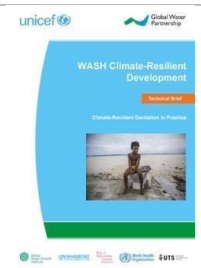
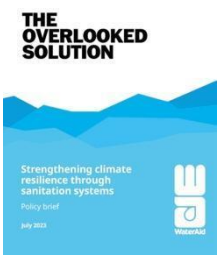
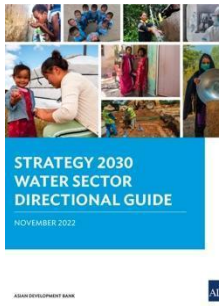
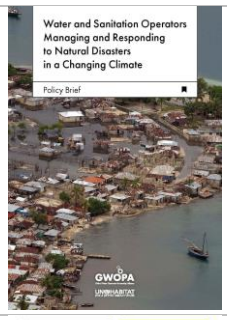
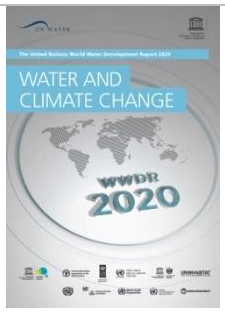
CLIMATE RESILIENT SANITATION: COALITION FOR ACTION

Member Resources on Climate Resilient Sanitation

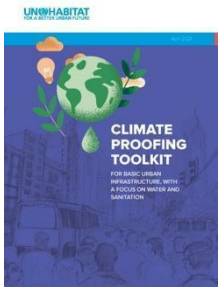
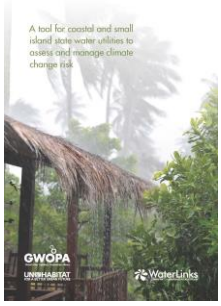
Call to action, policy and strategy

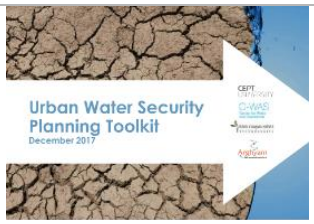
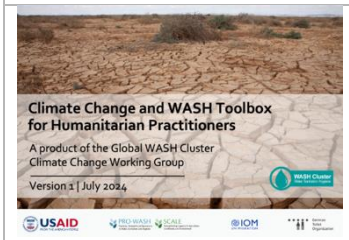
	[Ensuring access to climate-resilient sanitation services for 3.6 billion people by 2030: A call to action for acceleration] This call to action implores governments, development partners and civil society organisations, donors, academic and research institutions, the private sector, and climate activists to work collectively to ensure access to safe, climate resilient sanitation services for 3.6 billion people in developing countries by 2030, outlining specific actions for each stakeholder.
	[Technical Brief Climate Resilient Sanitation in Practice] This technical brief aims to help sector stakeholders better understand the rationale for and approaches to climate-resilient sanitation, shares resources for programming and outlines opportunities for climate financing and how the WASH sector can better access it.
	[Addressing climate change: Supplement to the WHO water, sanitation, and hygiene strategy 2018-2025] This document accentuates the need for countries to integrate climate resilience into their WASH planning and policies. It highlights key focus areas including monitoring, integrating climate resilience into risk management approaches, establishing climate-resilient water and sanitation in health care facilities, expanding research on climate change's impact on health outcomes, strengthening environmental surveillance, controlling vector-borne diseases, and integrating WASH within climate change, health policy, and Integrated Water Resources Management (IWRM) frameworks.
	[The overlooked solution: strengthening climate resilience through sanitation systems] This report sets out the need to take a systems-wide perspective along the entire sanitation service chain and highlights key opportunities and approaches to achieve this. This report sets out three approaches to adapting and strengthening sanitation systems, and three recommendations for prioritising sanitation in climate policies and financing and ensuring effective collaboration across sectors to build climate-resilient sanitation systems, communities, and the surrounding natural environment.

