HEALTHY ENVIRONMENTS, RESILIENT COMMUNITIES

The vital role of sanitation for improving climate resilience in the Pacific

November 2023

WaterAid

Acknowlegements

Rana Abdel Sattar, Judith Mary Alolo, Vimal Deo, Mark Ellery, Stephanie Hamel, Clare Hanley, David Hebblethwaite, Meredith Hickman, Chelsea Huggett, John Kelleher, Stella Kombul, Natalie MacDougall, Tom Muller, Kathryn Pharr, Bronwyn Powell, Thérèse Rudebeck, Doug Ruuska, Rosie Sanderson, Bernice Sarpong, Amelia Wenger, Juliet Willetts

Suggested citation: Goff, F., and Oza, T. (2023), Healthy Environments, Resilient Communities: The vital role of sanitation for improving climate resilience in the Pacific. Melbourne: WaterAid

Authors: Fraser Goff and Tanvi Oza

Design: Caity Hall and Boran Mao

In our efforts to emphasise the importance of climate resilient sanitation in the Pacific, we acknowledge the partnership of the following organisations and institutions who share our commitments to a resilient, healthy, equitable and prosperous Pacific:

The wastewater management and sanitation systems within communities such as this one in Fiji, have the potential to contaminate nearby water bodies that are used for drinking and bathing if not designed adequately

Contents

Executive summary

Why sanitation and why now?

It is well known that Small Island Developing States such as those that comprise the Pacific are among the most vulnerable to climate change. The combination of slow onset climate impacts such as rising sea-levels, and increasingly intense extreme weather events has been described as the "*single greatest threat to the livelihoods, security and wellbeing of the peoples of the Pacific*"[1].

Whilst the links between climate change and water are increasingly recognised, the links between climate change and sanitation have not received the same attention. This needs to change. Universal access to safe sanitation is a foundational public service and at the heart of sustainable development. Sanitation is a critical entry point in achieving outcomes across all of the Sustainable Development Goals (SDGs) – from poverty reduction, to improving education and nutrition, and reducing maternal and child mortality.

The Pacific region is one of the most off-track regions to meet the SDG6 targets for basic sanitation and the situation is getting worse, not better. Between 2000 and 2020 over half a million people gained access to basic sanitation in the Pacific, however the sanitation gains were outpaced by population growth (UNICEF, 2021a). Approximately 70% of the population of Pacific island countries lack access to basic sanitation, including access to running water to practice good hygiene after using the toilet. Open defecation rates are increasing in PNG faster than any other country in the world (WHO & UNICEF, 2023).

The need to focus on sanitation in the Pacific is even more urgent in the context of climate change. Climate change will increasingly impact sanitation services through flooding, droughts, and sea-level rise. This will contribute to widespread damage to critical sanitation infrastructure, contamination of drinking water sources from overflowing septic tanks and pit latrines, wastewater discharge into important aquatic ecosystems that provide livelihoods, and exposure to pathogens from open defecation and unsafe hygiene practices.

Current efforts to improve sanitation in the Pacific are not sufficient to address these challenges. A step change is needed in both the level of investment and priority given to sanitation by Pacific governments and the international development community. This should include adapting existing sanitation systems to become climate-resilient and ensuring newly developed systems can withstand the impacts that both acute and long-term climate hazards present.

This paper aims to consolidate data on the status of climate change and sanitation in the Pacific and demonstrate how climate-resilient sanitation is a critical entry point for achieving the SDGs in the region. It presents evidence to build a case for a concerted, collaborative effort to accelerate climate-resilient sanitation services in the Pacific and provides recommendations to make this a reality[2].

70% of population in Pacific Island Countries lack basic sanitation services.

The context: climate change and sanitation in the Pacific

Pacific Island Leaders declared a climate emergency in July 2022 and called on all development partners to prioritise climate action. While climate change projections vary from country to country, almost all Pacific Island countries are projected to receive more rainfall and fewer droughts, with rainfall predicted to be more intense and more

1 Hon. Ro Filipe Tuisawau, Fiji Minister for Public Works, Transport and Meteorological Services, speaking on behalf of the Pacific Islands Forum Chair at the United Nations Water Conference 22 March 2023

2 Additional resources including a Policy brief for Pacific Island Governments and Policy brief for Donors can be found here.

frequent. Tropical cyclones are predicted to become less frequent but more intense and extreme sea-level events are likely to be more frequent as the effects of natural variability are compounded by long-term sea-level rise (PACCSAP, 2014).

Household sanitation access in the Pacific ranges from almost universal in Palau to minimal in PNG (Figure i). Some countries in the Pacific, including Cook Islands, Palau and Fiji have achieved near-universal household sanitation access to basic service levels. However, in other countries less than half of the population accesses basic sanitation; this includes some countries with the largest populations such as Papua New Guinea and Solomon Islands, with 19% and 35% basic sanitation access respectively (WHO and UNICEF 2023). Rural areas typically have lower sanitation access than urban areas.

