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<tr>
<td>AIAS</td>
<td>Water and Sanitation Infrastructure Administration</td>
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<td>AQUA</td>
<td>National Agency for Environmental Quality Control</td>
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<td>AURA</td>
<td>Water and Sanitation Regulatory Authority</td>
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<td>CLTS</td>
<td>Community-Led Total Sanitation</td>
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<td>CBD</td>
<td>Convention on Biological Diversity</td>
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<td>CRA</td>
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<td>DHS</td>
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<td>DINAB</td>
<td>National Directorate of Environment</td>
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<td>DMF</td>
<td>Delegated Management Framework</td>
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<td>DNAAS</td>
<td>National Directorate for Water Supply and Sanitation</td>
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<td>DNDA</td>
<td>National Directorate of Autonomous Development</td>
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<td>EMUSA</td>
<td>Municipal Sanitation Company (Quelimane)</td>
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<td>ESR</td>
<td>Rural Sanitation Strategy</td>
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<td>GoM</td>
<td>Government of Mozambique</td>
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<td>IAF</td>
<td>Inquérito dos Agregados Familiares (Household Survey)</td>
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<td>INDC</td>
<td>Intended Nationally Determined Contribution</td>
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<td>INGC</td>
<td>National Institute of Disaster Management</td>
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<td>INGD</td>
<td>Institute of Disaster Risk Management and Reduction</td>
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<tr>
<td>IOF</td>
<td>Inquérito do Orçamento Familiar (Family Budget Survey)</td>
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<td>JMP</td>
<td>Joint Monitoring Program for Water Supply and Sanitation</td>
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<td>LRI</td>
<td>Lower-Respiratory Infections</td>
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<td>MAEFP</td>
<td>Ministry of State Administration and Public Services</td>
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<td>MDGs</td>
<td>Millennium Development Goals</td>
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<td>MOPHRH</td>
<td>Ministry of Public Works and Housing</td>
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<td>National Adaptation Programme of Action</td>
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<td>National Climate Change Adaptation and Mitigation Strategy</td>
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<td>NTD</td>
<td>Neglected Tropical Diseases</td>
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<td>PRAVIDA</td>
<td>Water for Life Program</td>
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<td>PRONASAR</td>
<td>National Program for Water Supply and Sanitation in Rural Area</td>
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<td>SDPI</td>
<td>District Planning and Infrastructure Services</td>
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<td>UN</td>
<td>United Nations</td>
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<td>UNFCCC</td>
<td>Framework Convention on Climate Change</td>
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<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
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<td>USD</td>
<td>United States Dollar</td>
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<td>WASH</td>
<td>Water Sanitation Hygiene</td>
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INTRODUCTION
INTRODUCTION

This report addresses the impact of climate change on sanitation in Mozambique. The report is divided in 4 sections, namely:

i) The Mozambican urban and rural sanitation context; ii) climate change impacts on sanitation and how this is impacting the sanitation service chain; iii) the relevance of the policy framework relating to sanitation or climate change and iv) sanitation adaptation options in the face of climate change.

The report is based on field survey (primary data) and research from national and international experience (secondary data). It is focused on practical strategies that various actors can take in order to increase resilience in the sanitation sector given the climate change impacts in Mozambique.

The study has revealed the diversity of how climate change events (whether cyclones, floods or droughts) are affecting the sanitation sector. This is impacting both urban and rural areas. Although the policy framework attempts to outline sanitation as a key priority of the Government of Mozambique (GoM), various gaps are evident, in particular in relation to rural sanitation. Amongst these are the lack of a comprehensive policy framework when it comes to sector financing. If this were in place it would cover the full sanitation value chain, and deal more explicitly with rural sanitation. The study goes on to propose various options to better deal with climate change and its impact on sanitation, increasing resilience in the face of both slow onset climate events and climate ‘shocks’. These include investment in community-based initiatives, tighter links between disaster response and development actors working on sanitation, more work on urban drainage and support to building resilient infrastructure at community level.
THE MOZAMBICAN CONTEXT OF URBAN AND RURAL SANITATION
When looking across the spectrum that deals with both sanitation and climate change, four government ministries come to the fore. These are the Ministry of Public Works, Housing and Water Resources (MOPHRH); the Ministry of State Administration and Public Function (MAEFP); the Ministry of Land and Environment (MTA) and the National Institute of Disaster Risk Management and Reduction – INGD (see Figure 1). We look at each of these in turn.

Figure 1: Sanitation and climate change policy framework
2.2 Ministry of Public Works and Housing – MOPHRH

2.2.1. Overview

Access to safe water and sanitation has been an integral part of the Mozambican Government’s national development plan, strategies and policy for several decades now, with explicit references made to the various links between safe water, adequate sanitation and poverty reduction. In recent years, the GoM has made significant steps in response to water supply and sanitation policy reforms through the development and adoption of several policy documents (including the National Strategy for Urban Water and Sanitation 2011-2025, PRONASAR, the PRAVIDA). The WSS (2011-2025) defined that universal coverage and sustainability of drinking water supply and sanitation services should prevail by 2025 across urban Mozambique. In these terms, sanitation includes the entire set of mechanisms, services and technologies, that encompass excreta management, including emptying, transport, treatment and final disposal. Although the strategy pays heed to the need for sanitation systems to be sustainable, it does not demonstrate how to deal and integrate climate change-related impacts into sanitation sector. Worse still, the WSS (2011-2025) does not mention climate change at all. This demonstrates that there is ample scope (and indeed need) to better incorporate climate changes and its related impacts into the regulations and policies governing the nation’s sanitation sector.

2.2.2. Policy backdrop

The National Water Policy (NWP) was approved by a resolution of the Government in 1995 (Resolution No. 7/95, of 23 August). The NWP came in following the Water Law in 1991 (Law No. 16/91 of 3 August). In 1995, the Government’s major priority was the restoration of basic water services, in particular the supply of water to urban, peri-urban and rural areas. There was also the need to introduce new partners into the water sector in particular private operators and suppliers, and to develop new approaches in the provision of water services.

The Water Law 16/91 forms the basis for the institutional set up in the water sector and started the water sector reforms, undertaken by the GoM. The GoM addresses the water supply and sanitation sector priorities through the MOPHRH and the respective DNAAS.
The DNAAS is the lead water supply and sanitation subsector entity, responsible for policy development, sub-sector planning and monitoring, and coordination of actors in the rural space, in close collaboration with local Provincial and District Governmental Units. The District Planning and Infrastructure Services (SDPI) represent the MOPHRH at the provincial level by its provincial Directorate of Public Works and housing and at the district level. Meanwhile, the management of sanitation services is largely the responsibility of local authorities, especially in the rural areas. The DNAAS’s mandate is to ensure policy implementation, adequate technical and financial assistance and supervision of policy effectiveness of local water and sanitation initiatives.

### 2.2.3 Urban sanitation

The NWP established the legal framework of a Delegated Management Framework (DMF), which focus on the promotion of the integration of private management in the water sector in Mozambique, as a necessary condition for improving the quality and efficiency of the water services. In line with the DMF, the Decree No. 74/98, of 23 December, established an independent regulatory authority for the water sector, the Water Regulatory Authority (AURA). AURA approves the tariff and protects the public interest.ii

An important change came in 2009, when the DMF was extended to public sanitation systems and to secondary systems, thereby creating the Water and Sanitation Infrastructure Administration (AIAS) by the Decree No. 19/2009, of May 13. The decree transferred the responsibility for sewerage infrastructures, wastewater treatment plants, from DNAAS, to the AIAS and municipalities. AIAS is also responsible for the regulation, based on the laws and standards (decree 30/2003 and 15/2004), of any delegated arrangements for sanitation systems, where contracts are signed between local operators and local authorities. Furthermore, municipalities that retain the operation of sanitation services receive regulatory standards through AURA.

Two decrees - 30/2003, regarding the regulation of public water distribution and wastewater systems and 15/2004, regarding building regulations relating to domestic water distribution and wastewater drainage systems - provide standards for onsite sanitation and sewerage infrastructure. These decrees define the technical conditions for domestic and public water supply and wastewater systems in order to ensure their proper functioning and to preserve public health (Weststrate et al., 2019).
The importance of adequate construction regulations regarding resilient infrastructure

Despite this range of regulations and policies, some observers suggest that the prevailing legal framework, especially at the national level, lacks clear provisions when it comes to the construction of pit latrines and faecal sludge treatment and disposal (Weststrate et al., 2019).

Given that climate change is already impacting the sector, the Mozambican regulatory framework could use more focus on how to incorporate climate change into the various standards that govern on-site sanitation, covering the safe collection, transfer, and treatment of faecal sludge. This is in order to protect both human and environmental health. Beyond this, there is also scope for encouraging independent providers of sanitation services to better incorporate climate resilience when it comes to the design and operation of their systems. This may require a range of incentives, balancing both ‘carrot and stick’.

2.2.4. Rural sanitation

Very recently, the GoM approved the Rural Sanitation Strategy (ESR) 2021-2030, through Resolution No. 53/2021. The ESR specifically aims to eliminate open defecation and achieve universal access to basic sanitation and hygiene services for households, schools and health facilities by 2030. The ESR presents 4 strategic pillars, which focus on institutional capacity building and decentralised implementation; promotion of effective community behaviour change and for supply of sanitation and hygiene services.

PRONASAR (Mozambique’s National Water Supply and Sanitation Programme) aims to increase access to improved water and sanitation services in rural areas.

The wider aim of PRONASAR is to support universal access of the SDGs, for which the sanitation component aims to: (i) increase the coverage and promote the end of open defecation, (ii) improve the institutional framework and strengthen institutions, (iii) strengthen the role of the local government, and (iv) development of options to promote local investment in sanitation. The PRONASAR program does takes into account the impacts of climate change.
The strategic pillars and the components, especially component 4.2 ("support communities to scale up the rural sanitation") provide several excellent entry points towards building a more integrated sanitation policy that can deal with climate change.

Opportunities that come here relate to strengthening local systems and communities; expanding the availability of sanitation services by catalysing domestic private sector resources (including establishing an enabling environment for women entrepreneurs and supporting business development); addressing harmful gender norms that prohibit women and girls from equally benefiting from sanitation investments; and accelerating the adoption of behaviours that address sustainability by ensuring that sanitation service infrastructure is sustained and maintained.

Furthermore, the ERS encourages the participation of the private sector and local entrepreneurs in the provision of sanitation services that respond to the impact of climate change. However, there are limitations in integrating climate change into the activities that are described under different components. For example, activity 4.2.1, talks of “disseminating to households and local leaders technical options and local materials for the construction of resistant latrines”. Arguably the focus here should not be on resistance but rather on resilience. Another issue is the fact that although the strategy mentions the need to include private sector, there is no incentive for such actions and given the weak role that the private sector currently plays in rural sanitation, there is no vision for how this may be changed.
The Ministry of Land and Environment (MTA) holds the mandate for promoting the country’s sustainable development through the implementation of the country’s environmental policy. The mandate also covers the National Adaptation and Mitigation Climate Change Strategy (NAMCCS) and associated adaptation plans, which includes the Nationally Determined Contribution (NDC).

The Environmental law (Law No. 20/97, of October 1st) defined the measures and legal basis for the management and proper use of environmental resources required for the sustainable development activities, which is applicable to all public or private entities with the mandate to directly or indirectly influence the policy implementation. The Environmental Law promotes the rational use and management of water, which includes water supply and sanitation in the sustainable development of the country.

The MTA’s mandate comprises inter-sectoral coordination, planning and environmental management and reporting, land-use planning and resettlement promotion of environmental education. The MTA is also a national focal point for the UNFCCC (United Nations Framework Convention for the Climate Change).