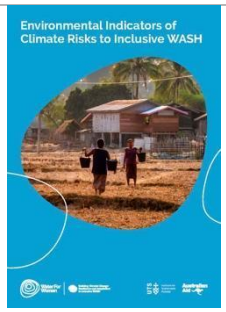
	[Strategy 2030 Water Sector Directional Guide – A Water-Secure and Resilient Asia and the Pacific] This Water Sector Directional Guide (WSDG) provides the strategic direction of the Asian Development Bank (ADB) for the water sector. It describes the context and rationale that will guide ADB's agenda in supporting developing member countries (DMCs) with financing, knowledge, convening ability, and technical assistance (TA) to ensure improved coherence, relevance, efficiency, and effectiveness of ADB's water sector investments. It is intended for both an internal ADB audience and an external audience.
	[Water and Sanitation Operators Managing and Responding to Natural Disasters in a Changing Climate: Policy Brief] This policy brief provides an overview of the current context and relevant initiatives implemented by water and sanitation operators in their response to natural disasters and climate-related hazards. It explores and assesses operators' tools and mechanisms aimed at securing water, sanitation and hygiene (WASH) for all during times of crises, including the governmental and regulatory measures that seek to secure long-term service sustainability through provision of technical and financial support to operators.
	[Opportunities for sustainable sanitation in climate action - Factsheet of Working Group 3] This SuSanA factsheet sets out key interactions between climate change and sanitation. It examines the relevance of sustainable sanitation in light of the Paris Agreement on climate and the Sendai Framework for Disaster Risk Reduction 2015–2030. It also introduces some of the more climate-resilient, low-carbon sanitation solutions available, and practical advice on how to integrate climate and sanitation strategies.
	[Discussion paper: Climate, Sanitation and Health] This paper provides an overview of the impacts of climate variability and change on sanitation and the implications for health. It outlines potential adaptation options for strengthening climate resilience of sanitation governance, policies, systems, and services, and highlights further research needs and imperatives for policy and programming. It has a global focus, noting that the specific issues may differ across countries with varying levels of onsite and sewerage sanitation systems.
	[The United Nations world water development report 2020: water and climate change] This report aims to help the water community to tackle the challenges of climate change and inform the climate change community about the opportunities that improved water management offers in terms of adaptation and mitigation. It focuses on the challenges, opportunities and potential responses to climate change, in terms of adaptation, mitigation and improved resilience that can be addressed through improving water management.

Guidance, tools and toolkits

Adaptation

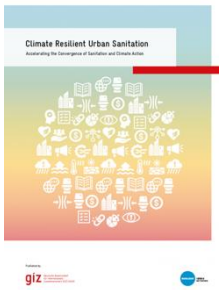
	Climate Proofing Toolkit: For Basic Urban Infrastructure with a Focus on Water and Sanitation The Climate Proofing Toolkit is a set of steps, tasks, and tools to provide guidance to policymakers, planners, practitioners, engineers, and utility managers to ensure that the potential climate change impacts are factored in the design, construction, location, and operation of current and future basic urban infrastructure, with a focus on water and sanitation.
	Sanitation safety planning - Second edition The sanitation safety planning approach follows the Stockholm framework for preventive risk assessment and management and uses the methods and procedures of hazard analysis and critical control point (HACCP). The manual incorporates experiences of using sanitation safety planning in more than 25 countries across different regions and was developed under the guidance of a strategic advisory group and with review by experts and practitioners. This publication is the update of the document published in 2015 entitled “Sanitation safety planning: manual for safe use and disposal of wastewater, greywater and excreta”.
	Coastal Climate Impact Analysis and Sanitation Hazard Assessment Framework This handbook provides stepwise guidance for facilitating authorities responsible for citywide sanitation services to develop an adaptive action plan for ensuring the resilience of their city’s sanitation services to the impacts of sea level rise.
	A Guide for Integrated Conservation & Sanitation Programs & Approaches This guide was prepared by The Science for Nature and People Partnership (SNAPP) Improving Coastal Health working group led by Wildlife Conservation Society. It aims to create awareness among stakeholders about the impacts of poor sanitation and wastewater pollution on ocean health and the importance of more integrated solutions, outline the benefits of an integrated approach for achieving human and ecosystem health goals and simultaneously improving climate resilience, and provide guidance to the conservation and sanitation sectors on how to work in partnership.
	A Tool for Coastal and Small Island State Water Utilities to Assess and Manage Climate Change Risk This guidebook is designed to help utilities in coastal and small island states identify and assess climate change impacts that threaten their operations and then formulate responses. It draws principles from the Water Operators’ Partnership (WOP) between Yarra Valley Water, Melbourne, and the National Water Supply and Drainage Board, Sri Lanka, but has universal application.