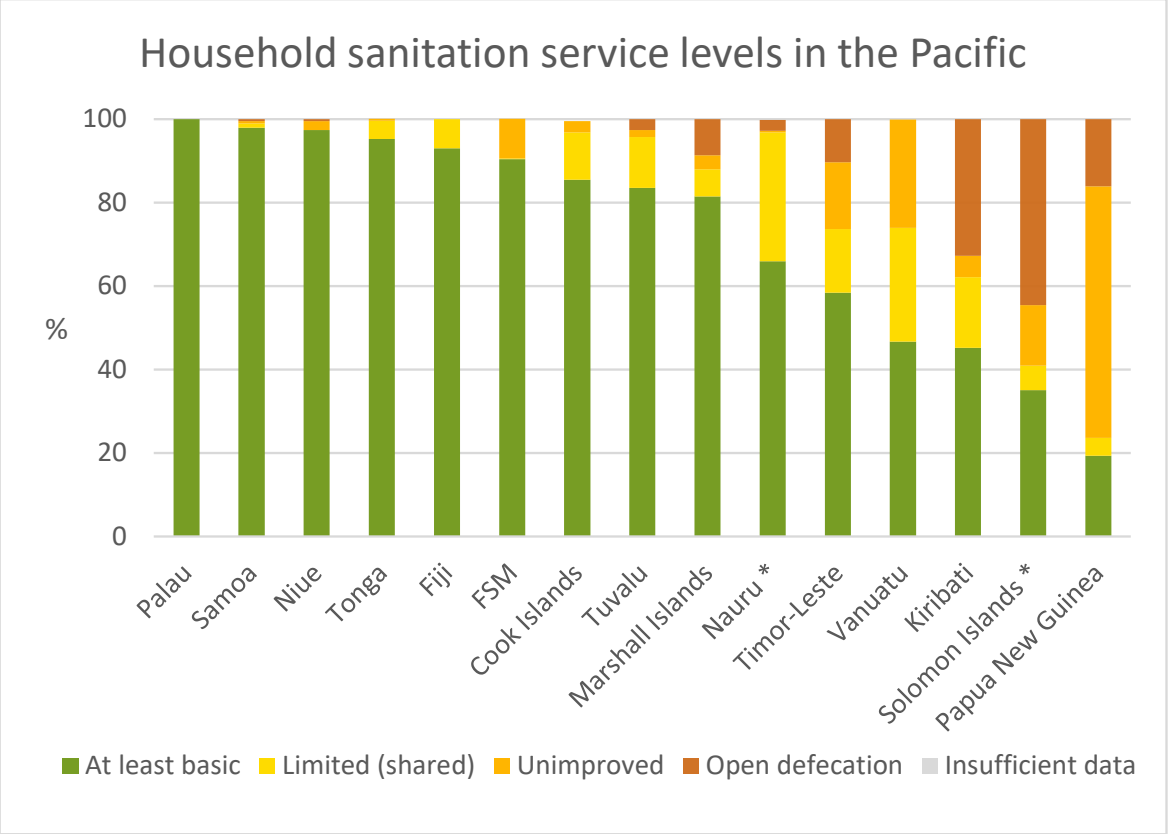


Figure i – Household sanitation service levels from JMP data 2022 (WHO & UNICEF, 2023)

The Pacific is the worst-performing region globally for sanitation access in schools, with 40% of schools across the region having no sanitation service at all. Again, PNG and Solomon Islands have the lowest rates of access, with 64% and 42% of schools without any sanitation service respectively. With regards to healthcare, the Cook Islands is the only Pacific country with basic sanitation in the majority of its health care facilities.

40% of schools in the Pacific have no sanitation service at all

The poor state of sanitation has widespread implications for climate resilience and sustainable development in the Pacific. It is linked to:

- **Public health concerns** from outbreaks of sanitation-related diseases such as cholera, typhoid and diarrhoeal disease.
- **Child stunting**, which impacts almost half of children under five in Timor-Leste and PNG, and has lifelong impacts on their wellbeing, educational attainment and economic opportunities.
- **Educational attainment** – sanitation access in schools helps reduce student absenteeism and drop-out rates, especially among girls.
- **Freshwater resource protection** – particularly in low-lying atoll states such as Kiribati, Tuvalu and the Marshall Islands.
- **Climate vulnerability** in urban areas of Fiji

and Vanuatu where inadequate sanitation contributes to the growth of informal settlements into flood-prone areas.
- **Tourism and the economy** – poor sanitation may reduce the appeal of tourism sites and impact on the productivity of workers.
- **Environmental health** – Poor sanitation impacts the environmental health of lagoons, reefs and fisheries.

1.6% of Pacific Island countries' GDP is lost every year due to inadequate sanitation and water

The impact of climate change on sanitation and its cascading effects on users and ecosystems

All sanitation services are directly at risk of impact from a changing climate and disasters. For example:
- Destruction of sanitation infrastructure from cyclones, floods and storm surges
- Corrosion of sanitation infrastructure from sea level rise
- Changes in biological processes such as breakdown of faecal sludge from changing temperatures
- Failure of sewage systems causing wastewater backflows, and bypassing of wastewater treatment plants, during floods
- Damage to wider systems that sanitation relies on including electricity and roads to transport faecal waste to treatment facilities.

Damage or destruction of sanitation infrastructure has cascading effects on users and ecosystems. It may lead to increased diarrhoeal disease through reduced use of sanitation services and increased open defecation; spread of water-borne disease; and pollution of sensitive ecosystems such as coral reefs or drinking water sources through contamination of ground water.

These considerations must be accounted for in long-term sanitation planning. This includes adapting existing sanitation systems so they are able to withstand climate impacts, as well as budgeting for the additional costs of loss and damage of sanitation infrastructure. While this is true for all countries, it is particularly relevant for the Pacific due to the significant threats of frequent disasters such as cyclones, storm surges, tsunamis and coastal inundation.

Why is sanitation in the Pacific currently off track?

The geographical, cultural and economic contexts in the Pacific present locally-specific challenges which contribute to the current low service levels in the region. Attempts to address gaps in workforce capacity and financing with overseas aid and loans has rarely been holistic enough or of a duration to secure widespread sustainable change or promote political prioritisation. Governments in the Pacific countries with the lowest sanitation rates – Papua New Guinea, Solomon Islands, Kiribati and Vanuatu – typically have the lowest public budget allocations for water, sanitation and hygiene (WASH), as little as US$1.3 per capita per year (see Figure ii).

Low levels of investment are compounded by the high cost of delivering sanitation services. The Pacific's challenging geographies require contextually-appropriate sanitation technologies while its small and fragmented populations, often isolated by vast ocean distances or challenging mountain terrains, lead to complex supply chain issues, limited economies of scale and high costs of delivering services.

Cultural taboos and social norms also cause complexities. Discussion of sanitation and hygiene practices is taboo in many Pacific cultures and the highly gendered nature of some sanitation topics introduces additional sensitivities. Social norms and cultural customs can be both an asset and a challenge to sanitation. Customs such as *kastom, wantok* and *vanua* may drive rapid sanitation behaviour change in communities through social relationships and reciprocity. However, highly localised customs may limit the scalability of successful sanitation programs.