According to the Manual of Regulatory Governance and Substance, 2016, under the sanitation component, the MTA, via the Directorate of Environment (DINAB), is the ministerial department with the mandate to coordinate and liaise with other institutions.

In regard to the climate change, the MTA has established the National Directorate of Climate Change, which amongst other roles, has the mandate to propose legislation, policies, development strategies and plans that are conducive to reducing vulnerability, building resilience and increasing the adaptive capacity to climate change as well as promoting low carbon development and mitigating greenhouse gas emissions in the context of sustainable development.

The Regulations on Environmental Quality Standards and Effluent Emissions (approved by Decree No. 18/2004, of June 2, signed by MICO) allocate responsibility for supervising the allowable concentration of pollutants in wastewater that can legally be discharged into watercourses. MTA’s responsibility for this is discharged via the National Agency for Environmental Quality Control (AQUA). The policy establishes standards for water quality assessment, in accordance with water use categories.
Recent policy dealing specifically with climate change
In recent years, the GoM, through the MTA, has made significant steps in response to climate change. This includes key policy reforms, including the National Adaptation Programme of Action (NAPA) 2007; the National Climate Change Adaptation and Mitigation Strategy, and the Nationally Determined Contribution (NDC) Roadmap. Mozambique has also ratified the United Nations Framework Convention on Climate change (UNFCCC). The NAPA presents the immediate and urgent adaptation needs of Mozambique. It identifies specific objectives, including strengthening the country’s early warning system; promoting public awareness and information dissemination on climate change; improving institutional coordination between those working to identify the country’s vulnerabilities and reducing hazard related risks; and promoting the integration of climate change into district planning. The PRONASAR program does take into account the impacts of climate change and treats it as a cross-cutting issue. On the other hand, it does not mention how sanitation system in the rural areas should be approached in terms of climate-innovative technology, nor what is required in regards to the treatment and disposal of human waste in a rural setting.

Mozambique’s ‘Initial National Communication’ to the UNFCCC identifies seven sectors particularly vulnerable to climate change: agriculture; forests and pastures; livestock; water resources; coastal areas and resources; infrastructure; and health and fishing. The National Communication further outlines two-adaptation pathways, namely: (i) integrating environmental concerns with socio-economic development and (ii) sustainably managing natural resources across sectors.

The National Climate Change Adaptation and Mitigation Strategy (NCCAMS) was developed in 2012 and sets out action guidelines for building resilience, including climate change mitigation, in communities and the national economy. The strategy recognizes that Mozambique has limited investment in modern technology, and weaknesses in its infrastructure and social services, especially those related to health and sanitation.

The National Climate Change Adaptation and Mitigation Strategy includes sanitation as one of the key strategic areas and defines as a priority the improvement of drainage, as well as rural and urban sanitation systems.
In 2018, the Government of Mozambique prepared its First Nationally Determined Contribution plan (First NDC) under the Paris Agreement climate change umbrella. The plan highlights a universe of 25 strategic actions, where two focus on the water sector, water resources and water supply and sanitation. Furthermore, these NDCs are more aligned with the PRAVIDA plan than are the various water sector plans (including PRONASAR and the National Strategy for Urban Water and Sanitation).

Beyond this, there may be opportunities to incorporate sanitation into the promotion of renewable energies and the production of fertilizers, specifically in those actions laid out by the Ministries of Agriculture and Rural Development and the Ministries of Energy and Mineral Resources.

In 2021, the Government of Mozambique updated and enhanced its Nationally Determined Contribution (NDC) 2020-2025, which was presented in COP26 in Glasgow. The newly updated NDC is consistent across sixteen (16) strategic areas of climate change interventions, including for both adaptation and mitigation. The updated NDC brings an innovative approach to the adaptation component, by giving equal weight when it comes to water resources management and sanitation priorities. Specifically, the updated NDC highlights actions and measures for the sanitation sector. The new NDC suggests, for instance, the promotion of more resilient rural sanitation solutions to floods, as well as the development of more appropriate infrastructure and construction technologies for rural sanitation (whether viewed from the perspective of environmental protection or preservation of infrastructure).

Some opportunities remain to be explored. For instance, when it comes to mitigation interventions, especially in the strategic area of waste management and energy recovery, there is an opportunity to integrate aspects such as eco-sanitation systems. Such systems offer the potential to convert human waste into organic fertilisers and provide fossil-free energy inputs into electricity generation, heat and cooking. Furthermore, recycled water from sanitation systems, when adequate safeguards are taken, can be used for crop irrigation.xii

Finally, there is a need to integrate rural sanitation solutions into preparedness & emergency-related processes, especially in the second ‘strategic adaptation’ areas of the NDC, in order to strengthen capacity at community level to better prepare for and respond to climate risks.
The Ministry of State Administration and Public Service’s (MAEPF) primary mandate is to coordinate the decentralisation process; public sector reform management; and the development of the local public administration (Presidential Decree No. 39/2020). The MAEPF is thus key in ensuring a direct link to all municipalities, both in providing technical assistance as well as monitoring Municipal Councils. The Department of Local Government Development (DNDA) assists in the elaboration and ratification of development plans, land use plans and personnel plans of local authorities.

Backdrop to decentralisation in Mozambique

The decentralisation process in Mozambique began in 1994, with the approval of legislation promoting the gradual decentralisation of authority to District and Municipalities. Amongst these policy reforms were the definition of the institutional framework of the Municipal Districts (Law 3/94), the creation of Local Governments (Law 9/96), the Law on Local Authorities (Law 2/97, complemented by Laws 7 to 10/97), the Law on Municipal Finances (Law 11/97, which attributes to the Municipalities the competence to invest in water supply and sanitation systems) and the structure organic of the District Government (Decree 6/06).

When it comes to the water supply and sanitation sector, the Laws 2/97 and 11/97 have particular importance, in that one defines the competences of the different municipal bodies when it comes to providing public services. Specifically, provision is made for municipalities either create autonomous services (that is, delegate to third parties) or meet the needs of the citizens via municipal public companies (when the community context is favourable to this or it proves to be the most efficient solution).
### Post Disaster Reconstruction Policy and Regulations Framework

The GoM has adopted several institutional reforms relating to policies and action plans that deal with reducing disaster risk. The aim is to minimise not just the loss of human life, but also the impact on livelihoods and critical infrastructure. One means for reducing disaster risks is by increasing the resilience of people, institutions and infrastructure to climate and climate shocks, through mainstreaming disaster and climate resilience in public investments, territorial planning, and public financial management (whilst building capacity at all levels).\textsuperscript{xvii}

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**A municipal sanitation company in Quelimane**

In Quelimane, the city council chose to establish a Municipal Sanitation Company (EMUSA) via its Resolution n° 8/2014. EMUSA is responsible for sanitation, covering the management, planning, operation, maintenance and investment in the provision of public sanitation services. This includes drainage, sewerage, hygiene promotion, solid waste management and cleaning, either directly or through contracting and partnerships. Furthermore, the resolution transfers all public sanitation services so that they come under the responsibility of EMUSA.

In the context of climate change, the services that are provided either by autonomous or municipal public companies play a major role in how climate change can be integrated into urban sanitation.\textsuperscript{xv} These are the local institutions with the most technical, human, material and financial capacity, albeit it remains limited. Furthermore, from a legal standpoint, EMUSA has a favourable context when exploring how best to ensure that sanitation systems can deal with the impact of climate change.

Last but not least, under the decentralisation process, engaging the MAEFP/DNDA can be important. This is not just because they offer a promising means to push for the integration of climate change into urban sanitation planning, but also as this is the best avenue for integrating sanitation into the decentralisation process.\textsuperscript{xvi}
The Impact of Climate on Sanitation in Mozambique

The below figure gives an idea of how the relevant institutions – those with a mandate for both policy and local-level measures concerning climate change and sanitation – relate in Mozambique. The MTA is meant to be the key coordinating institution of environment affairs, climate change adaptation and mitigation, with MOPHRH the lead on water supply and sanitation.

The INGD is the coordinating institution for disaster risk management. The MAE-FPs primary mandate is to coordinate the decentralisation process and provide technical assistance to as well as monitoring the Municipal Councils. At local level, the SDPI and city councils have autonomy and with it a wide mandate that, with climate change being considered a cross-cutting issue, covers many areas.

Disaster risk reduction and sanitation in Mozambique
The DRR Law (Decree No. 76/2020) recognizes the sanitation sector as an integral part of the Disaster Risk Management and Reduction Coordinating Council. The law also recommends that the sanitation sector should be part of the damage assessment phase. The Coordinating Council for Management and Disaster Risk Reduction is chaired by the Prime Minister, through the INGD and includes ministers who oversee different areas, including sanitation sector.

The Disaster Management Law (Law n° 15/2014), gives guidance on prevention and mitigation, as well as the development of actions for the reconstruction and recovery of areas affected by disaster.

The Master Plan for DRR (2017–2030), also highlights that the urban population resides in informal neighbourhoods and peri-urban areas, lacking proper infrastructure, sanitation, drainage, and basic services. Because of that, flooding events in urban areas can result in severe limitations to public services. INGD consider sanitation sector as relevant specially, during the disaster preparation and reconstruction (recover) phase.

The disaster management law considers the sanitation sector as a priority sector and defines prevention measures, committing governments to adopt legislation on construction and other projects that include sanitation in order to make them more resilient to the impact of floods, cyclones and erosion, amongst climate-related phenomena.

2.5 Scope for improved co-ordination

The below figure gives an idea of how the relevant institutions – those with a mandate for both policy and local-level measures concerning climate change and sanitation – relate in Mozambique. The MTA is meant to be the key coordinating institution of environment affairs, climate change adaptation and mitigation, with MOPHRH the lead on water supply and sanitation.

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Under the MOPHRH there are three key coordination instruments: The National Water Council was created through the Water Law (Decree nº 25/91), foreseeing it as the main coordination mechanism in regard to water management; the Multi-sector Sanitation Group (MSG), and the Subsector Water and Sanitation Group (GAS).

The MSG focus mainly on both the implementation of the National Campaign on Environmental Sanitation and Hygiene Promotion and follow up the decisions reached in international commitments related to water and sanitation issues. The MSG led by MOPHRH, composed by key government sectors at central level, Municipalities and cooperation partners, such as UNICEF, World Bank, WSUP and WaterAid. While the GAS is a consultation forum to reach the water and sanitation goals in the country expressed in PQG. In relation to these platforms, there is a need for a better articulation to ensure integration and proper engagement between the parts, including reaching out to rural communities that are the most in need.
**Gaps in legislation**

The major gap in the current legislation and institution frameworks related sanitation in Mozambique is the fact that climate change has not yet been treated as a major threat by the sanitation sector, at least when it comes to the Mozambican legal framework governing regulation and standards.

For instance, there is a need to ensure closer alignment between the event-preparedness process in Mozambique and the role that resilient rural sanitation can play in dealing with floods. There may also be options in mitigation measures to include re-use and ecosan approaches.

At institutional level, there is a lack of coordination between Municipal, District, Provincial and National to deal with Sanitation and climate change. Although there are several coordination platforms, those focus on the central level and very less addresses rural sanitation concerns.

The MTA is the key ministry entity responsible for environmental issues, climate change and sustainable development which was initially coordinated by an inter-institutional CONDES (National Council for Sustainable Development) led by Prime Minister. At is stands, CONDES is currently facing several limitations and no longer active due to it being starved financial resources and undermined by political infighting.

