

Considering climate change in urban sanitation: conceptual approaches and practical implications

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As global warming continues to exacerbate weather variability and extremes to new limits, the effects of climate change will increasingly require proactive planning for sustainable sanitation services. In addition, it is vital that today's investments in systems and service models remain appropriate in a changing climate, and do not tie up future funding in avoidable repairs and replacements. Climate change can also provide impetus to seek improvements in the resilience and sustainability of sanitation systems.

This learning brief presents highlights from the learning paper 'Considering climate change in urban sanitation: Conceptual approaches and practical implications,' which is aimed at prompting new thinking and action on climate change in urban sanitation.

The brief provides conceptualisation of climate change impacts on urban sanitation, and offers policy and programming principles and actions that could be taken up in response.

It draws on **risk-hazard, resilience** and **vulnerability** perspectives developed in the field of global environmental change, and the experiences of SNV Netherlands Development Organisation and the Institute for Sustainable Futures at the University of Technology Sydney.

It shows that addressing the problem of climate change in the urban sanitation sector requires actions across multiple domains that are well-beyond the current focus on technical aspects, which are currently given most attention.

Conceptualisation of climate impacts

The implications of climate change for society are wide-ranging and can be framed in different ways. Below we

describe how climate change could alter the conditions of urban sanitation access and service delivery from three perspectives: risk-hazard, resilience and vulnerability (Figure 1, on next page). These perspectives are then applied to analyse the possible climate impacts for the urban sanitation sector.

Key messages

Climate change threatens urban sanitation through increasing physical risks, heightened uncertainty and deepening inequalities. Policy and programming responses that span institutional, technological, social and environmental domains should be designed to account for all of these impacts.

Adaptable and flexible urban sanitation service delivery and management models assist with uncertainty and volatility driven by climate change. Adaptable and flexible services can be built through the development of management processes and infrastructure that can be easily changed to suit emerging or unexpected conditions.

Climate change is likely to affect traditionally vulnerable and marginalised groups the most; so solutions must prioritise their needs. Urban sanitation policy and programming responses to climate change should be designed to provide equitable benefits and avoid exclusion of marginalised groups from decision-making or participating in climate action programmes.

Risk-hazard: increased risk to systems situation

Perhaps the most common perspective on the impacts of climate change is the risk-hazard approach, which interprets the threat of climate change in terms of the physical risk that climate hazards pose to urban sanitation systems (Eakin and Luers, 2006).

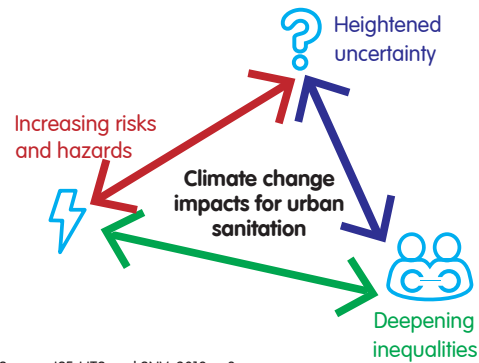
Viewing climate change consequences for the urban sanitation sector through this perspective involves identifying the hazards that create the highest level of risk for sanitation service delivery and developing control measures to reduce risk.

Climate change-driven hazards can increase or create risks for urban sanitation services in many ways:

- Damaging or destroying sanitation infrastructure itself (toilets, pumps, treatment, emptying trucks).
- Disrupting the services on which sanitation depends (drains, water supply, roads, electricity).
- Reducing the functionality or accessibility of sanitation infrastructure.

Predicting the flow-on effects of disruption in urban sanitation is particularly complex because of the numerous steps in the service chain, the non-homogeneity of sanitation systems across a city, and the dynamic interconnected flow paths where changes in behaviour, technology or operation of one part ripples across the urban environment.

FIGURE 1: Perspectives on climate change impacts



Source: ISF-UTS and SNV, 2019, p.8.