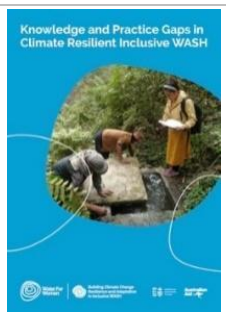
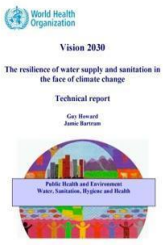
	[ClimateFIRST (Climate Framework to Improve the Resilience of Sanitation Technologies)] ClimateFIRST is designed to help sanitation commercial and NGO implementers, and research and development personnel, to assess and improve the resilience of sanitation technologies.
	[Rural sanitation and climate change: Putting ideas into practice] This publication aims to address gaps in rural sanitation and hygiene thinking through unpacking the reasons behind the limited progress towards addressing climate change in the sanitation and hygiene sector, exploring climate impacts on rural sanitation and hygiene practices, placing people, households, and communities at the centre of programming, and providing actionable ideas to integrate climate thinking into rural sanitation and hygiene programming at the household and community level.
	[Compendium of Water and Sanitation Disaster Resilient Technology Options] This Compendium provides drawings, examples and pictures that aim to contribute to the promotion of disaster risk reduction measures and climate change community-based strategies that ensure resilience of WASH facilities.
	[Urban water security toolkit - A case of Bhuj] Assessment and in-depth understanding of the current water supply scenario is a key step in planning for a water-secure city. This document provides tools for stakeholders to move towards water secure cities. Developed based on the experience in Bhuj, it contains guidelines and tools for improving water security that can be used in other cities.
	[Climate Resilient WASH Systems Academy Course] It is a 10-hour, 7-module on-line course on Climate Resilient WASH created by Water for People, IRC, and WaterAid. It covers climate-WASH linkages and definitions, social inclusion, risk assessment, design and implementation, finance, and advocacy.
	[Climate Change and WASH Toolbox for Humanitarian Practitioners] This toolbox offers capacity strengthening resources and tools to help organizations understand and address climate change in WASH, particularly related to adaptation, mitigation, and environmental mainstreaming. Resources include technical and training guides, online courses, and learning briefs. The intended audience of this toolbox is professionals in the humanitarian sectors, with a particular focus on those working in WASH.
Mitigation	

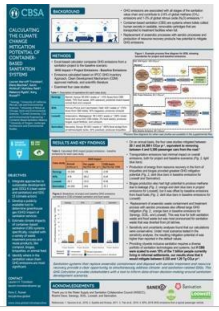
	[ECAM (Energy Performance and Carbon Emissions Assessment and Monitoring Tool)] ECAM is a free and open-source tool that empowers water and wastewater utility operators to assess their greenhouse gas emissions and energy consumption.
	Greenhouse gas excel-based calculator The goal of this excel-based tool is to produce robust and defensible estimates of the impact that a sanitation project has on greenhouse gas emissions. To accomplish this, all emissions resulting from the project's processes are summed, and they are compared to a baseline scenario. Calculations are based on emission factors provided by the Intergovernmental Panel on Climate Change (IPCC) when available. In the absence of IPCC factors, Clean Development Mechanism (CDM) methodologies or peer-reviewed scientific literature were used.
	Transformative WASH for climate resilience toolkit This toolkit contains key resources to help water, sanitation and hygiene practitioners deliver transformative WASH programming with an explicit focus on supporting local communities and institutions to shift harmful norms that exclude the diverse voices of women, people with disabilities and marginalised groups.
	Environmental Indicators of Climate Risks to Inclusive WASH This learning resource summarises a range of indicators that practitioners can use to monitor the key risks of six climate hazards to household water and sanitation access. Specifically, the indicators pertain to changes in the natural or built environment that may be outside the sphere of control of a water and sanitation program.
	UN-Water GLAAS (Global Analysis and Assessment of Sanitation and Drinking-Water) Data Portal GLAAS provides policy- and decision-makers at all levels with reliable, easily accessible, comprehensive data on water, sanitation, and hygiene (WASH) systems, including on governance, monitoring, human resources, and finance. GLAAS monitors elements of water, sanitation and hygiene systems that are required to sustain and extend water and sanitation services and systems to all, and especially to the most vulnerable population groups.
	Eco-sensitive Inclusive Sanitation: Scaling from cities to State and National level This document provides details about the approach taken in cities of Wai and Sinnar in Maharashtra, India to attain the eco-sensitive sanitation services through implementation of various initiatives such as scheduled desludging, setting up of nature based FSTPs and ensuring close loop resource recovery assisting in developing carbon sinks and use of clean energy ensuring reduction in indirect emissions.