*There is thus an urgent need to improve multispectral coordination in the context of climate change in Mozambique, which implies the revitalization such as CONDES.*
HOW CLIMATE CHANGE IMPACTS THE SANITATION SERVICE CHAIN
Mozambique is a vast country with a variety of topographies and climates from the low-lying coastal zones all along the east to the extremely hot and dry expanses of Tete province in the north west. Mozambique is considered the fifth most vulnerable country in the world in the Climate Change Vulnerability Index, primarily due to climate risk exposure and weak socio-economic development.

Most of the major cities in Mozambique are located in coastal areas, infrastructure (roads, water networks, schools, hospitals) is in poor condition and there is a rapidly growing urban population meaning that people are forced to build in risk prone areas along the coast.

While the experts are still unable to predict exactly which scenario will play out for Mozambique it is expected that there will be rising temperatures affecting the rainfall patterns. The country is likely to see an increase in both flooding and droughts. Much of the country lies in the path of tropical cyclones and will be susceptible to the impacts of sea level rise. Rural areas will also see an increase in extreme weather events with longer dry spells followed by intense rains.

These rains, falling on extremely dry ground, will cause more severe flooding than in previous years. Overall, it is expected that the country will see a decline in annual rainfall. The coastal areas including Maputo and Beira may also experience issues related to saline intrusion as a result of sea level rise.

### Impacts

When discussing climate change and its impacts, there are two important points to make at the outset. The first is that whilst climate change may be accelerating, it is not a new phenomenon. The second is that it affects different areas of the world differently and in unpredictable ways. When it comes to sanitation, one of the key impacts is that it has on the hydrological cycle, introducing increased uncertainty as well as increased variability (higher highs, lower lows).

For some parts of the globe, increased dry spells are already being experienced, along with higher temperatures. One consequence of this is the increase of wildfires that are being seen.
Higher sea temperatures also contribute to more violent and more frequent storms, a particular concern for a coastal country like Mozambique. Yet when it comes to sanitation, flooding is arguably the primary risk and the primary means by which society ‘experiences the negative impacts of climate change’ (ISF-UTS and SNV, 2019).

Tropical cyclones may cause damage to already weak infrastructure and housing, including sanitation. Flood events may cause latrines to overflow contaminating water supply and there will also be a likely increase in vector-borne disease. Rising sea levels will increase erosion and allow saltwater intrusion into aquifers which can in turn have impacts on agriculture and water supply. Conversely drought, whilst devastating for agriculture and biodiversity may have a positive impact on sanitation as waste will decompose more efficiently.

### 3.2 Impacts of climate change

#### 3.2.1. Reviewing the impact of climate change on sanitation in selected sub-urban, urban and rural areas

To support the work a selection of field surveys were undertaken. With restrictions on travel due to the Covid19 epidemic still in place, certain limitations were in place. Nevertheless, it was possible to undertake field surveys in selected areas across the country thought of as representative of the broader picture.

Interviewees were asked to mention the major climate-related threats that they face in their communities. In general, all community members expressed concerns about climate and weather events, the categories offered being floods, cyclones and droughts. Drought was the least of concern as a standalone topic (2.2%) but 46.7% of respondents were concerned about all the events listed. Beyond this, floods elicited special concern (26.67%), followed by cyclones (24.4%). These results are consistent with reports from INAM, INGD and DNGRH, which also emphasise the existence of three major climate threats in Mozambique.
3.2.1. Reviewing the impact of climate change on sanitation in selected sub-urban, urban and rural areas

Survey participants were asked to indicate the major effects of climate change in their communities that they live. Their feedback prioritised the impact on infrastructure, including water supply and sanitation related (houses, roads, bridges, and water supply & sanitation systems, drainage systems) with 44.4% citing this as their primary concern. Crop destruction (6.7%) and flooded neighbourhoods (6.7%) were also of concern. Health implications were perceptible to some, but did not form a significant response (see table below).

These findings suggest that each type of climate-related vulnerability affects people differently. It also indicates that all communities - whether urban, sub-urban or rural – can suffer from diverse impacts of climate change (and all feel that climate change is impacting sanitation in their communities).

<table>
<thead>
<tr>
<th>Province</th>
<th>Infrastructure destruction (%)</th>
<th>Erosion (%)</th>
<th>Human losses (%)</th>
<th>Neighbourhood (%)</th>
<th>Trees Crops (%)</th>
<th>Livestock flooded (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M. City</td>
<td>28.9</td>
<td>2.2</td>
<td>2.2</td>
<td>6.7</td>
<td>6.7</td>
<td>2.2</td>
</tr>
<tr>
<td>Maputo Province</td>
<td>15.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Sofala (Beira)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>44.4</td>
<td>2.2</td>
<td>2.2</td>
<td>6.7</td>
<td>6.7</td>
<td>2.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Province</th>
<th>Increase in water treatment (%)</th>
<th>Increase in diseases (%)</th>
<th>Increase in living costs (%)</th>
<th>All (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>M. City</td>
<td>2.2</td>
<td>2.2</td>
<td>4.4</td>
<td>13.3</td>
<td>71.1</td>
</tr>
<tr>
<td>Maputo Province</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.2</td>
<td>17.8</td>
</tr>
<tr>
<td>Sofala (Beira)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Total</td>
<td>2.2</td>
<td>2.2</td>
<td>4.4</td>
<td>26.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>
When climate change impacts household’s livelihoods and economic activities (e.g., agriculture and livestock activities) it has a knock-on effect. One effect is to increase the cost of living and reduce household disposable income. This then reduces the ability of households to either rehabilitate (after storm damage) or sustain sanitation infrastructure at household level. Although the major impact of climate change on sanitation are more often reported in urban and peri-urban contexts, rural households are also in a precarious situation.

This links, in part, to lower income levels, as well as the sort of ‘sanitation infrastructure’ that the CLTS approaches common in rural Mozambique bring about. Latrine superstructures built from cheap materials (straw, sticks, reeds, plastic sheeting) are not capable or resisting strong winds or floods and thus relatively small climate-related shocks can destroy them. Equally pits that are dug under the superstructure are rarely lined, such that flooding events can lead to collapse (especially in coastal areas, where sandier soils predominate).

## Rural sanitation challenges

In recent months a new policy for rural sanitation has been released (see preceding section). Whilst the updating of the policy is a welcome development, gaps remain when it comes to how the threats posed by climate change to rural sanitation are to be addressed.

In rural and suburban contexts sanitation remains the responsibility of household and stated national policy involves ‘community-led total sanitation’ (CLTS) approaches, which not only stipulate zero hardware subsidies but also do not specify standards when it comes to the construction of latrines.

According to the statistics, more than 65% (INE Highlights - National Statistical Institute) population in Mozambique live in rural areas. Their income is mostly less than 1 USD per day. Thus, funds available for sanitation are low and, even where ‘triggered’ to move off open defecation by CLTS approaches, tend not to invest in particularly robust or resilient latrines.

When, during the field surveys, rural households were asked about the key challenges they face the high cost of construction materials was highlighted, as was a lack of knowledge about improved sanitation technology solutions.

Field visits provide indications that communities are taking steps to make their rural latrines more resilient, but this is without significant external support.
A useful measure would be to investigate what local practises are being followed and how these cope in the face of climate shocks. Those practises that show promise (such as using old sacking to provide stability to pits in sandy soils, or techniques that make roofing less likely to be damaged, perhaps learning from resilient building techniques) could be better documented, organised and then incorporated in training that supports other communities. Beyond this, influential voices have questioned whether the zero-subsidy approach enshrined in CLTS is appropriate in contexts where frequent storm events damage latrines and set communities back. Although it may be problematic, could discussions on how to support particularly vulnerable communities revisit this issue, albeit in a way that does not undermine more broadly the willingness of communities to invest in sanitation without ‘waiting’ for external support?

3.2.3. ‘Lived experience’ of extreme events and sanitation

More than a dozen stories were collected from the three principal areas of the country (North, Centre and South), ranging across rural and peri-urban contexts. All the stories show similar patterns, namely poor sanitation infrastructure at the household level, with unimproved latrines generally built from rough materials (no improved sanitation) and recurrent challenges posed by extreme weather events.

These events, which, on the coast, include cyclones destroy not only the latrines built but very often the main housing of the respondents (which, if not totally destroyed, tend to suffer significant damage to their roofing). Households, poor to begin with and setback in the aftermath of such an event, lack financial resources to rebuild and become disheartened by the damage suffered. Thus, communities that have previously been declared ‘open defecation free’ (ODF) tend to ‘slide back’.

All respondents cited a lack of government support following events. It is unclear what the GoM’s vision in providing a long-term solution to these challenges is.
Quiassoma Ali lives in the neighbourhood of Cotocua, Morroril district, Nampula. She uses a traditional latrine built from precarious materials. In 2018, a cyclone destroyed the latrine and partially destroyed her house. With little money and no government support, she had to build the latrine again with precarious materials.

Whilst it may not be possible to avoid any damage in future climate-shocks, resilient building techniques may be able to assist Quiassoma, whilst external support could help improve the materials used both above and below ground.

Adelaide Chilaulé lives in Maxaquene in Maputo. She uses an open-air latrine type bathroom. When it rains, Adelaide becomes fearful for her latrine, with the little privacy it offers easily destroyed. The latrine is currently full, whilst the build quality is poor, Adelaide fears it one day collapsing during use. She needs to seal up the existing latrine and dig a new pit, or empty the existing and build a better top structure with better materials.

Yet at 77 years old, with no formal income, any such steps will require external financial support. To date she has not received any support and when it rains heavily she struggles to find somewhere to meet her bathroom needs as her current latrine offers no shelter at all.
4. Service coverage patterns and trends

Over the entire period from 2003-2020 sanitation coverage has increased, as defined by those using improved sanitation systems. This broader trend however masks an important fact, namely that coverage fell between 2014 and 2020 –not just the national average, but also within the sub-sectors of urban and rural (see graphical comparisons below of the IOF survey periods 2014-15 & 2019-2020).

As to be expected, open defecation is higher in rural areas than in urban areas, fortunately with a sustained trend of it decreasing in each time segment over the entire 17-year period. Thus the ‘backsliding’ has been a consequence of households reverting to using unimproved sanitation systems, making people more vulnerable to the health and economic impacts associated with poor sanitation access.

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1 For high-income countries it is estimated that the SDGs require an acceleration in coverage expansion of 1.5 times current rates. For low-income countries the expected rate is 14 times. Mozambique is part of this latter group.
Already rural sanitation in Mozambique lagged behind the rest of the continent.

According to UNICEF, in 2015, rural sanitation coverage in Mozambique was lower than for Sub-Saharan Africa as a whole (35 percent) because of less attention paid to rural districts (UNICEF 2015).

Equally, in urban areas, the World Bank stated in 2018 that, regardless of sanitation access (improved or unimproved), Mozambique’s sanitation service chain - the emptying, transportation, treatment, and disposal of faecal waste - was underdeveloped. Faecal sludge management systems are also vulnerable to climate change, although this is expressed differently than for sewerage systems.

A possible explanation for this falling away of households could be climate change. Although it is difficult to test this hypothesis in a rigorous fashion, comparison of sanitation coverage rates against trends and patterns in climate-related events is instructive.

4.1 Service coverage patterns and trends

Sanitation businesses in Mozambique are active across three important markets – sanitation markets in urban, peri-urban and rural areas. The sanitation value chain includes the construction of sanitation facilities, cleaning, emptying, transport, treatment and disposal of waste. The sanitation value chain is often used to described the ‘sub-markets’ within which sanitation businesses operate. The diagram below explores this further in the context of Mozambique.

Where and how could sanitation businesses be affected by climate change?