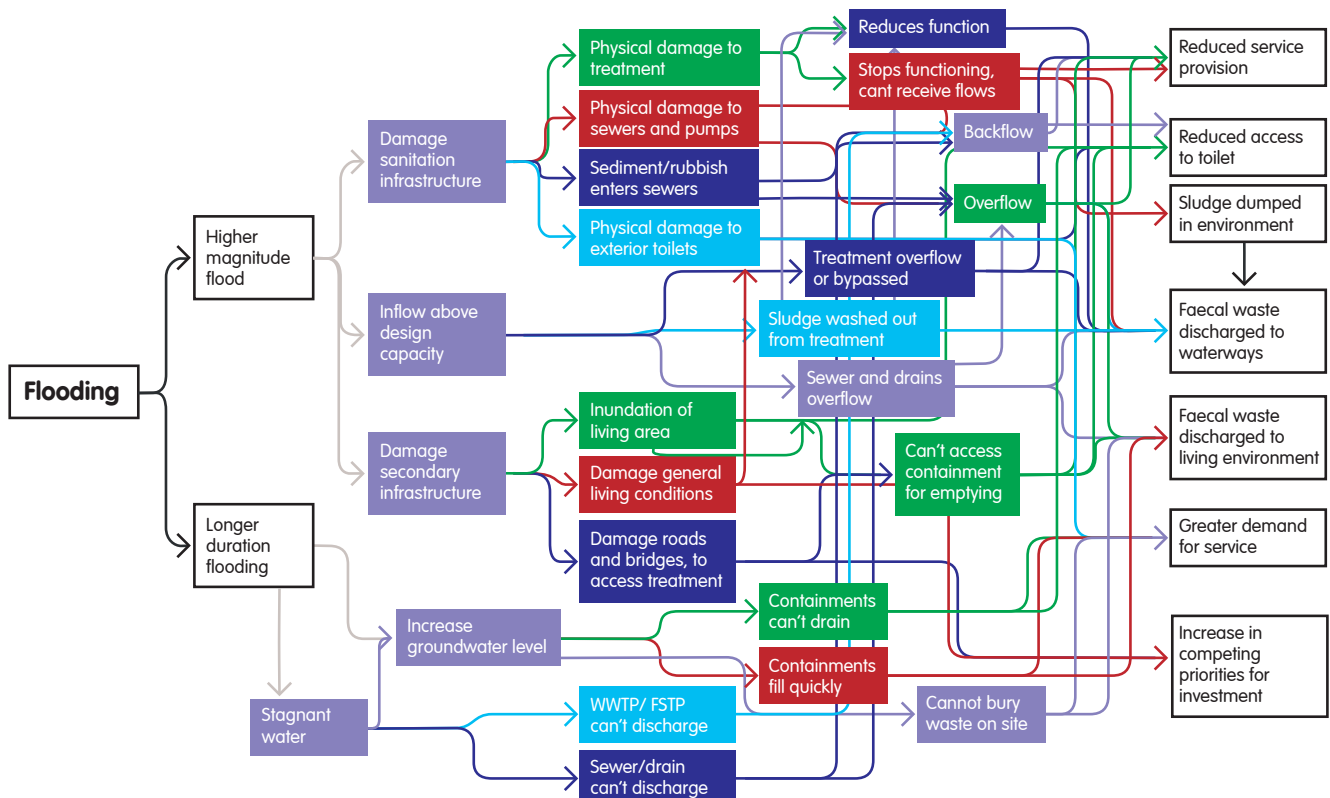
This complexity is evident in Figure 2, which illustrates the multiple effects of flooding (as one climate change hazard) on sanitation infrastructure.

Resilience: heightened uncertainty

Another perspective, known as the resilience approach, emphasises the **uncertainty** or **unpredictability** that climate change creates for society and nature (Folke, 2006). Because of the high level of uncertainty, some outcomes in the urban sanitation sector may be impossible to predict and therefore cannot be precisely planned for.

Conventional risk management strategies will fail because they are predicated on knowing what will happen. The

FIGURE 2: Systems diagram of effects of flooding on urban sanitation services



Source: ISF-UTS and SNV, 2019, p.9.



resilience approach therefore aims to address uncertainty by developing a high tolerance for surprises, variability and volatility.

Supporting sanitation access under increasing uncertainty requires **flexibility** and **adaptiveness** so that there are multiple ways to deliver services. It also requires an understanding of urban sanitation **systems dynamics** and **continual learning**, so that service providers and users know when it is appropriate to change how services are being delivered and accessed.

Oftentimes, urban sanitation systems are poorly equipped to handle uncertainty and changing conditions. For example:

- Sewers may not be designed to handle both increased wet weather and water restrictions leading to overflows or sedimentation and fouling.
- A treatment plant may be designed without bypasses to allow high flow by-pass or flexible operation when one part is damaged.
- Users may only have private toilets, with no access to public toilets, or only one service operator exists to empty pits and tanks.
- Many cities lack up-to-date plans, asset registers of sanitation infrastructure and services, and learning processes to adapt management to changes in system performance.
- Sanitation operators or managers may have limited knowledge of the capacity of the system to withstand hazards or how to adapt the system to changing conditions.