Research reports

Adaptation

	Urban sanitation and climate change: A public service at risk This report discusses the current state of thinking and action on urban sanitation and climate change, focusing on four key components important for citywide sanitation: institutions, policy and planning, financing, infrastructure and service provision, and user engagement. The report offers a knowledge and learning agenda, to support a rapid shift in practice to better account for climate change impacts.
	Unlocking carbon credits for sanitation In 2022, the Container Based Sanitation Alliance (CBSA) led a feasibility study to understand whether carbon credits could become a viable income stream for sanitation providers and help to reduce the funding gap. This brief describes the results of this study, and the actions needed to make carbon credits accessible to sanitation providers, providing an additional revenue stream.
	Climate Resilient Urban Sanitation - Accelerating the Convergence of Sanitation and Climate Action This report aims to better understand how climate change impacts will affect urban sanitation systems, and what needs to be done to address this. It does so by collating and reflecting on existing knowledge and highlighting how some cities have approached adaptation. It intends to engage with and propose to a diverse set of sector leaders an outline of the next steps needed to support cities in building the climate resilience of their sanitation services and infrastructure.
	Climate Resilient Urban Sanitation in Indonesia: Hazards, Impacts and Responses in Four Cities This report presents findings of data collected in 2020–2021 from low-income households, sanitation service providers, and local governments in four Indonesian regions. The report presents findings on impacts to sanitation systems, capacity to prepare and respond, as well as principles of climate resilient sanitation. This report also provides recommendations for local and national government and water and sanitation stakeholders regarding climate resilient sanitation.
	Papers to Practice – Podcast Episode 6: Action for resilient citywide sanitation co-developed with local governments in Indonesia This episode is part of podcast season that looks at understanding the interrelations between sanitation and climate change. Juliet Willetts, professor at the Institute for Sustainable Futures at the University of Technology Sydney, discusses how we empower governments in low- and middle-income countries to address climate change.

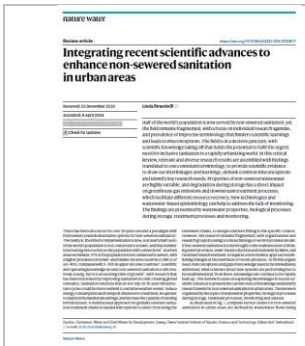
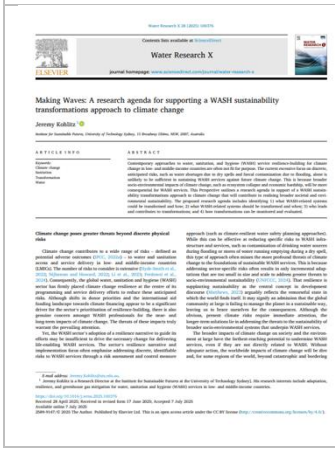
	[Climate Finance for the WASH sector in Asia-Pacific] These regional and country briefs identify the main barriers to climate finance access, highlight proven pathways to funding and recommend ways for civil society organisations (CSOs) and funders to improve access to funds for climate-resilient WASH. Pacific Region | Cambodia | India | Indonesia | Pakistan | Papua New Guinea
	[Knowledge and Practice Gaps in Climate Resilient Inclusive WASH] This report outlines the unique strengths and contributions that Water for Women can make to building climate change resilience and adaptation in inclusive water, sanitation and hygiene, through contributions to the regional and global sectors and enhanced internal capacity. It provides a summary of outcomes from consultations and analysis concerning climate change and water, sanitation and hygiene, both within Water for Women and externally, including country perspectives and regional and global agencies.
	[Vision 2030: the resilience of water supply and sanitation in the face of climate change: technical report] This report presents the findings of research into the projected impact of climate change on water and sanitation services by 2020 and by 2030.
	[Rural sanitation in a changing climate: Reflections and case studies] This report describes case studies of how climate change can be accounted for in rural sanitation programming in three countries: Burkina Faso, Bangladesh, and Lao PDR. Intended for implementers and government authorities, it illustrates how climate risk and vulnerability assessments can inform programming and service delivery, and how climate change can be integrated into rural sanitation interventions such as CLTS.
Mitigation	
	[Managing the climate impact of human waste: A study to understand the methane emissions from faecal sludge and potential abatement approaches] Study developed by USAID's URBAN WASH activity, aimed to understand current sources and drivers of methane emissions from sanitation systems in low and middle income countries. These emissions were found to be high and likely to increase over time. The study also identified approaches and interventions for adoption and relevant evidence gaps.