In urban areas climate change can impact sewerage and drainage networks. In Mozambique these are largely operated by municipal public entities, although there are some exceptions. These entities often rely on SME for maintenance, which implies a potential knock-on effect.
Still in urban contexts, those not served by sewerage commission faecal sludge transportation services to take their waster away for treatment and disposal. This is a market shared between the private sector and municipal providers. Whomever provides this service, there are jobs created and valuable income for families generated.

In peri-urban locations the markets differ, although there is some overlap with more urban areas. Here there are small business assisting with the construction of sanitation infrastructure (not just indoor or outdoor toilets, but also latrines and the substructure that these entail). There are also, usually informal, markets for the manual emptying (and disposal) of faecal sludge.

These services are mostly carried out by local MSMES, but also by community associations. In Maputo these are supported by municipalities and have formal contracts.

In rural areas, the construction and sale of slabs for latrines and the excavation of latrines provide opportunities for sanitation businesses. Jobs, income from the sale of slabs and wages from work performed in construction (excavation) are the resulting earnings.

The diagram below seeks to highlight the linkages between climate change, public-private-or-household investment and these services.

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### Figure 4: Niche markets for sanitation businesses along the sanitation value chain and the potential impact of climate change on them.

<table>
<thead>
<tr>
<th>Sanitation Businesses</th>
<th>Services Rendered in the Communities – MSME and Community Associations Subsidized by Municipal Councils</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Build and sell concrete slabs for latrines - micro and small businesses, companies, local shipyards and hardware</td>
</tr>
<tr>
<td>Urban Areas - Affected by the Effects of Climate Change (Floods, High Temperatures and Little and Small Earthquakes) on Through Eventual Permanent Job Creation and Income Generation for Companies.</td>
<td>Municipal Cleaning Services – Municipalities Authorities</td>
</tr>
<tr>
<td></td>
<td>System Maintenance Services - Carried Out by SMEs</td>
</tr>
<tr>
<td></td>
<td>Fecal Sludge Transportation to Treatment Areas</td>
</tr>
<tr>
<td>Peri-Urban Areas - Include the Construction of These Systems and the Manual Disposal of Fecal Sludge</td>
<td>Construction Work Services on Systems</td>
</tr>
<tr>
<td></td>
<td>Sales of Concrete Slabs to Cover the Latrines</td>
</tr>
</tbody>
</table>

| Rural Areas - Gains Includes Employment (Mostly Seasonal) and Incomes from Supply of Slabs; Losses Come from Opportunity Cost Derived from Acquiring Services in a Catastrophic Situation | --- |
| Construction (Build) | Emptying | Transportation | Treatment | Disposal |
Negative impacts identified are mainly related to extreme weather events. Where these destroy existing infrastructure, families can face catastrophic expenditure requirements in order to replace facilities. A further need for investment may arise from a desire to ‘upgrade’ existing sanitation facilities to make them more resilient or robust in the face of climate change.
The link between climate events, household costs and sanitation entrepreneurship

Coverage of sanitation is increasing slowly, but vulnerable households that are not resilient to the effects of climate change remain prevalent. On-site sanitation – especially external latrines – are particularly susceptible to climate shocks. From the perspective of a sanitation entrepreneur, whilst the destruction of systems could be perceived to lead to new demand, the reality is that many families with low incomes struggle to quickly replace infrastructure damaged by extreme events or retain their standing as customers for other sanitation services.

From a social standpoint, it is crucial to reduce catastrophic expenditure shocks to households linked to repairing the damage to sanitation facilities imposed by climate shocks. To do this, more resilient systems are needed for vulnerable households. Ways to do this include: promoting increased investment in improved sanitation systems, finding service levels of technology options that are both adapted to conditions and levels of income / vulnerability. Here the focus should arguably be on rural and peri-urban areas;

In this both government investment and stronger sanitation markets are likely to be needed, whether at local rural level, or district level – whether in peri-urban or urban areas. The private sector and entrepreneurs may need training support on appropriate technologies and perhaps subsidy support. Community enterprises could provide another approach to address localised challenges. In all cases it will be up to government to create the appropriate incentive frameworks and to support training and other capacity building.

From a budgeting perspective, the resource allocation process in the GoM budget could be improved, particularly when it comes to budget classification and transparency. This would permit better tracking and accountability of sanitation services – and assist with support from external parties, whether private, development partners, donors, communities, etc. As such, engaging with ongoing reforms of the public finance management system and decentralisation process provides twin opportunities to secure further resources to support such activities (and vulnerable communities and households).
SANITATION ADAPTATION OPTIONS IN THE FACE OF CLIMATE CHANGE
5.1 Coping with extremes, dealing with unpredictability

Climate change may not be a new phenomenon, but its impact on the sanitation sector is increasing, via both increased uncertainty as well as increased variability in existing patterns. Mozambique is one of the most vulnerable countries in the world in respect to climate change and has already experienced the consequences. The increasingly violent storms battering its coastline, such as cyclone Idai, providing one recent tragic example.

Sanitation stakeholders must deal with both the impact of extremes and the consequences of unpredictability. The resilience of the system is an important part of how the sanitation copes (resilience being the concept that a system can deal with both shocks and with long-term change and, by becoming more resilient, sanitation systems can ‘bend without breaking’). This means any analysis of how climate change affects sanitation must look beyond shocks and consider less dramatic, but equally important, system stresses.xxviii

As important is to go beyond technology to consider the socio-political-economy, for sanitation does not ‘stand-alone’. Sanitation is a human right and not just a service to be delivered (or not delivered) – the issues of who gets what and when is inextricably tied up in larger issues of equity and politics. Moreover, sanitation is indelibly bound to the water sector. Achieving resilient sanitation will certainly require a more resilient drinking water supply.

5.2 Key stakeholder groupings

In thinking about who is impacted by climate change, one must equally consider the twin cycles of disasters and slow onset climate change. Each poses a differing challenge to different groups, depending on where they live, their disposable income, the nature of their housing and their access to formal services. Not only are the most vulnerable in society the most vulnerable to disaster, they suffer most and longest climate change’s slow onset events.

In thinking about how best to respond to challenges, three important groupings come to the fore. These are 1) citizens and households; 2) sanitation providers; and 3) policymakers, politicians and regulators.
Regardless of how responsive these last two groups are, citizens will deal better with the challenges of climate change where community organization is strong and communities can take measure to deploy their own solutions. Organized communities also have more influence with external parties, whether politicians, policymakers or service providers. Politicians tend to the more short-term, highly responsive in response to visible shocks, less stimulated by slow onset challenges. Policymakers for sanitation are highly diverse – developments in drainage, solid waste, housing or coastal protection can be as, or more, important than those in the ‘narrow sanitation sector’. Providers too are diverse – some inside government, some private. Some formal utilities, some informal businesses. NGOs and social enterprises too have an important role to play.

**Sanitation ‘resilience’ in the face of climate change**

Resilience is the lens through which we look at how sanitation deals with such changes, implying systems that can deal with both shocks and with long-term change. A useful definition comes from ‘The City Water Resilience Approach’ xxix: “Urban water resilience is the capacity of the urban water system, including the human, social, political, economic, physical and natural assets, to anticipate, adapt, respond to, and learn from shocks and stresses, in order to protect public health, wellbeing and the natural environment, and minimise economic disruption” (Anon, 2018). Adapting a definition from the ‘water sector’ serves to further underline the unbreakable link between sanitation and water. The main risk of inadequate or unsafe sanitation - especially in a flood situation - is contaminated drinking water. In an urban setting then, delivering sanitation resilience goes a long way to delivering urban water resilience. And vice versa. Part of the solution to achieving resilient sanitation is certainly to be found in making drinking water supply more resilient.

**5.2.1. Opportunities to increase ‘sanitation resilience’**

The remainder of this section considers what each of these actors can do in the face of climate change, but does not seek to be exhaustive. One or two opportunities are highlighted for each group – with short-term and long-term options. The following table does two things: 1) gives a summary of the recommendations that follow; and 2) reflects on the changes in accountability these steps may bring about and how this may contribute to increasing ‘sanitation resilience’. xxx
### Actor / Response / Adaptation

<table>
<thead>
<tr>
<th>Actor / Response / Adaptation</th>
<th>Short - term</th>
<th>Long – term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citizens, communities, households</td>
<td>Floods wash human waste into the environment, causing disease and consequences that linger long after floodwaters have receded. Community preparedness plans can reduce this, as can safe and frequent waste disposal. They can also ensure options remain open to communities affected by disaster. Container based sanitation may offer one innovative route to resilience in this regard.</td>
<td>In the long-term building social capital within communities and engaging them on sanitation and climate-change related issues can improve resilience markedly. Community based approaches to adaptation can be brought to bear in relation to sanitation. Equally, resilient building methods can be applied to make sanitation infrastructure within communities more resilient.</td>
</tr>
<tr>
<td>Accountability changes</td>
<td>If communities are better prepared for the more frequent disasters climate changes brings, this can include being more able to put pressure on both policymakers and sanitation providers when events occur. This can make outside actors more responsive to community issues – either after the event or even before it. Great social capital within communities improves accountability more broadly, potentially rebalancing some of the challenges poor communities face in dealing with inequalities (that are otherwise exacerbated by climate change).</td>
<td></td>
</tr>
<tr>
<td>Providers, municipalities, water companies, NGOs</td>
<td>Some disasters come with warning, meaning temporary steps can be taken (e.g., sandbags) to protect key infrastructure – both that operated by the utility or municipality (e.g., wastewater treatment plants) and that within communities (e.g., shared or institutional sanitation blocks). Providers can also be proactive in reaching out to citizens, with education and awareness (E&amp;A) activities. An innovative step may be to offer pit emptying promotions in the run up to likely flooding, both to strengthen the delivery chain as well as remove waste from the environment.</td>
<td>Co-ordinating with existing and planned drainage projects – whether externally or internally funded – can assist sanitation providers to ‘future-proof’ their assets, as well as bring the voice of the sanitation sector into wider decisions on urban drainage. Responsive providers can also map flood prone areas, particularly in poor neighbourhoods, helping to make decisions about how to protect assets and site new developments appropriately. Project analysis that allows for increased uncertainty to be factored into operational and budget decisions can also help sanitation providers to cope with climate change.</td>
</tr>
</tbody>
</table>

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**xxxi**
### Accountability changes

**Sanitation providers** can use climate change as a means to strengthen relationships with the communities they serve and even, perhaps, to reinforce their supply chains in ‘times of plenty’. By being proactive in this regard they can also improve their image in the eyes of policymakers and politicians, thus reinforcing their side of the ‘compact’. Forward-looking project analysis that incorporates uncertainty – or invites collaboration with ‘other sectors’ - could arguably strengthen their hand when it comes to influencing policy change.

### Politicians, policymakers, regulators

The sanitation sector has occasionally been slow off the mark to make the case for support following a disaster – allowing others to make the running. Preparing, in advance, quick response plans may strengthen the voice of the sector in the aftermath of a ‘climate event’. Likewise, proactive engagement with organisations – inside or outside government - whose mandate is disaster relief could ensure that sanitation is better factored into response. This same thinking suggests that a doubling-down of public investment in institutional (and other, shared) toilets as these can provide as valuable ‘backstop’ during emergencies.

Given climate change is due to strike different areas of Mozambique – 2300 kilometres long - in different ways – more research into local threats and vulnerabilities would be a valuable investment. Likewise, on a local scale, especially in urban areas, mapping (overlaying sanitation infrastructure with flood prediction maps) to better understand areas of weakness would help the entire sector become more resilient. Frequent (and predictable) damage to infrastructure in typhoon-prone areas makes sanitation marketing, with no subsidy, a particularly hard sell. In such instances there may be a public health and equity argument for revisiting the ‘no hardware subsidy’ consensus that prevails in the international sanitation sector.

