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FACT SHEET

SANITATION SYSTEMS

ADDRESSING CLIMATE CHANGE IMPACTS ON INFRASTRUCTURE:
PREPARING FOR CHANGE

Newly constructed latrines at a camp for internally displaced persons in Liberia.
Photo Credit: USAID/OFDA

- Many sanitation facilities are located at the lowest elevation possible and are therefore vulnerable to climate change-related sea level rise, storm surge, and flooding. More severe storm events can overwhelm facilities. Lower stream levels and higher temperatures can affect water quality.
- Climate change impacts on sanitation systems could have negative health implications as well as damaging ecosystems.
- Relocating facilities to higher elevations, separating storm and wastewater sewers, and improving treatment to produce a higher quality effluent can help mitigate climate risks.

SANITATION SYSTEMS ARE INTEGRAL TO DEVELOPMENT PRIORITIES

Basic sanitation is crucial to the overall health of communities, as well as the environment. So, sanitation initiatives, often in conjunction with hygiene projects, are frequently high priority programs for development organizations. Water-related diseases are the most common cause of illness and death among the poor in developing countries. Estimates indicate that more than two billion people live without access to adequate sanitation. Unsafe drinking water, inadequate sanitation, and poor hygiene cause nearly two million deaths each year; children under the age of five account for the vast majority of these deaths.

Lack of sanitation can hinder other development priorities such as improved global health, economic productivity, and food security. Water, Sanitation, and Hygiene (WASH) programs seek to increase access to the drinking water supply or sanitation services, improve the quality of those services, and/or promote hygiene. Some water and sanitation programs offer opportunities to help people adapt to climate variability and change. But when climate is not considered, , the objectives of other programs may well be undermined. ***As a result, supporting climate change adaptations for sanitation systems will increase the resilience of development programs to improve public health and environmental protection.***

SANITATION SYSTEMS INCLUDE:

- Latrines
- Septic and leach field systems
- Wastewater treatment infrastructure

SANITATION SYSTEMS SUPPORT:

- Health
- Economic productivity
- Environmental protection and ecosystem health
- Tourism
- Food and water security

CLIMATE STRESSORS CAN SIGNIFICANTLY IMPACT SANITATION SYSTEMS

Sanitation facilities are highly sensitive to storm surge, sea level rise, and flooding. Wastewater collection and treatment facilities are often situated at the lowest point possible as their operation leverages gravitational pull, but they can therefore easily be inundated by water level rise. When storm water and sewer collection systems are combined, higher intensity storms can overwhelm treatment facilities leading to a failure of treatment. Septic systems and leach fields need to be separated from the water table for effective treatment but rising groundwater levels during flooding or rising sea levels will limit their effectiveness. ***Rising water levels due to storm surge, sea level rise, and flooding can lead to a failure of sanitation systems, impacting community health.***

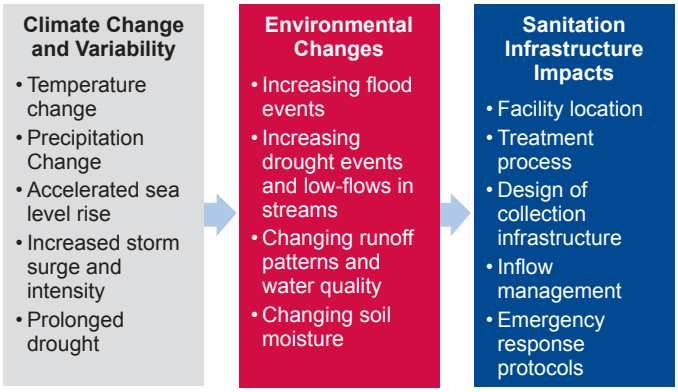
Lower stream flows during both short- and long-term drought periods can limit the effectiveness of receiving water bodies to absorb and dilute pollution coming from sanitation facilities. In addition, higher temperatures can cause more frequent algal blooms and increase bacterial and fungal content in water. In cities, the "urban heat island effect" can intensify temperature increases, exacerbating water quality issues. These effects lead to eutrophication, increased pathogen loading, and lower dissolved oxygen levels. The resulting decreased ability to absorb and dilute pollution will require improved sanitation systems to protect the public health and environment of downstream communities.

Table 1. Examples of Potential Climate Change Impacts on Sanitation Infrastructure and Services

	Wastewater Treatment	Latrines	Septic and Leach Field
Temperature Increase	• Lower water quality due to increased algal blooms and pathogens, and lower dissolved oxygen	• Increased odors making use less attractive	Minimal impact
Increased Intensity of Precipitation and Storm Events	• Overwhelmed treatment systems, especially associated with combined sewers or through inflow/infiltration • Inundation of outfall causing discharge to back up • Flood damage to collection systems and treatment facilities • Disruptions of pumping and treatment due to power loss	• Decreased separation from groundwater due to rising water tables • Inundation and overflow of latrines	• Decreased separation from groundwater due to rising water tables
Prolonged Drought	• Reduced capacity of water resources to absorb and dilute pollution due to lower flows in receiving streams • Reduced treatment performance due to lower flows	Minimal Impact	Minimal Impact
Seal Level Rise	• Inundation of low-lying treatment facilities requiring relocations • Inundation of outfall causing discharge to back-up	• Inundation of low-lying latrines requiring relocation • Decreased effectiveness due to rising water tables	• Inundation of low-lying septic systems requiring relocation • Decreased effectiveness due to rising water tables