Vulnerability: deepening inequalities

A third perspective, the vulnerability approach, begins with the premise that climate change **does not affect everyone equally** (Miller, et al., 2010). Some people are more likely to be exposed to climate hazards, suffer greater harm when exposed to hazards, or have less capacity to take action to maintain their well-being when faced with climate-related hazards.

The vulnerability approach often sees climate change through a **social justice** lens and seeks to **empower** the most disadvantaged groups, so that they can pursue their development goals and meet their needs in the face of climate shocks and stresses.

Climate change disproportionately affects traditionally vulnerable sanitation users:

- Low-income households or people living in informal settlements often reside on marginal land more prone to climate hazards and are more exposed to the health risks of poor sanitation and polluted water.
- Informal or low-income settlements often have inadequate access to basic water, sanitation and drainage systems. These systems are more likely to be damaged or create increased risk compared with more robust systems.
- Marginalised groups, including women, ethnic minorities, elderly and people with disabilities, often have greater difficulty accessing sanitation in challenging conditions, and have fewer resources to adapt to climate change.

- Marginalised groups often have relatively less power to influence decision-making processes about how government and communities should allocate resources to protect society from climate change risks.
- The costs of recovering from natural disasters may divert resources from efforts to address inequality in basic services for vulnerable communities.

Implications for policy and programming

The above perspectives on risk-hazard, resilience and vulnerability have informed the following **six principles to guide the development of climate change responsive urban sanitation systems**.

Optimised and robust hardware to resist shocks.

Consider the robustness of new hardware to the range of predicted climate hazards but also ensure that existing infrastructure operates at optimal capacity.

Flexibility and diversified risk. Provide alternative options and operational strategies for infrastructure and services to reduce reliance on single systems.

Adaptive management to withstand disturbances.

Adaptiveness is developed through continual learning and adjusting to changing conditions.

Raised awareness and knowledge to minimise risk.

Stakeholders can take better preventative or adaptive action if they are prepared for climate hazards and uncertainty by building awareness of the risks and knowledge of how to adapt and respond prior to extreme weather events.

Consideration of system dynamics. Urban sanitation systems are dynamic and complex, involving multiple steps in the sanitation service chain, service configuration and alternative flow paths. Examine all parts of the chain to consider how services can be sustained if one component (e.g., a pump or truck) fails because of climate hazards.

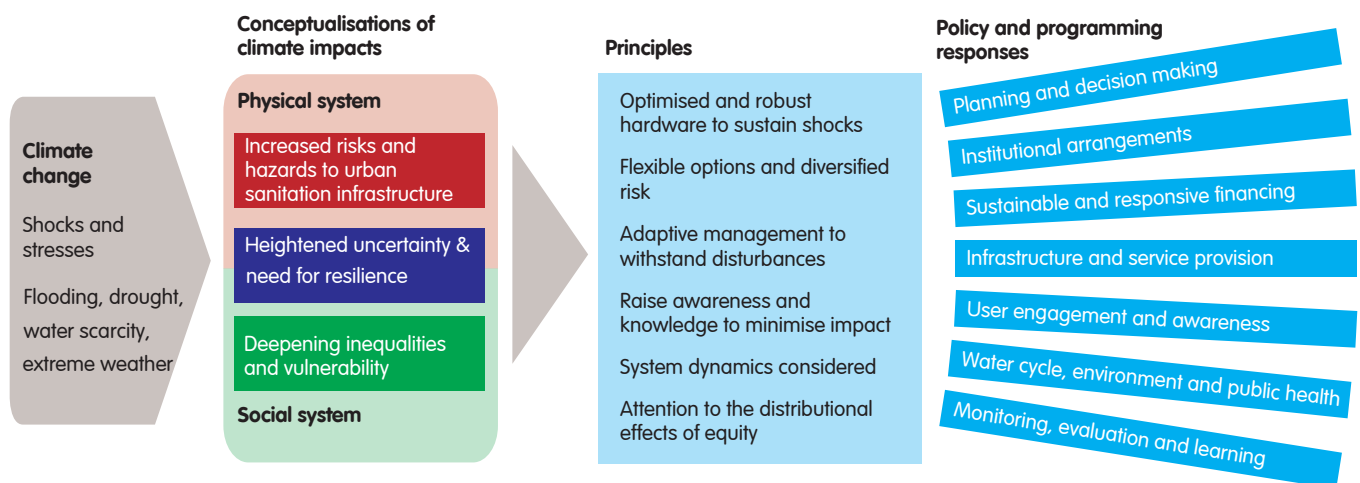
Attention to distributional effects on equity. Proactive attention is needed to ensure that efforts to improve the sustainability of sanitation services in a time of climate change, are equitable.