### Accountability changes

Adding to the information base around this topic is to increase the public good and an important contribution the government can make. It also serves to increase the accountability between all actors involved and enable other proactive steps to take place, with a solid foundation to build on. Both collaborating with other arms of government and investing in institutional sanitation serves to increase the footprint of government in the sector and to boost the ‘community voice’ – either of which could be an invaluable contribution.

## 5.3 Learning from Beira

Beira is a fast-growing port city in the centre of Mozambique, the second largest city in the country. In 2020 it was estimated to have more than 600,000 inhabitants, of which more than 70% lived in informal housing and at least 45% did not have access to a consistent and quality water supply, nor safely managed sanitation (Zhang et al, 2020). As a city particularly exposed to the impacts of climate change and with a dynamic plan to deal with urban sanitation challenges, Beira makes a good case study to explore not only how climate change impacts different actors, but what practical measures can be taken to adapt.
Beira is at the mouth of the river Pungwe and occupies largely low-lying land, making it vulnerable to the effects of climate change, particularly flooding, sea-level rise and coastal storm surges. Those living in informal housing are more likely to occupy the low-lying land and more exposed to flooding episodes.

Figure 6: Aerial view of Beira (Gischler, 2017)

Beira has long been a city identified as having specific climate-change concerns. It is also considered a dynamic city, with a keen interest in urban planning, reflected in part by support from the World Bank and European bilateral donors to the Beira Master Plan 2035. In March 2019 these concerns coalesced in tragic fashion when the city was hit by cyclone Idai – making landfall as a category 2 storm not far from the city and causing widespread damage, estimated at $1bn USD. The Mozambican authorities had predicted the possibility of such an occurrence but the exact timing was not anticipated. When Idai struck, coastal surges as well as heavy rain led to widespread flooding and significant damage to property (with many habitations having their roofing destroyed). Waterborne diseases were significant in the aftermath, linked to floodwaters spreading untreated human waste throughout the urban environment (Zhang et al, 2020).

The international response to the cyclone and the damage it caused was relatively rapid, with many organisations rallying around the mantra of ‘Build Back Better’.
The recovery plan to rebuild Beira asked for over $900 million USD – nearly a quarter of this required to reconstruct the primary drainage system over five years. Yet two years after the cyclone, at the sums committed – over a ten-year period – come to at best a third of this amount.

Even before the disaster, Beira municipality operated in a context of highly constrained resources – the city is similar in size to Rotterdam, yet that Dutch port has 200 times the municipal budget that is available to Beira. Prior to cyclone Idai, a significant project to improve drainage and introduce grey-green infrastructure had transformed areas of the city, notably assisting during the flooding in the aftermath of the cyclone (Dicker at al 2020). Equally, the response plans largely focus on drainage.

Sanitation is integrated in some of the ‘Build Back Better’ planning but, notably, is a relatively minor element in an under-funded portfolio. The city has its own municipal provider – SASB (Serviço Autónomo de Saneamento da Beira) – that deals with both drainage and sanitation. Yet the budget of the organisation is highly constrained and there are real limits to what the SASB can achieve.

5.3.1. Long-term options for communities

The flooding in Beira – both that following cyclone Idai and that earlier in the year (in January 2019 the city experienced a ‘1-in-50-year flood’) - revealed a few things. Firstly, that it was poorer households, with less adequate housing, that experience the worst effects. This reflects the fact that they tend to be in lower-lying land and that they are less well served by drainage and flood protection. Anecdotal evidence also points to the double-edged sword that is poor solid waste management (SWM) – not only do residents in areas where SWM services are inadequate suffer from day-to-day nuisance and health risks, but rubbish clogs the drainage systems and contributes to worse initial flooding and longer-lasting periods of standing water thereafter.

Flooding and inequality
In vulnerable country like Mozambique, far fewer people die from drowning or violent death during a flood (or cyclone) compared to those that die from waterborne diseases in the aftermath. This is a function of interruption in safe water supplies and the pollution of existing water supplies (as well as floodwaters) by the viruses and bacteria present in untreated human waste. Depending on the severity of the incident, individual households may or may not be in a position to respond (for instance by collecting and storing safe drinking water away from the floodwaters).
Flooding also poses a physical risk to sanitation infrastructure, for instance when bridges are washed away and take sewerage pipes with them, or where septic tanks are ‘popped’ out of the ground during a flood. But it also affects different social classes differently – the wealthier are more likely to be in formal housing and this housing is less likely to be in a floodplain or low-lying area. Thus, as flooding takes place, it has the effect of deepening inequality. This surely affects shelter (contrast the damage to informal housing versus informal housing during a storm), yet it also has other, more insidious, impacts.

In urban Africa, poorer areas are far more likely to ‘sit’ with floodwater for days or weeks following a flood event, as well as more likely to share sanitation. Persistent drainage issues can thus cut their access to their usual sanitation facility, forcing them into open defecation or other indignities and health risks. xxxvii

Moreover, after a ‘climate event’, it is the better resourced neighbourhoods tend to capture the lion’s share of the recovery effort, despite being less adversely affected in the first place. This is partly a function of local politics, but also visibility of those areas, the sympathies of local officials and service providers and greater articulation of needs (and push for those needs to be met).

What has this to do with climate change and sanitation? Both climate shocks and slow onset climate change are entwined with existing questions of inequity and vulnerability. Arguably one of the best things that poor communities can do to combat this is to be prepared to articulate their needs.
Whilst this should be an ongoing process, the ‘powers that be’ tend to be most receptive in the immediate aftermath of a flooding or storm event. One way to balance the inequity inherent in the system - and in much of the ‘Build Back Better’ rhetoric - is to be well prepared with budgeted plans, so that a strong case can be made for a more equitable and holistic allocation of resources when those decisions are being made.

“Social capital, such as the development of community cooperation and networks, like those developed in Kenya through community adaptation planning committees and in Odisha through community disaster management taskforces, has been shown to be an important aspect of developing local adaptive capacity and resilience”.

Natural capital also has a key role to play in adaptation processes, as well as providing other social and economic benefits (Dicker et al, 2021).

Building social capital is clearly a long-term endeavour with multiple benefits that go well beyond climate change adaptation and sanitation. Nevertheless, the impact of flood events can be a major prompt to the coalescing of a community around commonly-held challenges. Activities to forestall some of the obvious challenges can also act as a focal point.
Community-based approaches to climate change Adaptation

Adaptive capacity is described as a community’s potential to adapt to the challenges posed by climate change including the ability to be actively involved in processes of change. This requires skills and a diversity of assets within the community in question. A community-based approach to climate change adaptation may require communities to adopt new livelihoods, lifestyles or patterns of behaviour and so this is a process that needs to be sensitively and carefully facilitated. More information about this approach can be found in Ensor and Berger (2009).

The following case study from Indonesia highlights the strengths of a community-based approach (based on Megaw et al, 2020):

Climate change is expected to affect Indonesia through increased average temperatures, increased frequency and intensity of rain events, increased sea level rise and an overall decline in annual precipitation. ISF-UTS led a process of collaborative design ‘to assess how climate change affects livelihoods, WASH services, and gender and social inclusion outcomes’. Several types of approaches were used including:

- Climate-sensitive community mapping: facilitating community members to identify where climate-related hazards affect the community
- Climate impact diagram: helping communities to understand the impacts of climate change on access to sanitation starting from a hazard and using picture cards to explore relationships within a wider system
- Assessment of climate impacts on sanitation accessibility: identifying how climate can worsen barriers to access and how community can build toilets to help people overcome barriers.

The process helped to identify that sanitation facilities were difficult to access in heavy rain and that in seasons of drought the lack of water meant that people abandoned pour flush latrines and turned to open defecation. The community then identified their strengths in responding to climate change and actions that they and the local government could take to maintain WASH access in extreme climate events. These included good maintenance of public toilets; community cooperation to build toilets for each household; a collective fund to respond to disasters; getting support from government for training; and, growing bamboo for construction of toilets.
The organising of community groups to maintain drainage channels or help raise the paths to shared sanitation facilities is an example of using social capital to forestall challenges. When a disaster strikes, such groups can be mobilised to provide self-help to the more vulnerable – for instance, the aged and disabled (Satterthwaite et al, 2007). Particularly where shared facilities can be ‘built up’ above common flood lines – as well as access routes to them maintained – they can arguably provide not only a useful service to the community in the good times, but a fallback position for those who lose access to closer ‘individual facilities’ when flooding strikes. Community organisations can also help advocate for – and perhaps provide advice on – how to safeguard other facilities against flooding. For instance, the raising of individual latrines is one possible response.

Finally, there may be merit in exploring how resilient building methods can be used not to just protect the primary shelter but also sanitation infrastructure, such as shared community sanitation or individual latrines (Murphy, 2006). According to the Centre for Affordable Housing Finance in Africa, cyclone Idai caused severe damage to 90% of the buildings in Beira. Yet affordable housing, built using simple cyclone resistant techniques, such as the use of screws instead of nails and metallic straps, suffered minimal damage and withstood the impact of the storm (Nkhonjera, 2020).

5.3.2. Short-term options for providers

As the below graphic (World Bank, 2016) shows, the service chain for sanitation can be complicated, meaning there are a range of sanitation providers. Each is affected by climate change in a different way, regardless of whether we are looking at slow onset changes of climate related shocks.
A big difference exists between the aspects of provision that are mobile and those that involve fixed infrastructure. Examples of the former include the vacuum trucks that empty septic tanks or latrines as well as much of the equipment used in building toilets or latrines. Examples of the latter include the sewerage network, pumping stations and treatment works.

In the short term there is little that can be done in relation to the fixed infrastructure – albeit in the longer-term decisions around where to site that infrastructure can be informed by climate change scenarios. Some steps can be taken to protect above ground infrastructure – whether communal toilets or wastewater treatment plants from flooding – by protecting them and key access roads or paths with sandbags. This can serve a double purpose. Firstly, ensuring the continued access of communities to sanitation by protecting communal toilets. Secondly, by preventing the waste stored in these facilities from being washed into the urban environment and adding to the health risks.

In relation to non-fixed assets, it is helpful that there is often prior warning of impending events (in Mozambique it is not uncommon for forthcoming flooding to be anticipated a week in advance – and, of course, there is a ‘flood season’). A simple measure is for sanitation providers to conduct education and awareness activities around the dangers of drinking floodwater and broadcasting advice on measures that households can undertake (such as stocking drinkable water in sealable containers, ensuring a supply of soap, etc).

An innovative suggestion is that those providers that offer emptying services not only increase services at ‘risky’ times of the year (more frequent emptying made possible by preventative maintenance on vehicles or amendments to staffing) but promote them more aggressively in these periods, perhaps by offering limited-time discounts to services. This offers something of a win-win.

Not only are sanitation services thus more widely-used, but flood events are harnessed to raise broader awareness around sanitation. Emptying pits and septic tanks prior to a flood event also reduces the amount of human waste that can be washed into the urban environment when flooding does occur.
5.4 Learning from Maputo

Maputo is Mozambique’s capital city with Greater Maputo being the most densely populated area in Mozambique. The Greater Maputo metropolitan area [from herein ‘Maputo’] consists of Maputo, Matola Municipalities and Boane Village and Marracuene District. Maputo is situated on the western shore of Maputo Bay.