Figure 1 provides further information on how climate change and variability can affect sanitation-related decision-making and details factors to be considered. Table 1 on the next page provides examples of potential climate change impacts on sanitation infrastructure and services. Climate change risks vary in relative magnitude and importance, with a range of cost implications, compounding effects, and impacts on development objectives. For example, dry and low-flush pit latrines have relatively high resilience to climate change impacts due to lower sensitivity and significant adaptive capacity through changes in design.

Figure 1. Climate Change Impacts Can Affect a Range of Sanitation-Related Decisions



MAINSTREAMING SANITATION-RELATED ADAPTATION INTO EXISTING PROGRAMS

USAID, other development organizations, and local decision-makers can identify appropriate adaptation action priorities and integrate them into existing capital improvement and maintenance programs. Where appropriate, collection, processing, and disposal systems may have to be relocated or re-routed. For example, septic tank systems situated in coastal areas would have to be strengthened or relocated to prevent inundation and contamination of ground water due to rising sea levels. Response strategies can be designed and prioritized based on decision-makers' assessment of the following factors:

- ***Criticality*** – How important is the sanitation infrastructure to the community or region? Are backup services available?
- ***Likelihood*** – Given climate scenarios, what is the probability that sanitation systems will be affected?
- ***Consequences*** – How significant is the impact? Will climate changes permanently or temporarily disrupt sanitation services?
- ***Resources available*** – Can changes be made with only modest cost increases to already-occurring replacement? Does sanitation infrastructure have to be replaced or relocated prematurely?

Adaptation options can range from hard to soft responses. "Hard" options refer to structural changes (e.g., moving septic tanks and associated pipelines to higher ground). "Soft" options refer to management, operational, and policy changes (e.g., increasing maintenance of tanks and pipes, maintaining backup systems.) See Table 2 for a list of sanitation-related adaptation options that fit within the Climate-Resilient Development (CRD) Framework and the Overview for further guidance.

Some adaptation strategies may require little or no additional funding, if climate factors are incorporated into upfront planning and design. Other strategies may require significant additional resources. By intentionally integrating climate information into program development and investment decisions, development practitioners can avoid maladaptive projects such as constructing septic tanks in low-lying areas or flood plains and combining storm and sanitary sewers. ***Mainstreaming climate considerations into careful planning processes will ensure that sanitation programs maintain their value in the long-term.***

Table 2. Examples of Sanitation-Related Adaptation Options by Project Cycle Stage

Project Cycle Stage	Project Cycle Actions	
	• Identify sanitation-related development goals important to the country, community, or sector you are working with • Identify inputs and enabling conditions necessary to achieving those goals • Consider the impacts of climate and non-climate stressors on those inputs	
	• Assess climate impacts on sanitation systems • Assess climate impacts on human health from reduced water quality associated with pollutant discharge	
 Planning Policy Changes Project Development	**Adaptation Options (Examples)**	
	SANITARY INFRASTRUCTURE • Evaluate improving, elevating, or moving treatment facilities to prevent overflows and inundation • Plan back-up power systems for treatment and pumping facilities • Site septic and leach field systems at higher elevations • Develop plans for reclaimed water systems	WATER QUALITY • Develop a source water protection plan that accounts for the impacts of low flow on the ability of natural systems to dilute and absorb pollutants
 Construction Operation Maintenance Program Activities	**Adaptation Options (Examples)**	
	SANITARY INFRASTRUCTURE • Move existing facilities or site new facilities on higher ground to account for flooding or sea water rise • Separate storm water and sewage collection systems • Implement programs to reduce inflow and infiltration • Integrate information on climate change impacts into training and education about sanitation systems • Clean latrine systems more regularly to prevent overflows	WATER QUALITY • Construct new or improve existing treatment facilities
	• Track performance of inflow and infiltration reduction programs • Monitor water discharges for changes in effluent characteristics • Monitor water quality levels and evaluate need for new or modified source water protection plans	

FURTHER READING

ICLEI, 2011. Adapting Urban Water Systems to Climate Change: A handbook for decision makers at the local level. http://iwahq.org/ContentSuite/upload/iwa/all/Water%20climate%20and%20energy/SWITCH_Adaption-Handbook_final_small.pdf

WHO, 2010. Guidance on Water Supply and Sanitation in Extreme Weather Events. http://www.wsscc.org/sites/default/files/publications/who_guidanceextremeweathereventswash_2010-eng.pdf

WHO, 2010. Vision 2030: The Resilience of Water Supply and Sanitation in the face of Climate Change. http://www.who.int/water_sanitation_health/publications/vision_2030_technical_report.pdf

Questions, feedback, suggestions, and requests for support should be sent to **climatechange@usaid.gov.**

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