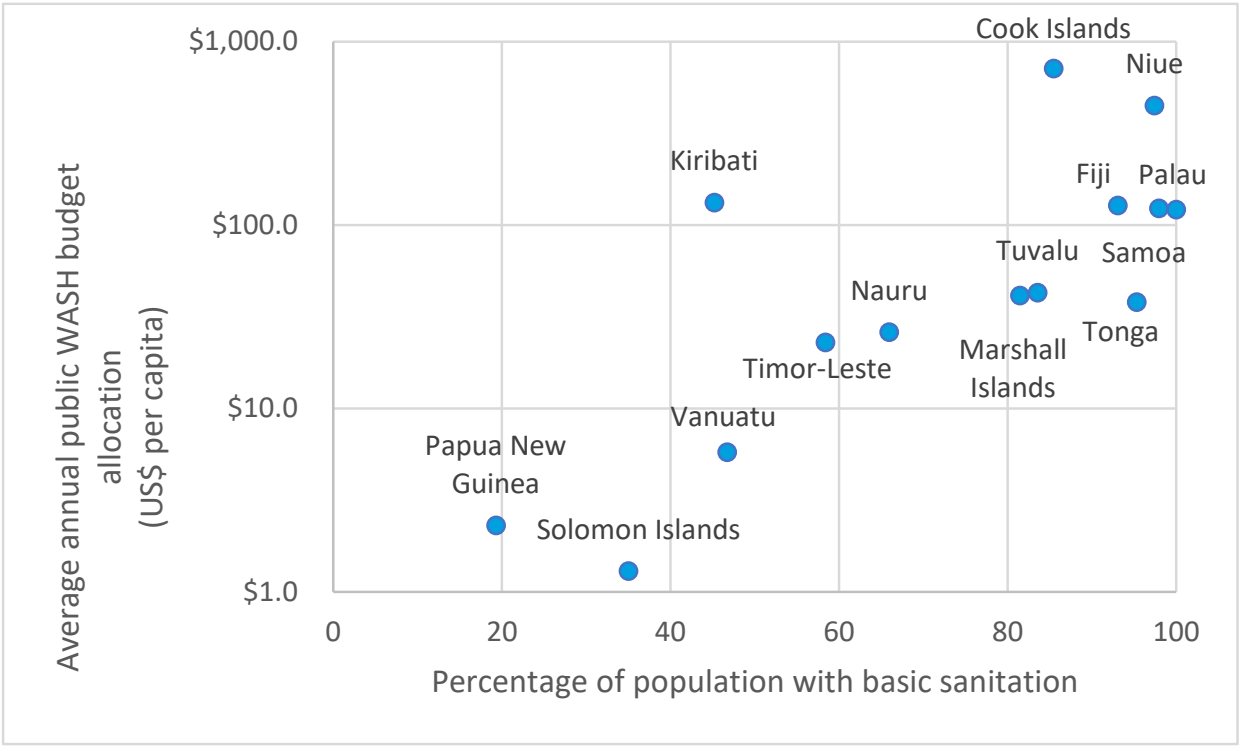


Figure ii - Household sanitation service levels by level of annual public WASH budget (author graph)

Towards a roadmap for climate-resilient sanitation in the Pacific

Achieving climate-resilient communities requires a step change in access to safe sanitation services. Focusing solely on water will not solve the significant challenges that climate change presents to communities in the Pacific who are already falling behind in their SDG commitments. Greater priority needs to be given to advancing sanitation access throughout the Pacific, and all sanitation systems need to become climate-resilient.

Drawing on existing frameworks for climate resilient sanitation systems, five key entry points have been identified to catalyse the step change required for climate-resilient sanitation in the Pacific. Each entry point and key recommendations are summarised below.

Policies and Planning

Policies, strategic plans, legislative frameworks and National Adaptation Plans (NAPs) for climate resilience provide the foundations to coordinate various sanitation stakeholders, incorporate sanitation within climate adaptation initiatives and build the case for increased funding. While most Pacific countries have at least one national policy for sanitation, few countries have comprehensive sanitation plans or strategies covering sanitation in urban and rural contexts, schools and health care settings, or include sanitation in their National Adaption Plans for climate resilience.

Priority Recommendations

Pacific Island Governments should lead the development of national sanitation roadmaps that set standards and strategies to provide climate-resilient sanitation services in community, school and health-care settings.

Pacific Island Governments should include sanitation-specific actions in National

Adaptation Plans and operationalise those commitments to improve sanitation services' preparedness and resilience to climate change and disasters. This includes ensuring the right technical and financial support is provided to municipal and district focal points at sub-national levels to translate policies to local implementation.

Donors, NGOs and research organisations should partner to generate relevant and high-quality evidence and data that governments need to inform sanitation planning and investment. Evidence gaps include appropriate technology and service model designs for different contexts, good sanitation governance and models and political leadership, culturally sensitive community behaviour change approaches and reliable data on climate and sanitation access.

$ Adequate and appropriate financing

Sanitation is underfunded globally, and donor financing for sanitation in the Pacific is not currently well-aligned with sanitation needs. Increased investment is required to expand and improve sanitation services through construction and renovating infrastructure, scaling effective technologies and innovating new services and service models. Investment is also required in the enabling environment including developing capacity of actors involved at all levels, and the creation of a skilled and resourced workforce to design and implement the service chain. Funding must also be coordinated more strategically to optimise the use of diverse sources of public finance, private investors, donors, banks and service users themselves via tariffs and household investments.

$10 economic return for every $1 invested in basic sanitation in the Pacific.

Priority Recommendations

Pacific Island Governments should increase per capita investments in sanitation to maximise economic, health and environmental outcomes for Pacific peoples. This is especially relevant for **Papua New Guinea, Solomon Islands, Vanuatu and Timor-Leste** which have the lowest basic sanitation access rates in the Pacific.

Pacific Island Governments should advocate for increased donor funding to be directed towards sanitation systems, including within financing commitments and Loss and Damage funding.

Donors and private sector should increase the proportion of funding dedicated to basic sanitation service systems, including within climate financing commitments and Loss and Damage funding. Basic sanitation is foundational for national development and community climate resilience.

Donors and private sector should prioritise funding to strengthen sanitation enabling environments including collaborating around co-financing approaches. Donor investments in policies, regulations, community engagement, capacity and workforce development can leverage financing from government, the private sector and service users and create conditions for sanitation service models which are more financially sustainable in the long term.

Contextually appropriate and regulatable service models

Delivery of safely-managed and climate-resilient sanitation services requires a holistic and systematic approach that considers entire sanitation chains from containment through to disposal or reuse. While many utilities and departments responsible for sanitation in the Pacific may seek one-size-fits-all solutions for efficiency and simplicity, different service models and service chains must be designed for different climatic, geographic and social contexts. Better evidence, knowledge, guidance and awareness of the appropriate sanitation service solutions for different contexts can help overcome practical challenges in delivering services and adapting them to the impacts of climate change.