All six principles need to be incorporated into sanitation policy and planning to make urban sanitation systems more sustainable and equitable under climate change: through both improvements to the existing system and new investments. See seven pillars or categories of policy and programming responses in Figure 3.

- Planning and decision making
- Institutional arrangements
- Sustainable and responsive financing
- Infrastructure and service provision
- User engagement and awareness
- Water cycle, environment and public health
- Monitoring, evaluation and learning

Considering together the conditions created by climate change, the principles for responding to climate change and the urban sanitation pillars, we have identified implications and suggested actions for policy and programming (Table 1).

FIGURE 3: Conditions, principles and pillars for integrating climate change in urban sanitation



Source: ISF-UTS and SNV, 2019, p.13.

TABLE 1: Proposed policy and practice actions

| Pillar | Urban sanitation policy and programme actions |
|--------------------------------------|---|
| Planning and decision making | <ul style="list-style-type: none"> • Raise awareness and build understanding of local climate change hazards and social distribution of effects (e.g., by sharing climate data and assessments). • Plan for varied climate scenarios (e.g., by considering potential for both wetter and drier conditions). • Make climate resilience an objective of urban sanitation decisions (e.g., by including flexibility or adaptiveness in multi-criteria assessments, and planning to meet needs of vulnerable groups). • Consider how sanitation fits with planning of broader urban systems to maximise overall system resilience (e.g., consider flood management, disaster risk reduction, water security). • Prioritise infrastructure options that meet immediate needs and achieve long-term sustainability goals (e.g., by focussing on basic access to toilets that are also water efficient or resilient to flooding). |
| Institutional arrangements | <ul style="list-style-type: none"> • Include climate-relevant stakeholders in sanitation working groups and encourage sanitation actors to engage with cross-cutting sectors (e.g., emergency response, water resources, flood management). Inter-sectoral coordination is important for monitoring, warning and response systems. • Institutionalise adaptive management practices as part of sanitation management to facilitate anticipatory, responsive and planned adaptation (e.g., by implementing systems and funding staff for monitoring and learning). • Consider flexible management options such as decentralised or co-management arrangements to share knowledge and improve response to hazards (e.g., co-management of communal systems or multiple emptying providers), while balancing cost and capacity aspects. • Improve disaster response and recovery. Include gender-sensitive and socially sensitive processes for restoring sanitation during and after a disaster (e.g., by providing emergency toilets for short-term use) and rebuild systems that are more resilient and equitable. • Target inequalities by assessing the vulnerabilities of different social groups (e.g., through national policies that assign local responsibility, with accountability and compliance mechanisms). |
| Sustainable and responsive financing | <ul style="list-style-type: none"> • Plan for increased operation and maintenance costs associated with climate change and adaptive management (e.g., by including full life-cycle costs in options assessment). Consider who bears these costs and their ability to pay. • Identify climate change funding sources for sanitation adaption and resilience projects and support authorities meet application requirements (e.g., by building financial management systems that cover climate fund readiness criteria, with separate line items and reporting for climate change activities). • Recognise additional financial needs of vulnerable communities and target adaptive strategies to support their needs (e.g., by prioritising funding for adaptive strategies that will help vulnerable groups). • Regulate tariffs to ensure equity in periods of high demand or increased competition for services (e.g., by formalising tariffs for desludging, possibly cross-subsidising fees for disadvantaged or vulnerable groups). • Set up responsive financing mechanisms to allow all actors to access funds for both pre-emptive adaption and rapid response to disasters (e.g., by establishing budget items for non-specified repairs and accessible revolving funds for low-income households to rebuild toilets or empty tanks pre- or post-hazard). |
| Infrastructure and service provision | <ul style="list-style-type: none"> • Build operators' knowledge about existing sanitation systems and climate change risks to enable adaptive management (e.g., by involving operators in design and decision-making, by providing timely information on climate hazards and options to respond). • Prioritise no-regrets adaption that anticipates all climate conditions (e.g., by optimising operation of existing system, prioritising resource efficient infrastructure). • Consider whether 'robust' sanitation (i.e., higher-cost climate-proof systems) or 'repairable' options (i.e., lower-cost infrastructure that can be quickly rebuilt) make more sense in given context and climate risks. |