	[Calculating the climate change mitigation potential of container-based sanitation systems] This poster provides background information on greenhouse gas emissions and container-based sanitation, outlines the methods used to calculate the climate change mitigation potential of container-based sanitation systems, and summarises the key findings of this CBSA project.
	[Approaches to reduce GHG emissions from WASH services] The WASH sector emissions are underestimated, and many indirect emissions are not considered in the sector emission accounting. The study expands on emissions, factors, scenarios affecting the emissions from components of the services chains of water and sanitation.

Academic papers (open access)

Adaptation

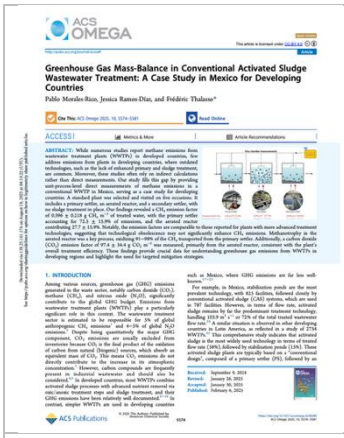
	[Co-developing evidence-informed adaptation actions for resilient citywide sanitation: Local government response to climate change in Indonesia] Addressing a gap in knowledge and practice on systems-wide adaptation response to climate change impacts on sanitation in cities, and fit-for-purpose approaches to prioritising risks, this paper shares a co-production process followed with four city governments in Indonesia. It presents both the process and outcomes of a simplified risk prioritisation and adaptation response identification approach.
	[Climate Change Impacts on Urban Sanitation: A Systematic Review and Failure Mode Analysis] This study responds to this gap by delivering a systematic review that overlays knowledge about the failures of urban sanitation systems today with the stresses that a future climate will impose.
	[Impacts of scheduled desludging on quality of water and wastewater in Wai city, India] This paper discusses the impact of scheduled desludging on water quality. It describes monitoring the quality of groundwater, river water, effluent from drains and supernatants from septic tanks. It reflects the linkages of scheduled desludging and improved supernatants and drain water quality, improving river and groundwater quality. The results suggest a positive impact of regular desludging on the performance of septic tanks. This has led to improvement in the quality of drain water, groundwater and river water.

	[Integrating recent scientific advances to enhance non-sewered sanitation in urban areas] This review presents the fragmented nature of research on non-sewered sanitation, calls for unified technical terminology and notes areas where rapid advances in scientific knowledge are starting to take off, and the importance of these to fulfil climate-resilient sanitation solutions in rapidly growing cities.
	[Designing for climate change: twenty-five design features to improve sanitation technology resilience in low-and middle-income countries] This study describes 25 design features that can be integrated into sanitation technologies to make them more resilient and discusses how the design features should be considered when developing new technologies.
	[8Rs for circular water and sanitation systems: Leveraging circular economy thinking for safe, resilient and inclusive services] This article contributes a heuristic in the form of a conceptual framework for applying circular economy concepts in the design and delivery of water and sanitation services in diverse Global South contexts. It is intended for researchers and implementers who are conceptualising or assessing circular economy options for sanitation and water.
	[Making Waves: A research agenda for supporting a WASH Sustainability Transformations approach to climate change] This research-based perspective paper argues for a sustainability transformations approach for WASH in response to climate change. It outlines a research agenda for the research community to chart a pathway for WASH sustainability transformations to sustain sanitation and water systems under climate change.

	[Assessment of sanitation infrastructure resilience to extreme rainfall and flooding: Evidence from an informal settlement in Kenya] Research article investigating the resilience of sanitation infrastructure in an informal settlement in Nairobi. The article presents a novel index for resilience assessment, adopting the How Tough is WASH Framework. results show that the type of sanitation infrastructure strongly influences resilience. Key factors shaping resilience include physical design, functionality, maintenance practices, and environmental conditions.