Priority Recommendations

Pacific Island Governments should convene sanitation actors in their country to clarify and document the appropriate sanitation service models for relevant contexts, including technologies, roles and responsibilities.

Pacific Island Governments should urgently accelerate access to basic sanitation services in schools and health care facilities. This is especially relevant for **Papua New Guinea, Solomon Islands and Timor-Leste.**

Donors and the private sector should support capacity development of government and sanitation service providers to enable sustainable service chains that prioritise operation and maintenance and community-level ecosystem-based approaches.

Donors and the private sector should invest in innovation to demonstrate contextually-appropriate sanitation service models for rural, low resource settings across the Pacific. This could include innovative, climate resilient technologies, circular economy approaches including waste to energy mechanisms, as well as sustainable sanitation business models.

Multi-sectoral collaboration and collective action

Universal, climate-resilient sanitation in the Pacific cannot be solved by one actor: national governments, civil society, private sector, donors and academia must work together. Such collaboration is key to establishing the sanitation enabling environment: developing and operationalising policies and plans, clarifying responsibilities, bringing experience and voices from communities to the national-level decision-making table and sharing good practice. These mechanisms are also essential to support collective advocacy to political leaders and scaling service delivery innovations.

Priority Recommendations

Pacific Island Governments should champion collaborative and collective regional platforms for sanitation. Regional platforms such as Pacific Water and Wastewater Association and the Pacific Resilience Partnership technical working group can enable regional capacity development, sharing of good practice and collective negotiation of environmental standards.

Donors and the private sector should fund a Pacific sanitation coalition to facilitate Pacific-wide access to technical expertise, policy development support, capacity development and knowledge exchange. The coalition could be housed within an existing organisation like SPC.

Donors and the private sector should prioritise partnership-based models between sanitation and other sectors such

as conservation, agriculture, nutrition and disaster risk resilience in future programs to jointly improve climate adaptation and address nexus issues such as childhood stunting, coastal ecosystem health and food security.

NGOs and research organisations should play a critical brokering role between communities, governments, the private sector and international donors. In remote low-resource settings such as the Pacific NGOs can provide a play a longer-term role by progressively strengthening sanitation service systems, facilitating knowledge exchange between actors internationally and between national and sub-national levels, providing a sense of stability and maintaining sector institutional memory. NGOs should also collaborate with complementary organisations to leverage inter-disciplinary skillsets and knowledge to tackle nexus issues around sanitation and climate change.

Sanitation service users are not only customers or passive recipients of sanitation services. They have essential roles to play in holding service providers and authorities accountable for the human rights to sanitation and a healthy environment. In many Pacific contexts community leaders already champion sanitation behaviours and households manage their own on-site sanitation services. However, in urban and peri-urban contexts, community-managed sanitation service models can place unreasonable burdens on service users and volunteer committees. In all contexts, inclusive and empowering mechanisms which support users to understand their rights and responsibilities, engage with decision-making and service improvement processes, represent valuable contributions to service resilience.

Engaged and aware sanitation service users

Priority Recommendations

Pacific Island Governments should consult widely and identify vulnerability hotspots to climate change risks. Social and climate vulnerability indexes can enable specific and targeted support to different social groups, especially those experiencing marginalisation.

NGOs and research organisations should work with communities to shift social norms and community behaviours to address sanitation-related taboos and drive equitable community-level decision making.

NGOs and research organisations should support community capacity and awareness building of the links between climate change and sanitation, disaster preparedness and response and the rights and responsibilities of sanitation users, service providers and decision-makers.

Pacific communities should hold service providers accountable for the provision of safe and sustainable, climate-resilient services.

Pacific communities should ensure that community-level decision making is inclusive. Decision-making regarding sanitation and conservation should consider the needs of different groups, and utilise traditional knowledge and understanding of the natural environment.

1. Introduction

School students outside the new toilet block at their school in Liquica, Timor-Leste.

Climate change: "the single greatest threat to the livelihoods, security and wellbeing of the peoples of the Pacific"[3]

Small Island Developing States (SIDS) such as those that comprise the Pacific are among the most vulnerable to climate change and face a unique set of threats including sea-level rise, tropical cyclones, coastal inundation and droughts. This means that they are constantly exposed to threats of extreme climate events, and the frequent economic and non-economic damage they cause. For example, in 2020, Cyclone Harold caused damages estimated at S$600M in Vanuatu – more than 60% of the country's GDP, where billions more have been lost over the last decade from slow onset climate impacts such as ocean acidification and sea-level rise (IRCWASH, 2022). Pacific Island Leaders have repeatedly recognised the existential threat of climate change to the livelihoods, security and wellbeing of the Blue Pacific Continent's people and declared a climate emergency in July 2022, calling on all development partners to prioritise climate action.

Universal access to safe sanitation is at the heart of sustainable development. The world is not yet on track to achieve SDG 6 – clean water and sanitation – by 2030, and the Pacific region is one of the most off-track regions to meet the SDG targets for basic drinking water, sanitation and hygiene services. Between 2000 and 2020 over half a million people gained access to basic sanitation in the Pacific, however the sanitation gains were outpaced by population growth; the population practicing open defecation in the region increased by almost 50,000 people (UNICEF, 2021a). Approximately 70% of the population of Pacific Island countries lack access to basic sanitation, including access to running water to practice good hygiene after using the toilet. Open defecation rates are increasing in Papua New Guinea (PNG) faster than any other country in the world (WHO & UNICEF, 2023). The need to focus on sanitation is even more urgent in the context of Pacific Island countries' high vulnerability to the impacts of climate change.

Why sanitation and why now?

Whilst the links between climate change and water are increasingly recognised, the links between climate change and sanitation remain less prominent in global conversations and a significant risk if deprioritised. Climate change will increasingly impact sanitation through: flooding, droughts, and sea-level rise contributing to widespread damage to critical sanitation infrastructure; contamination

3 Quote from Hon. Ro Filipe Tuisawau, Fiji Minister for Public Works, Transport and Meteorological Services, speaking on behalf of the Pacific Islands Forum Chair at the United Nations Water Conference 22 March 2023

of drinking water sources from overflowing septic tanks and wet pit latrines; wastewater discharge into important aquatic ecosystems that provide livelihood opportunities; and exposure to pathogens from open defecation and unsafe hygiene practices. The Pacific is already experiencing these impacts as one of the world's most climate-vulnerable regions.

