quality, reliability of water bodies on which people rely	Worked with local government on spring enhancement as part of climate resilient WSP processes	Trained 252 community and Water User Association members on springshed protection and management Developed draft guideline for Community-based Spring Shed Management			Planning to link WASH initiatives to broader water resource management issues, moving beyond household-level interventions

Photo: Flooded bridges can disrupt day-to-day life and cut off communities. Credit: SNV/Bart Verweij.

5.2. Future directions

The global WASH sector is continuing to evolve its understanding of and approaches to addressing the threats of climate change to WASH access and service delivery. SNV's CRRWASH approach provides examples for advancing climate-resilient and inclusive WASH practice in rural areas that can be further progressed. Three areas of climate-resilient and inclusive WASH praxis (theory put into practice) that build on the CRRWASH approach and the SNV water security framework and stand out as priorities for the global WASH sector are:

1. **Continue to make space for inclusion and safely managed services:** Social inequalities and inadequate access to WASH are principal drivers of vulnerability to climate change. As climate-resilient WASH and water security narratives and practices globally tend to focus on biophysical and technical dimensions, SNV's demonstrations of the necessity to account for socially differentiated experiences of climate change are critical. Further development of practical know-how on addressing inequality as an entry point to minimising climate risk requires attention alongside technical interventions.
2. **Redraw development boundaries:** The classical sectors of aid and development (e.g. WASH, water resource management) can be counterproductive. The impacts of climate change transcend current sectors, which accentuates the challenges of siloed approaches. SNV's overall approach to water security can help lead development actors away from seeing human rights to water and sanitation and environmental sustainability as competing priorities and towards integrated socio-environmental solutions.
3. **Transform systems and address risks:** Addressing discrete, near-term climate risks for WASH access (e.g. water shortages during droughts, contamination from floods) is needed, but may be inadequate on its own for resolving deeper, systemic problems that obstruct safe access to WASH for all and are exacerbated by climate change. Transformations involve further challenging power dynamics that create vulnerability to climate change, shifting the foundational policies and practices of WASH institutions to more sustainable pathways, and changing how WASH and other development actors think about solutions to climate change.

Cover photo: Person washes his face after a hard day's labour. Credit: SNV/Bart Verweij.

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