Mitigation

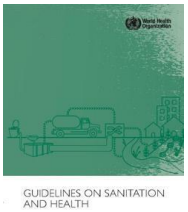
	[Whole-system analysis reveals high greenhouse gas emissions from citywide sanitation in Kampala, Uganda] Global estimates of emissions of greenhouse gasses do not take into account the complex service chain in rapidly growing cities in low- and middle-income countries. This paper presents an end-to-end analysis to estimate emissions from all stages of the sanitation-service chain, using Kampala in Uganda as an example. Significant further empirical and modelling work is required to update estimates of greenhouse-gas emissions from sanitation systems globally.
	[Non-negligible greenhouse gas emissions from non-sewered sanitation systems: A meta-analysis] This paper argues that current methods for estimating sanitation emissions underestimate the significance of methane emissions from non-sewered sanitation systems, and that the greenhouse gas emissions of these systems should be recognised as a non-negligible source.
	[A simplified open flux chamber method for the measurement of greenhouse gas emissions from activated sludge reactors] This research article presents a simplified, cost-effective method for measuring greenhouse gas (CH4, CO2) emissions from wastewater reactors. It uses a floating chamber and a gas analyzer, eliminating the need for separate flowmeters or tracer gases. Validated at a full-scale treatment plant, the technique offers scientists and engineers a simpler tool to improve GHG emission assessments.

	[Greenhouse Gas Mass-Balance in Conventional Activated Sludge Wastewater Treatment: A Case Study in Mexico for Developing Countries] This paper provides direct measurements of greenhouse gas emissions from a conventional wastewater treatment plant in Mexico, serving as a case study for global south contries where such data is scarce. It found the primary settler caused most methane (CH4) emissions (72.3%) , but high methane oxidation (91-98%) in the reactor kept overall emissions comparable to advanced plants. The study highlights the need to measure emissions from untreated sludge discharged into sewers.
	[Field-based methods for measuring greenhouse gases emissions from on-site sanitation systems: A systematic review of published literature] Peer reviewed journal article. This systematic review presents an overview and limitations of field-based methods used for the quantification of GHG emissions from OSS.

Financing

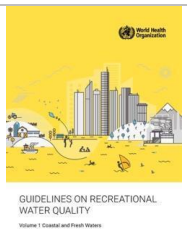
	[Sustainable sanitation and gaps in global climate policy and financing] This paper describes gaps in how sanitation is being addressed in mitigation and adaptation, including the limited climate financing provided and absence of sanitation in climate policy. The authors analysed the distribution of global non-sewered sanitation systems and used IPCC accounting methods to estimate the total methane emissions profiles from these systems. The literature was then examined to establish the level of uncertainty associated with this accounting estimate.
	[Blinded by the 'green-halo'? Equity in financing climate adaptation of urban sanitation] A peer reviewed research article on the equity of financing for climate adaptation. The article uses cross-case document analysis and complementary key informant interviews to examine sanitation adaptation investments in eight cities, focusing on their funding arrangements and social and intergenerational equity implications.

Relevant WHO Guidelines



[Guidelines on sanitation and health]

The purpose of these guidelines is to promote safe sanitation systems and practices to promote health. They summarize the evidence on the links between sanitation and health, provide evidence-informed recommendations, and offer guidance for encouraging international, national, and local sanitation policies and actions that protect public health. The guidelines seek to articulate and support the role of health and other actors in sanitation policy and programming to ensure health risks are identified and managed.



[Guidelines on recreational water quality: Volume 1 Coastal and fresh waters]

These guidelines focus on water quality management for coastal and freshwater environments to protect public health and are aimed at national and local authorities, and other entities with an obligation to exercise due diligence relating to the safety of recreational water sites. They may be implemented in conjunction with other measures for water safety (such as drowning prevention and sun exposure) and measures for environmental protection of recreational water use sites.

[Safe use of wastewater, greywater and excreta]

In 2006, WHO published a third edition of its *Guidelines for the safe use of wastewater, excreta and greywater in agriculture and aquaculture*. In four volumes, these Guidelines propose a flexible approach of risk assessment and risk management linked to health-based targets that can be established at a level that is realistic under local conditions. The approach is to be backed-up by strict monitoring measures.