Since 2015, the United Nations General Assembly has defined access to sanitation as a standalone human right, separate to the right to water (UNOHCHR, 2015). As a human right, every person is entitled to sanitation services that provide privacy, ensure dignity, and that are physically accessible, affordable, safe, hygienic and culturally and socially acceptable.

Beyond the human right to sanitation, people also have the right to a healthy environment, and universal access to safe sanitation services can inherently promote healthy ecosystems through safe containment, treatment and disposal of human waste.

> *"As Pacific Leaders, our vision is for a resilient Pacific Region of peace, harmony, security, social inclusion and prosperity, that ensures all Pacific peoples can lead free, healthy and productive lives" (PIFS, 2022)*

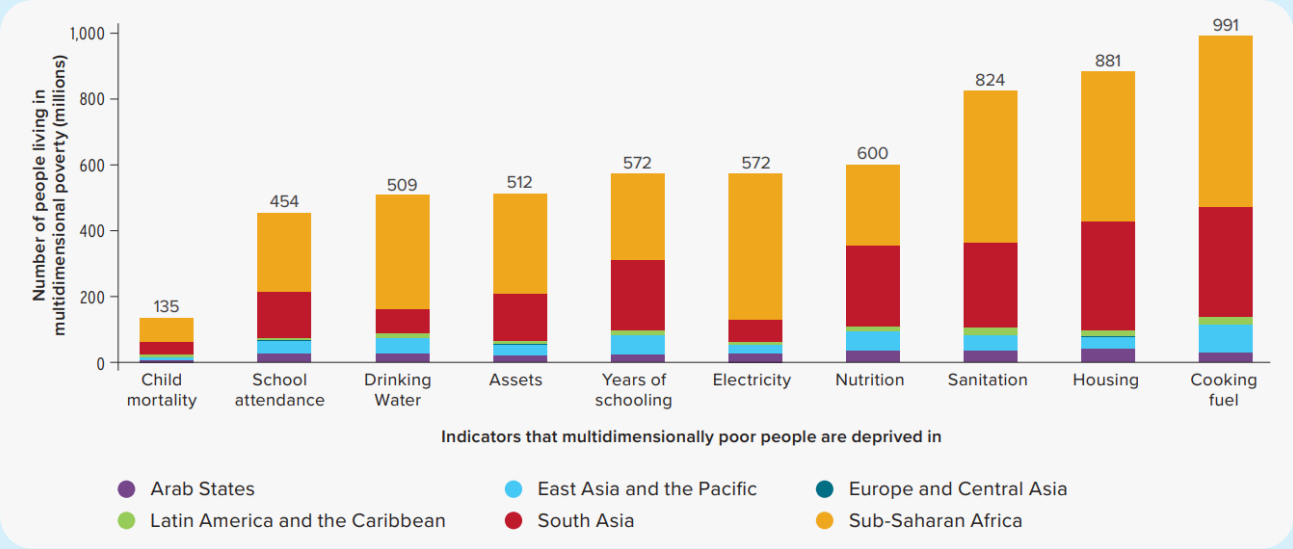


Figure 1 – Globally, sanitation is the third largest contributing factor to multidimensional poverty (UNDP 2023)

Access to universal, safe sanitation services is essential to realising the Pacific Leaders' vision of a resilient, prosperous and healthy Pacific outlined in the 2050 Strategy for the Blue Pacific Continent, and a critical entry point in achieving outcomes across the entire SDG agenda. Sanitation is key to improving human health through reducing maternal and infant mortality (SDG3.1-2), improving education by supporting school attendance among girls (SDG 4.5, 5.1), enhancing gender equity (SDG 5.1, 5.4), food security and ending malnutrition (SDG 2.2), safeguarding the health of ecosystems (SDG15.1), as well as poverty alleviation (SDG 1.1, 1.2) and driving economic resilience (Parikh et al. 2022).

Sanitation services are also key to alleviating poverty and achieving SDG 1 – No Poverty. The IPCC identifies the provision of water and sanitation services as one of the most effective measures to reduce climate-vulnerability in the near-term and as a 'low-regrets' climate adaptation measure (IPCC 2022). In the Global Multidimensional Poverty Index (MPI), which tracks the compounded effects of multiple measures of deprivation affecting poverty, sanitation was the third most-common deprivation experienced globally (Figure 1). Among the 19 countries that halved their rates of multi-dimensional poverty in one reporting period, 17 of these halved the population of people lacking basic sanitation as a key

contributor to poverty reduction (UNDP, 2023).

While there is credible scientific information available about climate change in the Pacific, applying this information to inform risk management, adaptation planning and decision making for the sanitation sector is a significant gap. Climate information can also often be under-utilised or used incorrectly in decision making, leading to inconsistent or incomplete strategic policy settings and missed opportunities for adaptation planning and investment in sanitation (CSIRO, 2021). These institutional and financial barriers have significantly hindered progress towards SDG target 6.2 – the target to provide universal access to adequate and equitable sanitation and hygiene, and end open defecation by 2030. Recent data indicates that the target is unlikely to be met. Worldwide, 129 countries currently are not on track to achieve 'safely managed' sanitation by 2030 (UN-Water, 2021) and 3.6 billion people (46% of the global population) still lack access to safely managed sanitation services (WHO/UNICEF, 2021).

While progress has been made since 2000, an estimated 1.4 million deaths and over 74 million DALYs[4] could have been prevented with adequate WASH in 2019, representing almost 3% of the global disease burden (WHO 2023a). Globally, one quarter of children under five are affected by chronic sanitation-related health conditions such as stunting[5], which has long-term, irreversible effects on their lifelong wellbeing, educational attainment and economic opportunities. Inadequate sanitation services contribute to economic losses of up to 6% of Gross Domestic Product (GDP) (World Bank, 2011). These health and economic impacts disproportionately affect the poorest, most disadvantaged populations (WHO 2023a).