TABLE 1: Proposed policy and practice actions *(continued)*

| Pillar | Urban sanitation policy and programme actions |
|--|--|
| Infrastructure and service provision (continued) | <ul style="list-style-type: none"> • Consider flexible technical and service solutions (e.g., by using decentralised systems, sewer diversion options, multiple emptying providers). • Establish operations and maintenance systems that enable adaptive management (e.g., by creating asset management system that links monitoring with response). |
| User engagement and awareness | <ul style="list-style-type: none"> • Communicate with sanitation users about climate change hazards (e.g., by holding meetings to explain potential climate hazards using familiar and simple language). • Contextualise climate change within lived experience of users and focus messages on how they can respond in near term (e.g., by comparing climate change risks with recent disasters and the associated sanitation problems). • Provide timely information to enable user preparedness and responsiveness with conscious effort to reach vulnerable groups (e.g., by setting up information and warning systems before, during and after events, by providing support for response). • Include community and users in decision-making to build knowledge, agency to take action and skills to adapt and manage systems (e.g., by involving community and explaining decisions about sanitation system options, design and operation). • Consider special needs of vulnerable communities and prioritise support for these groups (e.g., by tailoring outreach and response efforts). |
| Water cycle, environment and public health | <ul style="list-style-type: none"> • Work with other sectors on water and land management strategies to understand and reduce disruption to urban sanitation systems (e.g., by considering water resources and land-use plans when designing and siting sanitation infrastructure). • Mitigate downstream effects of climate change impacts on sanitation (e.g., monitor downstream water quality to inform action, reduce wastewater discharge through low-flow sanitation or on-site reuse). • Address potential for pathogen exposure in urban environments and consider how climate change may shift exposure and risks for different populations (e.g., by identifying risks through sanitation safety planning). • Consider opportunities to meet multiple objectives with sanitation improvements and look for win-wins (e.g., by using human waste as fertiliser and soil conditioner, by generating biogas for energy), where viable . • Reduce contribution of urban sanitation to climate change with options that have low energy intensity or low greenhouse gas emissions (e.g., reduced pumping requirements by choosing decentralised system or modifying treatment processes to reduce emissions). |
| Monitoring, evaluation and learning | <ul style="list-style-type: none"> • Establish warning systems and promote awareness of how to minimise risk (e.g., by issuing early flood warnings that allow time for opening/ closing valves, by educating users about avoiding drains and treating water following an event). • Develop rapid review and response strategies to enable adaptive management (e.g., by collecting data to track system performance during both normal operation and extreme events). • Review and re-set long-term objectives and develop response strategies (e.g., by incorporating new information about climate trends and risks for different groups). • Monitor effects of climate-related events on safe sanitation for different social groups (e.g., by establishing disaggregated data protocols). • Coordinate monitoring efforts with water supply, public health, transportation and other sectors whose operations affect or are affected by sanitation (e.g., by setting up systems to share timely information). |

Source: ISF-UTS and SNV, 2019, pp.20-22.

Concluding reflections

The different framings of climate change impacts, and the range of actions that can be taken up, demonstrates that effectively responding to climate change is about more than just designing sanitation infrastructure to be more resistant to physical climate-related hazards. It is also about considering how interconnected social, institutional and environmental systems can be managed to accommodate uncertainty and reduce inequalities.

Competing priorities and uncertainties can lead to inaction. In many cities in developing countries, planning for climate change hazards is currently perceived as a secondary concern given the major efforts needed to simply establish functioning urban sanitation systems. However, as global warming pushes climate variability to new extremes, the hazards will increasingly demand attention.

Uncertainty should not be a reason for inaction, particularly since strategies that are designed for uncertainty (such as adaptive management) are often also win-win.

Many cities struggle to deliver basic, equitable sanitation services with limited technical, financial and institutional capacities, let alone meet the ambitious aspirations of the Sustainable Development Goal for safe sanitation. Efforts to address climate change in the sanitation sector need to be sensitive to the limitations and help build these capacities and do so in alignment with existing programmes and approaches.

The full learning paper provides an overview of actions and considerations that could guide sanitation practitioners, donors and policy makers in ensuring that progress in this sector also addresses the risks posed by climate change. Delivering sanitation in an era of climate change requires that services be sustainable under evolving, uncertain conditions and that climate change adaptation be mainstreamed in urban sanitation policy and planning.



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Considering climate change in urban sanitation

Conceptual approaches and practical implications



This learning brief draws on the USHHD Learning Paper (January 2019) titled, 'Considering climate change in urban sanitation: conceptual approaches and practical implications' by ISF-UTS and SNV.

Access the full paper here: <https://on.snv.org/2RX7xP6>

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Images of urban and peri-urban slum areas in Bangladesh

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