As the capital city, Maputo is not short of policies and plans concerning climate change and sanitation, but there is little evidence of these being put into practice. In this work therefore we seek to identify some tangible quick wins that can align with this planning, but which do not require significant new investment. xli

A capital city learning to live with flooding and sea-level rise

Whilst the effects of climate change on Maputo are noted elsewhere in the wider work, it is worth noting here that Maputo has suffered continuous cycles of droughts and flooding with floods often exacerbated by cyclones. Of particular historical note are the floods in 2000, which destroyed informal neighbourhoods of Maputo. Flooding in major rivers saturated the city followed by a 1-in-50 year rainfall over three days. This renewed flooding destroyed roads and bridges and isolated areas within Maputo and Matola cities (Satterthwaite, 2007).

Maputo is so badly affected by these events due to its multitude of vulnerabilities: an extremely dense city with high levels of urban poverty situated in a low elevation coastal zone. Rising sea levels have already caused damage to agriculture through salt intrusion, further adding to the existing poverty (UN-Habitat, 2009).

The vulnerability of cities to untreated waste in the urban environment

This vulnerability compounds an existing weak state of sanitation in the city. A review of FSM in Maputo found that 90% of the population use onsite sanitation. This typically means a pour flush or improved latrine.
The quality of construction of these is generally poor, one consequence of which is that the risk of collapse during an extreme flood or cyclone is high.

Most of the onsite sanitation is found in informal settlements which are increasingly spreading to low lands and marshy areas with high flood risks. As shown in figure 8, of the onsite sanitation around half is unsafely emptied with the sludge ending up buried shallowly nearby. This increases the likelihood of this sludge being washed into the local environment during flooding events.

When it comes to waste treatment, there is only one treatment site in Maputo - Infulene - which is situated 9km from the city centre. Unlike in many locations, faecal sludge is permitted to be discharged to the stabilisation ponds at Infulene, partly in recognition of the lack of dedicated faecal sludge treatment centres. However, due to the distance involved and a lack of regulation, it is estimated that 25% of the safely emptied sludge does not make it to the treatment site and is dumped illegally.

When a flood event occurs in Maputo the lack of adequate drainage means that flood waters, now mixed with faecal sludge, do not quickly disappear.
The Luis Cabral settlement is by no means exceptional in this regard, with one resident suggesting that “a single one-day rain event can cause floods that persist for three days. If the rains persist for three days to one week, the water depth rises to 1m and it may take a month to disappear”. (Douglas et al, 2009) Consequently, after a flood event it becomes almost impossible to keep a significant proportion of residents and faecal sludge separated from each other, with resulting high levels of diarrhoeal disease. The most vulnerable are hardest impacted. An approach to sanitation in Maputo in the light of climate change therefore has to address this first and foremost.

5.4.1. Short-term options for communities

In the section on Beira, we considered what communities can do in the long-term and what providers can do in the short-term. Here we flip that analysis, first considering what communities can do in the short-term to respond to climate change’s impacts on sanitation.

Firstly, we must acknowledge that, above all, climate change exacerbates existing challenges related to sanitation in Maputo: namely the lack of formal faecal sludge services, transfer stations and treatment options for the 90% of the population who rely on these. Communities thus have relatively few options available to them to minimize the risk of contact with faecal sludge after an extreme weather event such as a cyclone or flood.
The Matlombe family from Bairro Maxaquene D, Quarteirão 22. The family, the father of whom is 78, all share the same open-air bathroom alongside five grandchildren. They spoke about the challenges around faecal sludge management:

“We have already had an outbreak during a flood season (rainy season), when it rained for three days and the bathrooms with latrine filled up with water and the resulting [dirty] waters came into contact with the soil and people. The next week people complained of rashes, burned on the skin, some wells were contaminated and people who drank such water ended up getting serious stomach problems.

From then until now, very little has been done to improve the bathrooms - like many families, we do not have income capable of building a decent bathroom. For now, when the latrine is full, we will pump the dirty water with [a local desludging vehicle] and try to clean the area.”

4.4.2 Reducing environmental pollution & promoting safe and frequent waste disposal

In the section on Beira, we considered what communities can do in the long-term and what providers can do in the short-term. Here we flip that analysis, first considering what communities can do in the short-term to respond to climate change’s impacts on sanitation.

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Community preparedness plans

Communities can also work on preparedness plans. These can include improving the use of existing information systems to ensure that flood warnings are communicated accurately and in a timely manner. This review should also include how information is shared with communities on how to prepare for climate-related shocks – and where to help if they arrive.

Participatory research in Maputo, conducted in 2014-15, focussed on the sanitation related consequences of flood events. This found that when emptying services are not available, part of a preparedness plan should include covering latrines and improving drainage around latrine structures once a flood warning is given (Broto et al, 2015)

Exploring container-based sanitation

In certain contexts, the innovation known as ‘container-based sanitation’ may offer a promising means to reduce environmental contamination due to poor disposal practices or the risks posed by the flooding of fixed latrines. CBS, as it is known, may offer certain advantages when viewed through the lens of climate change: CBS is suited to areas prone to flooding or with high water tables as they do not require a pit to be dug; CBS uses sealed containers and do not allow sludge to enter the environment even during a flood event; CBS uses containers with limited volume – certainly much less than your average pit latrine – such that, even in the worst-case scenario, there is less sludge able to enter the environment. Not only does CBS address mitigating against the impacts of climate change but there are suggestions that CBS is associated with significantly reduced carbon emissions compared to existing sanitation options. Additionally being a waterless system, CBS can also bring advantages to drought affected areas of which Maputo is one (Container Based Sanitation Alliance, 2020).
5.4.2. Long-term options for providers

A focus on drainage

In the long-term providers must join a coordinated approach by all stakeholders, supporting the existing government-led initiatives for overall sanitation and drainage upgrading including implementation of the Greater Maputo Sanitation and Drainage Masterplan; improvements to the Wastewater Treatment Plant at Infumene; and increased regulation of faecal sludge management. Around 70% of Maputo City’s residents live in informal settlements that lack basic infrastructure and the faecal flow diagram showed that 12% of faecal waste in Maputo ends up in drainage channels.

Providers would be well placed to focus on the planning and rehabilitation of drainage channels in Maputo, particularly in the informal areas of the city, with the aim of reducing floodwaters as quickly as possible.

This would increase the resilience of the city to peak events and would also protect infrastructure from more predictable rains which in turn makes that infrastructure stronger and more resilient to the peak events. Conselho Municipal de Maputo (CMM) is the institution with responsibility for urban planning including drainage. Partnerships between providers and the local community could lead to effective maintenance strategies. However as noted in Evans et al (2020) some work must be done to size drainage for new peak flood events and providers must be thinking in a future orientated way to ensure the relevance of the work undertaken today. xlv

Additionally siting new infrastructure away from flood prone areas is vital and providers have a key role in engaging with initiatives to map these areas and to construct responsibly. Where this incurs more cost, climate finance for resilience might be accessible.

4.5.6 The need for utilities to look outside traditional operations when considering climate change

In 2009-10, the World Bank undertook an international survey of 20 urban water utilities, with a view to better understanding how they perceived the risks from climate changes and what sorts of adaptation measures they were considering.
The report was keen to stress that utilities should be pragmatic in their planning and that the consideration of climate change should not “become a justification for overdesigning capital projects and seeking unwarranted financing in the name of adaptation” (Danilenko et al, 2010). The suggestion is that – for both water and sanitation – urban utilities or municipal providers are in a position to strengthen their capacity to implement climate adaptation measures, but that it is also vital to look at factors outside traditional operations (such as spatial development, pollution control, and solid waste and storm water management) and consider how these may evolve, in a scenario of a changing climate, to influence service delivery. Priority areas suggested for utilities included intelligent and flexible infrastructure design and operation; increased uncertainty and risk-based project economic analysis; and (the provision of) insurance for systems and for customers, notably the poor.

5.5 Tackling rural challenges

Whereas the responses of community and service providers, at least in the short-term, are likely to be tactical, policymakers can look to be strategic – as well as taking actions that assist the other two actors. Moreover, one of the key challenges facing politicians, policymakers or regulators is the issue of heightened uncertainty and how to bring more resilience into the system more broadly. We now look at these issues, with a particularly focus on rural Mozambique.

The contrasting context of rural Mozambique

The first thing to mention is that, in Mozambique, there are important regional differences in how climate change is forecast to impact rural areas. There is also an important South-North divide in terms of how resources are allocated and how ‘close to’ policymaking rural communities perceive themselves to be.

The dangers posed by exposed faecal sludge in a more spacious rural environment are less than in dense urban settlements, though the risks are by no means insignificant.
In 2015, heavy rains hit the north of Mozambique destroying 10,860 houses. Many latrines collapsed, although this was not captured in the statistics at the time. A study conducted shortly after this climatic event in Nampula province showed that ‘of those [interviewees] who received CLTS [in the past], 64.8% rebuilt their latrine; the equivalent figure for CLTS non-receivers was 39.9%.’

Further analysis suggested that rebuilding depends on ‘education, soil conditions, social cohesion, and a feeling of being safe from diarrhoea, the perception that many other community members own a latrine, and high confidence in personal ability to repair or rebuild a broken latrine.’ (Mosler et al, 2018).

In a rural context the focus needs to be on incorporating climate change impacts into sanitation programming – which means ensuring that the voices of communities on their lived experiences of climatic events are heard.

This must be holistic - changing weather patterns affect all aspects of rural life and they cannot be distinguished in the minds of the community. For example, a drought, which affects crops, means less money for latrine repairs.

### 5.5.1. Short-term options for policymakers et al

Policymakers can do a few things in the short term. These aspects do not require new policies, new institutions or new budget, but rather a shift in emphasis to recognise – and better respond to - the sanitation-related challenges of climate change in rural Mozambique.

Quick-response plans

Firstly, policymakers can prepare sanitation-related quick-response plans for the aftermath of an event. As well as funding contingency plans to put in front of newly approachable donors. This is something the sanitation sector arguably missed out on in the response to cyclone Idai, hence the relatively low profile in the ‘Build Back Better’ package for that city. As the frequency and severity of climate events increases, there are certain scenarios that are relatively predictable – having an articulate – and budgeted plan – for how to respond if and when they arise can greatly enhance the chances of sanitation being prioritised (and the sanitation-related consequences of events, such as flooding, reduced).
Secondly, those institutions that deal with sanitation can engage more with those that concerned with disaster response. Anecdotal evidence suggests that in the aftermath of recent crises organizations such as the Red Cross and others dealing with disaster response were not always familiar with sanitation issues, ranging from infrastructure provision in a disaster to the relevant WASH policies and approaches. Disaster response organisations frequently ‘game out’ scenarios around possible disasters – where possible sanitation policymakers should seek to inform these exercises (they can try to join in or, less intensively, merely make relevant datasets and evidence available in an accessible manner).

For policymakers in Mozambique, investment and focus on institutional latrines in these rural areas ensures that there is an option for communities after a climate event and avoids the instant return to open defecation.

One option is to look to access climate financing to ensure that toilet blocks at schools, health centres and in public and community spaces are resilient - flood proof and cyclone resistant. This would provide a safe sanitation option for communities when household latrines inevitably fail. Constructing high quality institutional sanitation blocks also ensures that the concentrated levels of faecal sludge in these areas is more likely to be contained in the event of an extreme event. This echoes work already being done as part of PRONOSAR, whilst projects by SNV and WSUP are also investing in this area.

5.5.2. Long-term options for policymakers

One of the defining characteristics of Mozambique is that different parts of the country have differing threats and vulnerabilities when it comes to climate change. When it comes to sanitation, this aspect needs to be better understood, so a first recommendation is for policymakers to invest further in understanding this.
For urban locations, comprehensive mapping exercises (such as the one highlighted in the box below) have highlighted the areas of cities and towns where the threats and vulnerabilities overlap. The World Bank in Mozambique has conducted a mapping exercise for schools but lacked funding to expand the work to other areas.