A study published in the Lancet found that between 2000 and 2019, the under-5 mortality rate decreased from 8.9 deaths per 1000 live births to 3.2 deaths per 1000 livebirths. "The global decrease in under-5 mortality is primarily attributable to decreases in the number of deaths caused by diarrhea" (Perin et al., 2022, p. 111)

Structure of this paper

Sanitation issues and approaches are increasingly well-documented globally; however, there is relatively limited literature on sanitation in the Pacific. This paper aims to consolidate data on the status of climate change and sanitation in the Pacific to demonstrate climate-resilient sanitation as a critical entry point for achieving the SDGs in the region. The paper presents evidence and recommendations to build a case for a concerted, collaborative effort from diverse stakeholders to accelerate climate-resilient sanitation services in the Pacific.

The paper has four key objectives:

1. Summarising the status of sanitation in the Pacific
2. Demonstrating the interlinkages between sanitation and broader social, environmental and economic issues;
3. Highlighting opportunities to create an enabling environment for climate-resilient sanitation in the Pacific by drawing on international case studies, and;
4. Presenting an analysis and recommendations for accelerating access to climate-resilient sanitation services in the Pacific.

The first chapter of the report sets the scene and provides a background of key climatic threats faced by the Pacific including relevant

4 Daily-adjusted life years, a measure of healthy life lost.
5 A child is considered stunted if they are two standard deviations below the mean height for their age.

geographic and demographic information. The chapter also explains the basics of sanitation including the differences between sewered and non-sewered systems. Chapter 3 outlines how climate change will impact sanitation services including the direct and indirect impacts on communities and ecosystems. The third chapter presents the current state of sanitation in 15 countries in the Pacific region, highlighting the current situation for household, healthcare, and school sanitation, as well as typical sanitation service models. Chapter 4 presents deep dives into the critical interlinkages between sanitation and the environment, society and economy, highlighting the critical foundation sanitation lays for sustainable development. Chapter 5 presents a synthesis of the research and identifies key entry points for improved sanitation and climate resilience in the Pacific, including key policy and financial considerations.

This is followed by a summary of key recommendations for various stakeholders. The final chapter presents case studies from the Pacific and beyond that demonstrate good practice examples and lessons relevant to Pacific sanitation actors.

The primary audience of this report is decision makers within Pacific national governments, sanitation practitioners and international funders to encourage prioritisation of sanitation services as a critical climate adaptation measure to accelerate progress towards the SDGs. It is complemented by policy briefs tailored to specific audiences.

This report specifically focuses on sanitation progress, challenges and opportunities in 15 independent and self-governing states in the Pacific (Figure 2).[6]

Figure 2 - The 15 Pacific countries primarily discussed in this paper

6 For the purposes of this paper, the Pacific countries primarily discussed are taken to be the members of the Pacific Island Forum of independent and self-governing states in the Pacific (excluding Australia and New Zealand), plus Timor-Leste. The full list is: Cook Islands, Federated States of Micronesia (FMS), Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu. Territories in administrative association with the US, France and New Zealand have not been considered in this study. While Timor-Leste is not always considered part of the Pacific region, we have included it here due to some commonalities in sanitation coverage, issues and opportunities.

2. Background

Geographical and demographical characteristics of the Pacific Islands

The Pacific Islands are broadly grouped into three sub-regions based on geographic and cultural similarities: Melanesia[7], Polynesia[8] and Micronesia[9]. The population scales of Pacific countries vary widely and data on development, health and wellbeing – including sanitation indicators – is therefore heavily skewed towards a small number of more populous countries (Table 1). With over two thirds of the population of the Pacific living in Papua New Guinea, progress in PNG is key to influencing regional statistics. Population distributions within Pacific countries also vary widely and urban areas, especially in Melanesia, are growing at rates faster than their national average which places pressure on urban services and infrastructure and contributes to the growth of informal and under-served settlements.

Table 1 – Estimated populations of Pacific countries in 2023

Country	Population	Percentage of Pacific population	Urban population (2022)
Papua New Guinea	9,501,006	66.3%	13.6%
Timor-Leste	1,340,434	9.4%	32.1%
Fiji	904,590	6.3%	58.2%
Solomon Islands	761.215	5.3%	25.6%
Vanuatu	314,653	2.2%	25.8%
Samoa	202,100	1.4%	17.6%
Kiribati	124,742	0.9%	57.1%
Federated States of Micronesia (FSM)	106,194	0.7%	23.2%
Tonga	99,026	0.7%	23.1%
Marshall Islands	54,366	0.4%	78.5%
Palau	17,989	0.1%	82.0%
Cook Islands	15,470	0.1%	n/a
Nauru	12,017	0.1%	100.0%
Tuvalu	10,876	0.1%	65.5%
Niue	1,510	0.01%	n/a
Non-independent states*	865,754	6.0%	n/a
Total	**14,331,942**	**100%**	**n/a**

Note: Population for Timor-Leste is for 2022 and comes from the Government of Timor-Leste census (2022). All other country estimates are 2023 projections compiled by the SPC Statistics for Development Division (SPC, 2023). Rural population proportions are from World Bank (2023)

* Including French Polynesia, New Caledonia, Guam, American Samoa, Northern Mariana Islands, Wallis and Futuna, Tokelau and Pitcairn.

7 Including Fiji, Papua New Guinea, Solomon Islands and Vanuatu
8 Including Cook Islands, Niue, Samoa, Tonga, Tuvalu
9 Including Federated States of Micronesia (FSM), Kiribati, Marshall Islands, Nauru and Palau

Box 1: Sanitation is more than a toilet

Sanitation is the management of human excreta, including faeces, urine and menstrual blood (WHO & UNICEF, 2020). While often equated with access to a toilet, sanitation is better considered as a system, in which a chain of interlinked technologies, services and behaviours isolate human excreta from the environment until it poses no risk to human or environmental health. Each sanitation service in the chain which contains waste, transports it, treats it and disposes or reuses it, is essential to prevent human excreta from contaminating environments, food and water and exposing people to potential disease.

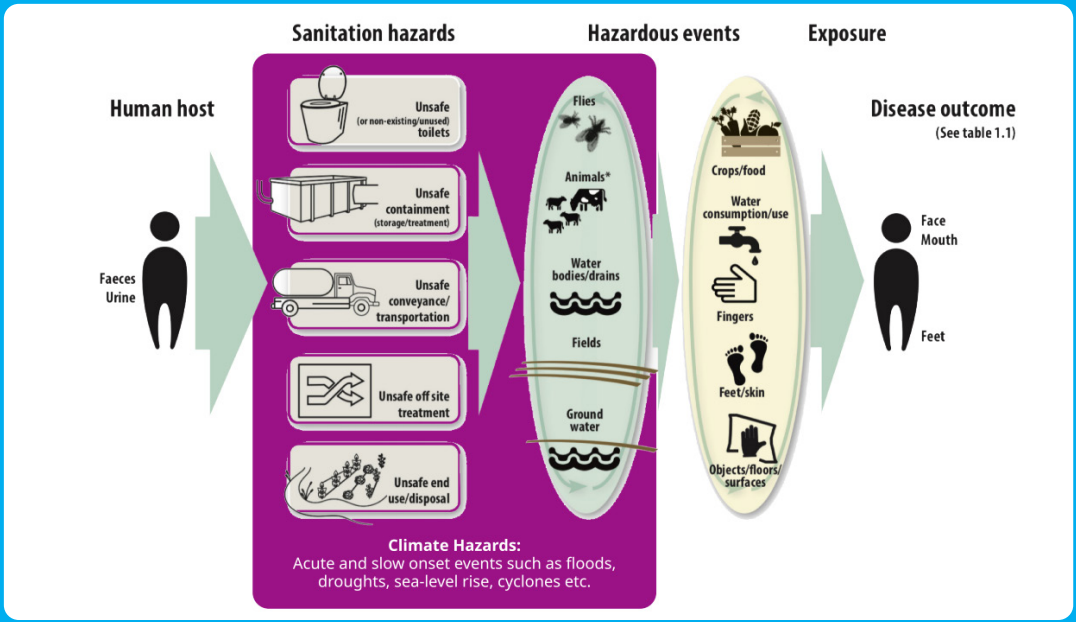


Figure 3 - Safe sanitation systems provide a primary barrier to protect people from exposure to faecal-borne diseases (WHO 2018)

The quality of sanitation services is often presented as a ladder, ranging from no access to services (open defecation), to safely managed services. The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) sanitation ladder is commonly used to classify and compare service levels (Table 2).

Table 2 - JMP service level definitions for household sanitation (WHO and UNICEF 2017)

Service Level	Definition
Safely Managed Service	Use of improved* facilities that are not shared with other households and where excreta are safely disposed of in situ or transproted and treated offsite
Basic Service	Use of improved facilities that are not shared with other households
Limited Service	Use of improved facilities shared between two or more households
Unimproved	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines
Open Defecation	Disposal of human faeces in fields, forests, bushes, open bodies of water, beaches or other open spaces, or with solid waste

** Improved facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, composting toilets or pit latrines with slabs.*

Pacific climate profile and climate change projections

Major features that influence the Pacific's climate include the El Nino Southern Oscillation (ENSO), the South Pacific Convergence Zone, the intertropical convergence zone and the West Pacific Monsoon. These features affect the regional pattern, seasonal cycle in rainfall, winds and tropical cyclone tracks among others. These influence the year-to-year risk of droughts, extreme rainfall events and floods, cyclones and extreme sea-level across the Pacific. On average, nine tropical cyclones occur in the western Pacific region between November and April each year. This causes significant and recurring economic losses. For example, extreme weather in Samoa in 1990 and 1991 cost $440 million – more than the country's gross domestic product (GDP) (ADB, 2013). Even under a low emissions scenario, economic losses from climate change in the Pacific are still predicted to reach 4.6% of the region's annual 2100 GDP equivalent (ADB, 2013).

Global temperature data sets show strong warming in the Pacific region since the mid-1970s where most of the warmest years on record have occurred in the last decade (Figure 4). Changes in rainfall over recent decades are more varied than temperature and show natural variability associated with climatic features such as the El-Nino Southern Oscillation. For example, La Nina events have been associated with severe drought in Tuvalu and floods in Fiji. Tidal gauges and satellites show that the average sea level in the Pacific has increased by about 15cm in the last 100 years and most estimates show that the rate of change has accelerated over the last few decades (PACCSAP, 2014).

Climate change projections vary from country to country however almost all Pacific Island countries are projected to receive more rainfall and fewer droughts with greater impacts likely to be seen by countries such as Fiji, Palau, PNG and the Solomon Islands. Long-term projections of extreme rainfall days differ for each Pacific Island countries, however scientists are confident that they will be more intense and more frequent. Tropical cyclones are predicted to become less frequent but more intense and extreme sea-level events are likely to be more frequent as the effects of natural variability are compounded by long-term sea-level rise (PACCSAP, 2014). Current estimates for sea-level rise depend on various emissions scenarios however estimates range between 20-60cm by 2100. Low lying Pacific islands are particularly exposed to the physical impacts of sea-level rise, especially communities that rely on coastal resources and infrastructure for livelihoods.

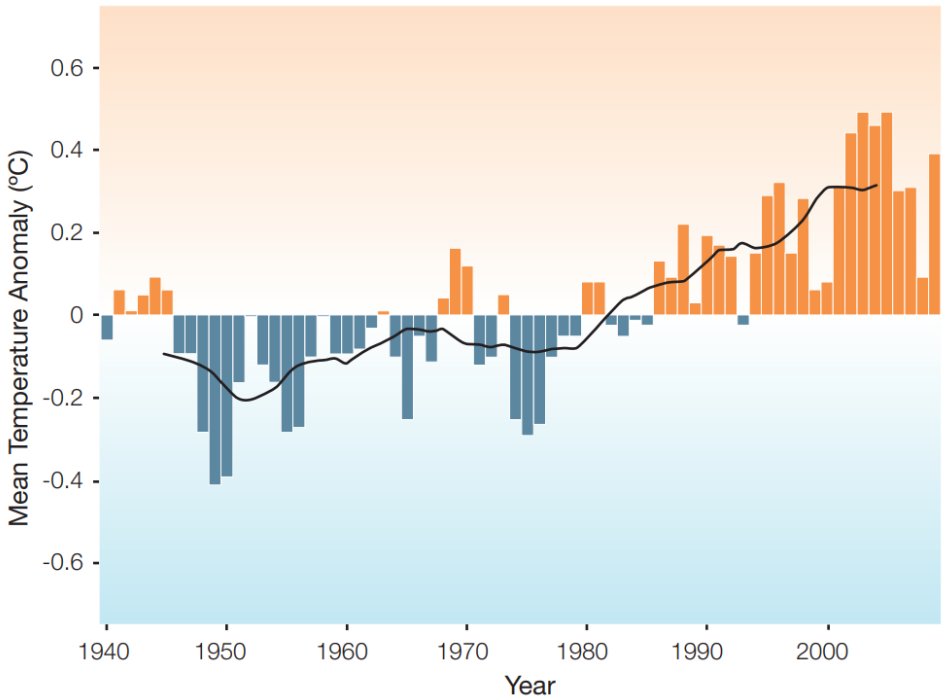


Figure 4 – Change in annual mean surface temperature compared to a 1961-1990 base period for the Pacific Islands and Timor-Leste. (Source: Pacific Climate Change Science, 2010)