The recently created sanitation budget line in Mozambique offers significant opportunities. This can be used not only to advocate for increased sanitation funding, but in-country stakeholders can direct money towards strategic pieces of work that will create opportunities for relevant and effective interventions.

Conducting this type of analysis across various rural districts will help identify priority areas where there is a combination of high risk and poor sanitation.

4.10 The value of overlaying sanitation mapping exercises with floodmaps

Without having a good underlying dataset, it is almost impossible to make specific targeted and contextual plans for climate change resilience, adaptation, preparedness or response. In Uganda in 2017 Kampala Capacity City Authority undertook a sanitation mapping exercise to identify the location of various forms of sanitation within the city boundaries. Recently a new project team followed up this work, overlaying the existing information with topographical data, allowing them to identify areas where the sanitation facilities would be most at risk of flooding.

Using this information, a number of interventions were tested that could be tailored to the types of extreme weather events and the specific sanitation types and locations. It was identified that the concentration of faecal waste in the flood water peaked within the first hour of the flood event. Modelling was then able to show that where latrines were formally emptied in the 5 days before the flood event and where sanitation facilities did not have direct connections to drains this concentration of faecal sludge in the environment was significantly reduced.

Investing in data, mapping and analysis in this case led to some implementable strategies that are achievable by the community or providers. The Fractal project identified that whilst climate data exists for Maputo, it is not being used for planning. There is a role for organisations embedded at all levels of society to facilitate coordination across the municipality.
The type of mapping exercise outlined above is one such opportunity, but others exist. Other work around sanitation and climate change (Evans, 2018) has emphasised the importance not only of maintaining existing infrastructure but also identify specific bottlenecks that constrain different areas of the service chain.

**Revisiting policy around sanitation subsidies**

In low-lying coastal areas of Mozambique, households are extremely vulnerable to flood events. After the recent cyclones, it became clear that household latrines needed to be built better standards – but this will not be feasible without external subsidy. This goes against the grain of prevailing wisdom in Mozambique – and elsewhere – which promotes a ‘zero-subsidy’ approach to household sanitation. There is thus a debate to be had on the pros and cons of not providing subsidy, perhaps revisited in light of climate change projections.

*It can be argued that ‘one size fits all’ national policies for rural sanitation – including Mozambican policy on CLTS and household-constructed infrastructure – have significant drawbacks when some areas of the country are repeatedly battered by climate-related shocks and others are not.*

These shocks cause not only houses to collapse, but also household level sanitation infrastructure (typically exterior latrines). If subsidies were to be provided, research would be needed into the best approach to providing them in an equitable and sustainable way. Clearly policies and regulation will be needed to guide this and support any rollout. Moreover, sanitation in such situations cannot be considered in isolation - it will be important to consider water and sanitation holistically as part of a wider system.
CONCLUSIONS
CONCLUSIONS

In line with its status as one of the countries most threatened by climate change, Mozambique is clearly vulnerable to climate change - a vulnerability that applies across the country. In recent years, particularly visible has been the impact on the coastal cities of Mozambique. Climate change is already having a significant impact on sanitation services and this is only going to increase in the coming years, as the world battles to keep temperature rises below 1.5 degrees.

The nature of how climate change impacts in urban, peri-urban and rural areas differs, as does the impact of climate shocks versus slow onset events. In the main however, it is the poor communities in peri-urban and rural areas that have the hardest time coping – in part due to their inadequate existing sanitation infrastructure or services and in part due to their reduced resilience (part of which is financial).

In this way climate change tends to exacerbate existing inequalities, across many sectors, with sanitation no exception. On the other hand, new policies and programmes, intended to combat the effects, offer new opportunities to bring about changes that could make a significant difference. As poorer communities tend to be less ‘visible’ to policymakers and sanitation providers, a useful lens is to look at how accountability in the sector current works, then seek to harness climate change adaptation efforts to not only bring direct benefits to vulnerable communities, but bring about systemic changes in how poor communities are able to engage with others on sanitation matters.

This report intends to reach out to key actors, namely, external financiers, sanitation providers and government bodies in order to avoid preventable tragedies that could otherwise affect millions of people across the country. It offers a set of solutions to make the sanitation sector more resilient in the face of climate events, ranging from changes to the legal framework, improvements in cross-departmental collaboration, amendments to policy frameworks (particularly around rural sanitation) and actions that can be taken either in the short- or long-term by policymakers, sanitation providers and communities themselves.
SUMMARY OF KEY RECOMMENDATIONS
The general recommendation of this study is that key stakeholders should recognise the specific challenges that Mozambique - considered the fifth most vulnerable country in the world in the Climate Change Vulnerability Index – faces in relation to the impacts of climate change on sanitation. This, plus the rapid urbanisation the country is facing, alongside enduring economic challenges, puts the country particularly at risk.

In this light, those with appropriate decision-making authority should focus on promoting the construction and establishment of climate-resilient sanitation systems, building specifically on local technologies and approaches, even as new technologies are explored.

In order to improve the existing institutional framework, making it more effective and sustainable, the following policy recommendations are made:

**Policy recommendations**

1. Design (or update existing frameworks) such that a complementary and comprehensive legal and policy framework, taking a long-term approach to financing, is put in place. The development of this should involve local communities and the private sector via a bottom-up model;

2. Reinforce systems for in order to better classify and call out interventions in the field of sanitation across existing State planning and budgeting systems. This should cover not just government expenditure but include that by development partners. This intervention should span planning processes, budgeting and monitoring and evaluation of interventions;

3. Build on and further develop existing mechanisms and instruments that can further promote sanitation knowledge in the relevant sectors;

4. Create (or resuscitate existing) platforms for dialogue between different actors, including the Government, private sector and civil society; and,

5. Support the incorporation of climate change considerations in the ways that sanitation projects are designed and implemented, including the sanitation technology options on offer, whether in rural and peri-urban contexts.
In order to adapt the existing financing structures to allow sanitation interventions to better accommodate climate change, the following financing recommendations are made:

**Financing recommendations**

**A.** Explore the use of government subsidies (credits) for the operators of urban sanitation systems;

**B.** Look to revitalise, in both rural and peri-urban areas, community water and sanitation companies by supporting them to better take into account issues around resilience, adaptation and mitigation to climate change;

**C.** Facilitate the easier import of sanitation equipment and technologies; and,

**D.** Explore how existing financing options can be made more widespread and more relevant to sanitation interventions, whether these be contingency plans, climate / sovereign insurance schemes, or others.
7.1.1. Sector-oriented recommendations

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<tr>
<th>Sector</th>
<th>Short-term (Up to 1 Year)</th>
<th>Medium to Long Term (up to 2-5 years)</th>
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<td></td>
<td>Rural</td>
<td>urban</td>
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<tr>
<td>Families / Citizens</td>
<td>Develop response plans and introduce safe disposal system. Upgrade and improve sanitation systems to adapt to extreme weather conditions (according to risk and vulnerability to natural disasters).</td>
<td>Develop response plans and safe disposal systems for cities, and especially for peri-urban areas. Building social capital within communities (community sanitation companies) and promote further engagement in sanitation and hygiene issues. Create a platform / mechanism for dialogue with local and municipal government authorities (to put pressure on policy makers and sanitation service providers during and after disasters).</td>
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<td>Replace non-modern sanitation systems with modern systems</td>
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<td>Government</td>
<td>Design emergency response plans and publicise the plans. Customise those plans and to support safe disposal systems. Implement awareness programs and promote initiatives around how to manage sanitation systems management during extreme events.</td>
<td>Prepare response plans that account for the effects of extreme events (floods and heavy rains). Plan for improved maintenance / replacement of conventional and community (peri-urban) drainage systems, as well as for the safe disposal and treatment of human waste.</td>
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<td>Sector</td>
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<td><strong>Municipalities</strong></td>
<td>Design local response plans. Promote the construction of safe disposal systems, including systems for unblocking drainage channels (focused on peripheral and underserved areas). Support temporary relief measures (such as sand bags) to protect sanitation infrastructure (whether private or municipal run) as well as within communities (for instance to protect shared and institutional sanitation blocks).</td>
<td>Design and implement stronger accountability mechanisms around interventions (in the context of climate change). Introduce the concept of ‘uncertainty’ in the way sanitation projects are planned for and budgeted (including a dedicated line item around ‘water and sanitation’ issues in appropriate other budget lines). Promote the construction of modern urban sanitation systems, and improved sanitation in rural areas. Strengthen relationships with communities in rural and urban municipalities in the country, including consultation mechanisms.</td>
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<td><strong>Private Sector</strong></td>
<td>Engage in new accountability systems around sanitation interventions. Design proposals for community sanitation projects (and respective business plans) ready for to the government and partner organisations interested in improving sanitation conditions.</td>
<td>Undertake project analysis that incorporates the concept of ‘uncertainty’ in plans and budgets. Improve reputation (vis-à-vis legislators and politicians) by undertaking ex-ante project reviews. Invest in social capital, in part to protect privately owned- and run- sanitation assets.</td>
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<td><strong>NGOs &amp; CSOs</strong></td>
<td>Create platforms for dialogue between actors in the sanitation sector to facilitate the introduction of sanitation issues into strategies, operational plans and local budgets. Support communities, government and the private sector to promote and implement safe and ‘improved’ sanitation investments, building techniques and treatment technologies.</td>
<td>Support and advocate for communities, local and central government institutions, by strengthening existing relationships with communities, the private sector and development co-operation partners. Support communities in the process of disseminating new sanitation technologies within communities. Improve reputation (vis-à-vis legislators and politicians) by undertaking ex-ante project reviews.</td>
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<tr>
<td><strong>Development Co-operation Partners</strong></td>
<td>Support the government to design sanitation management strategies that consider the impacts of climate change. Help mobilise additional resources for ‘climate-ready sanitation’. Support the financing and implementation of projects that promote safe sanitation practice.</td>
<td>Support the design of infrastructure development program ‘packages’, with a view to incorporating resilient technologies, adapted to climate change. Promote exchanges with countries facing similar challenges to Mozambique – that seek to mobilise financing for projects that support resilient sanitation systems.</td>
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ANNEXES
Decreto nº 18/2004: Regulamento sobre Padrões de Qualidade Ambiental e de Emissão de Efluentes. URL: http://www.impacto.co.mz/wp-content/themes/Arpora2_1_0/pdf/Padroes%20de%20Qualidade/DECRETE~3.PDF
Law No. 15/2014 establishing the legal framework for disaster management. URL: http://extwprlegs1.fao.org/docs/pdf/moz134835.pdf
Lei nº 20/97: Lei do Ambiente. URL: http://www.impacto.co.mz/wp-content/themes/Arpora2_1_0/pdf/Lei%20do%20Ambiente/Lei%2020.1997_Lei%20do%20Ambiente.pdf
Resolution No. 7/95, of 23 August National Water Policy
Key International Interlocutors

Alex Grumley | WASH Sector Leader | SNV Mozambique
Anna Nileshwar | Water & Environment Adviser (Research & Innovation) | Foreign, Commonwealth & Development Office | United Kingdom
Ben Lamorree | Process Manager | Beira Master Plan, Mozambique | Netherlands Enterprise Agency
Celia Way | Former researcher | University of Leeds | Member of the Future Climate for Africa (FCFA) consortium | United Kingdom
Juliet Willets | Research Director and Professor at Institute for Sustainable Futures | University of Technology | Sydney | Australia
Lisa Rudge | Water, Sanitation & Hygiene Adviser | Global Health and COVID-19 Directorate | Foreign, Commonwealth & Development Office | United Kingdom
Maarten Gischler | Senior Water Advisor Maarten Gischler | Netherlands Ministry of Foreign Affairs
Oliver Jones | Bluechain Consulting | former World Bank employee | United Kingdom
Sam Drabble | Water & Sanitation for the Urban Poor | United Kingdom & Mozambique

Key Domestic Interlocutors

Ord. Instituição
1 Direção Nacional de Abastecimento de Água e Saneamento (DINAAS)
2 MISAU (DNSP)
3 Ministério da Educação e Desenvolvimento Humano (MEDH)
4 Ministério de Terra e Ambiente (Direção Nacional de Mudanças Climáticas)
5 Banco Mundial (WB)
6 Autoridade de Regulação de Água e Saneamento (AIAS)
7 Direção Nacional de Gestão dos Recursos Hídricos (DNGRH)
8 Fundo de Investimento e Património do Abastecimento de Água (FIPAG)
9 Instituto Nacional de Meteorologia (INAM)
10 Universidade Eduardo Mondlane (UEM) – Faculdade de Engenharia/ Faculdade de Agronomia e Engenharia Florestal
11 OXFAM
12 UNICEF
13 Águas da Região de Maputo
14 Centro de Saúde de Xipamanine
15 Administração do Mercado de Xipamanine
16 Administração do Mercado de Mandela
17 Administração do Mercado de Malanga
18 Ministério da Economia e Finanças (MEF) – Direção Nacional de Saúde
19 Administração do Mercado de Xiquelene
20 Hospital Geral da Polana Canicho “B”
21 Ordem dos Engenheiros de Moçambique
22 Universidade Eduardo Mondlane (UEM) – Faculdade de Engenharia
23 CMCM – Direção de Saúde da Cidade da Matola
24 CMCM – Direção de Saneamento ou Salubridade da Cidade da Matola
25 Direção Provincial de Desenvolvimento Territorial e Ambiental da Matola
26 Administração do Distrito de Boane
27 Conselho Municipal da vila de Boane
28 Direção dos Serviços Distrital, Saúde, Mulher e Acção Social de Boane
29 Administração do Distrito de Marracuene
30 Direção Distrital de Saúde de Marracuene
31 Comunidade de Cumbane – Bobole
32 Comunidade de Matalana
33 Serviços Distritais de Educação, Juventude e Tecnologia de Marracuene
34 Serviços Distritais de Infra-estruturas de Planeamento de Marracuene
35 Serviços Distritais de Infra-estruturas de Planeamento de Boane
36 DFID
37 Embaixada da Suécia
38 União Europeia
39 Embaixada da Holanda
40 Cooperação Austríaca do Desenvolvimento
for Plan International Indonesia by ISF-UTS. Link.
UN-Habitat. Climate Change Assessment for Maputo, Mozambique: A Summary. Link.
WaterAid (unknown) Financing sustainable and resilient water and sanitation infrastructure in African cities. Link.


Under the climate change adaptation strategy of GoM, there is a window to include innovative concepts, such as: incentives to upgrade and refine the design off and on-site and potential decentralized wastewater treatment facilities to integrate solutions for capturing gas emissions and biogas digesters reduction of non-revenue water, and promotion of renewable energy as a backup solution in case of power cuts from the grid, instead of using fossil fuel powered generators to keep systems running. This window may provide one avenue to addressing the challenge.


1. NCD Mozambique 2020-2025 https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Mozambique%20First/NDC_EN_Final.pdf


Sanitation systems can enable the production of organic fertilizers and fossil-free energy for electricity, heat and cooking while used water can satisfy crop irrigation and cleaning needs. See https://www.sei.org/featured/how-sustainable-sanitation-can-drive-us-out-of-the-pandemic-crisis/


In order to meet the sanitation goals as outlined in the National Strategy for Urban Water and Sanitation, 2011-2025.
This strategy foresees an increase in coverage to approximately 67% by 2015, representing about 6.3 million people, and in 2025 expects the near attainment of universal coverage.


According to Mozambique’s Post Disaster Needs Assessment following the cyclone Idai striking the city of Beira, the population relaying on open defecation went up from 23% to 46% in the 14 hardest hit districts. On top of this, because the coverage of conventional drainage and sewerage does not reach the entire urban area, much of the population relies on individual on-site sanitation solutions, such as septic tanks or latrines. The floods that accompanied the cyclone, mixed this waste with the floodwaters, exposing vulnerable communities. Furthermore, the report mentioned that the Beira sanitation system city has significant cracks in the pipework, pumping stations are obstructed and inspection boxes and collection chambers inundated.

The plans, strategies and standards produced by DNAAS, AIAS, AURA and Municipalities should incorporate the voices of the communities and ensure that sanitation services and solutions respond community needs at rural level, where the voice of the community is captured based on effective stakeholder participation. Based on gaps discussed in this report, there is a need to build more integrated and harmonised sanitation policies, ones that focus on strengthening local systems and communities.

To do this they could provide an enabling framework for the expansion of sanitation services by via the domestic private sector, the provision of an enabling environment for women entrepreneurs and for business development. It would also help to explicitly address harmful gender norms that prohibit women and girls from equally benefiting from sanitation investments and find ways to accelerate the adoption of behaviours that address sustainability (by ensuring that sanitation infrastructure in both rural and urban communities is not only used, but properly maintained).

There is some experience in adapting sanitation systems so that they produce organic fertilisers and fossil-free energy. This could well qualify certain sanitation interventions to count towards mitigation actions.

See https://www.dw.com/pt-002/mo%C3%A7ambique-o-mais-vulner%C3%A1vel-do-mundo-%C3%A0s-mudan%C3%A7as-clim%C3%A1ticas/a-56340562

See https://unfccc.int/files/adaptation/knowledge_resources/databases/partners_action_pla.pdf

See https://assets.publishing.service.gov.uk/media/57a08a76e5274a31e00005f4/IDL-50408.pdf

Equally, higher temperatures are not necessarily a problem where sanitation is concerned as many biological processes work better, useful when it comes to drying beds, composting methods etc.

A consequence of rain falling on dry, hard ground tends to be more rapid and more concentrated flooding – with higher water levels and more violent floods. From a health perspective the most dangerous exposure is at beginning of a flood event as after a few hours more water means more dilution and a lower concentration of pathogens in the floodwater.

Other options are to cross-reference health and education statistics or living standards against climate events. Aspects of these can be found in the annexes to this report.


The challenges posed by climate change are expressed in different ways, over different timescales. The first group is linked to disasters – the short, sharp shocks that climate change makes not only more frequent, but also more violent.
Mozambique is sadly all too familiar with these, whether it be destructive cyclones arriving from the Indian ocean, extended floods coming down from the continental interior to the west, or the emergence of longer and more destructive heat-waves. The second group of challenges is linked to longer-term issues – not only planning and adaptation in order to manage and prevent risks, to deal with uncertainty, but also to deal with the slow onset changes that climate changes brings about. The impact of these can be unpredictable and complex – from the slow bleed of changing climate into conflict and migration – to the increased likelihood and severity of drought – from the inevitability of higher sea levels to the challenges of saline intrusion into aquifers.

One can make a strong case that any definition of ‘sanitation resilience’ should have common elements. An important part of the definition is that it goes beyond shocks to also look at stresses. Also important is that it goes beyond physical assets and technology considerations, to look at the socio-political-economy of the issue. In this it is vital to acknowledge that sanitation is a human right – for when we look at sanitation from the household perspective, particularly that of a poor household in a country such as Mozambique, a few things emerge. The reason we dig into issues of accountability is because this is a good way to think about how the three different groups are inter-related. Also because increasing accountability in the sector – whether responsiveness, compliance or transparency – is a good way to make the sector more resilient to begin with.

See this for more and an example of what this looks like - https://ndcpartnership.org/toolbox/climate-risk-informed-decision-analysis-crida

Personal communication, Dutch Ministry of Foreign Affairs
Personal communication, Netherlands Water Partnership and Beira Masterplan Unit
SASB has three types of revenues sources that cover six types of expenditures – estimated at $275 000 in 2015. The organization runs a net budget deficit that is likely covered by general revenues managed by the municipality (Zhang et al, 2020)

It is worth noting that periodic flooding is also planned for by informal dwellers and can be used as a means to empty otherwise full latrines: “On hilly ground or where there are seasonal floods one can rely on ‘natural flushing’. Here water coming into the pit (whose slab is often raised a metre or more above ground level) washes out some of the contents, either into a nearby watercourse or into the flooded neighbourhood (common practice in Dar es Salaam for instance)” (Schaub-Jones, 2005).

The reality in urban slums is that ‘individual facilities’ are rarely that – quite often they are shared between groups of households, either living under one roof (but in separate rooms) or clusters of neighbouring households.

https://wedc-knowledge.lboro.ac.uk/resources/e/mn/059-Raised-latrines.pdf

Even in communities where a significant proportion have household-level facilities, community toilets can provide a helpful ‘back up’ for times where people’s household latrines are inaccessible or even destroyed by floods or other events. With this in mind, such facilities should be built to be flood resilient.

Examples of the existing plans include: Urban Masterplan of Maputo (2008) - this identifies areas of Maputo that are especially vulnerable to climate change and suggests strategies to adapt including slum upgrading and land requalification. (Plano de Estrutura Urbana do Município de Maputo, PEUMM); Urban Solid Waste Management Master Plan in Maputo City; and, Urban Solid Waste Management Regulation. National policies including the National Strategy for Adaptation and Mitigation of Climate Change (2013 - 2025) will also be relevant but these are discussed more in another section.
Starting in 2012 WaterAid and Sheppard Robson undertook an exercise named “City-wide urban planning for sanitation and water”. This work mapped areas of Maputo vulnerable to sea-level rise, and highlighted sea-level rise, the associated erosion and saline intrusion as key issues to address. Suggestions arising from this work include a focus on ‘flood defence work to protect and drain low-lying parts of the city including the port and railway’ and ‘extending key sanitation infrastructure to the densest slum areas of the city’. (WaterAid, unknown).

See https://cbsa.global/about-cbs described CBS as “a sanitation service which provides toilets that collect human excreta in sealable, removable containers on a regular basis and safely disposes of or reuses excreta”.

Sanitation produces methane and nitrous oxide in the anaerobic breakdown of human waste. In a CBS system waste is contained in sealable containers which can be transported to treatment facilities thereby reducing the anaerobic breakdown of waste and requiring less energy than conventional wastewater treatment.

Funded through the World Bank ‘Cities and Climate Change’ project, AIAS produced a Sanitation and Drainage masterplan for Maputo in 2016. Amongst the short-term solutions proposed, totalling almost $285 million (USD), were new drainage ditches and stormwater sewers, the construction of wastewater pumping stations, wastewater treatment plants, faecal sludge treatment plans and faecal sludge transfer stations.

There is little information globally on rural sanitation and climate change but Kohlitz and Iyer (2021) provide arguably the best starting point. WaterAid, Plan International and UNICEF (2019)’s Guidance for Programming for Rural Sanitation also has useful guidance.


This work was done as part of the HyCRISTAL project (https://wash.futureclimateafrica.org/home) and is presented in a paper that is currently in draft. The information for this case study was gathered through personal communication with the paper author, Dr Celia Way.

See https://futureclimateafrica.org/summary-of-fcfa-work-in-mozambique/

Improved regulation of FSM services, particularly around these bottlenecks, is another area that observers have highlighted as needing attention.
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