3. The climate and sanitation nexus

All sanitation services are directly at risk of impact from a changing climate and disasters with cascading impacts on users and ecosystems (Annex 1). Long term climate change as well as acute climate hazards can cause significant economic and non-economic loss and damage that cannot be avoided through mitigation or adaptation (Figure 5) (IRC, 2022). These considerations must be accounted for in long term sanitation planning including adapting existing systems so that they are able to withstand climate impacts, as well as acknowledging that destruction may be inevitable and setting budget aside for frequent build back. This is particularly relevant for Small Island Developing States such as the Pacific Island Countries due to significant threats of frequent disasters such as cyclones, storm surges, tsunamis and coastal inundation.
Examples of direct impacts on sanitation systems from acute and slow-onset climate hazards include:

- Destruction of sanitation infrastructure from acute climate hazard such as cyclones, floods and storm surges,
- Corrosion of sanitation infrastructure from slow onset climate hazards such as drought and sea level rise,
- Increased odours and changes in biological processes such as breakdown of faecal sludge within toilets from changing temperatures,
- Failure of sewage systems causing wastewater backflows or discharge of untreated wastewater due to treatment plant bypassing during floods,
- Damages to wider systems that sanitation relies on including electricity and roads to transport faecal waste to treatment facilities

These direct impacts have cascading effects on users and ecosystems (see also Box 2), including:

- Reduced usage of services and increased open defecation leading to increased diarrhoeal disease
- Threatened health and safety of sanitation workers and users from odours and changes in biological processes that release by-products
- Spread of water-borne disease
- Pollution of sensitive ecosystems and habitats including coral reefs, mangroves, as well as inland terrestrial ecosystems that provide critical services to communities including food and protection from coastal storm surges
- Pollution of drinking water sources through contaminated groundwater
- Displacement and redistribution of populations
- Reduced hygiene practices and less flushing due to increased water scarcity or system blockages
- Significant costs of repair

As such, incorporating the additional costs of loss and damage on sanitation infrastructure is essential across the entire sanitation supply chain to ensure that appropriate financial measures are in place for communities to be resilient to the impacts of climate change.

Box 2: Sanitation and urban climate vulnerability in the Pacific

The links between sanitation and economic development are already affecting people's exposure to climate change risks in urban areas in the Pacific. One reason that Suva, Fiji, has expanded eastward into flood-prone land is the availability of sewerage connections to the city's wastewater treatment plant, located in the east. In Port Vila, Vanuatu, new subdivisions are required to provide either sewered sanitation or adequate soakage area for septage, necessitating minimum lot sizes (Ministry of Lands and Natural Resources, 2019). These requirements have contributed to a shortage of land development and available housing which drives new residents into informal settlements in flood-prone areas which are at greater risk of inundation and climate-induced disasters.

Figure 5: Examples of the economic and non-economic losses of climate change on sanitation systems

4. State of sanitation in the Pacific

The geographical, cultural and economic contexts in the Pacific present locally-specific challenges which contribute to the current low service levels in the region. Some common factors include:

Challenging geographies require contextually-appropriate sanitation technologies. These diverse challenging environments include atolls with high water tables across much of Micronesia and Polynesia, to steep mountainous terrain in Papua New Guinea, Solomon Islands and Timor-Leste, and high-density urban centres with limited land availability for sanitation facilities to treat and dispose of human waste safely. Within each country, and even each island, multiple different locally-appropriate technologies and service models are required to respond to these conditions.

Expensive market access and costs of doing business. Relatively small and fragmented populations, whether isolated by vast ocean distances in Micronesia, or challenging mountain terrains in PNG and Timor-Leste, complicate sanitation supply chains, inflate the costs of sanitation products and services and limit the economies of scale possible elsewhere.

Cultural taboos. Discussion of sanitation and hygiene practices is taboo in many Pacific cultures. The highly-gendered nature of many sanitation topics introduces additional sensitivities about who can participate safely in community dialogues, especially in the many patriarchal cultures.

Complex social structures and norms. Social norms and cultural customs in the Pacific can be both an asset and a challenge to sanitation. Customs such as *kastom, wantok* and *vanua* may drive rapid sanitation behaviour change in communities through social relationships and reciprocity. However, highly localised customs may limit the scalability of successful sanitation programs.

Systemic failures and underinvestment. The water and sanitation sector systems of many Pacific countries have a history of underinvestment and neglect from public financing and overseas aid. Sanitation financing, especially from overseas aid, is often project-based and has prioritised capital expenditure on major infrastructure over establishing the systems required for basic sanitation services (UNICEF Pacific, 2023). Fragmented approaches to financing rarely consider the sanitation service chain holistically, leading to skills shortages in key services, and gaps in the recurring finance needed for service operation, maintenance and rehabilitation.

Limited political prioritisation. Global experience shows that political prioritisation can catalyse rapid sanitation improvement. Governments in the Pacific countries with high sanitation rates typically have the greater public investment in water, sanitation and hygiene (WASH) while those with the lowest sanitation rates – Papua New Guinea, Solomon Islands, Kiribati and Vanuatu – typically have the lowest budget allocations for WASH, as little as US$1.3 per capita per year. Within this, sanitation is often neglected; less than 7% of public WASH budget is directed to sanitation in Solomon Islands and Vanuatu.

Household sanitation service access in the Pacific

Household sanitation access in the Pacific ranges from almost universal in Palau to minimal in PNG (Figure 5). Some countries in the Pacific, including Cook Islands, Palau and Fiji have achieved near-universal household sanitation access to basic service levels. However, in other countries less than half of the population accesses basic sanitation; this includes some countries with the largest populations such as Papua New Guinea and Solomon Islands, with 19% and 35% basic sanitation access respectively (WHO and UNICEF 2023).

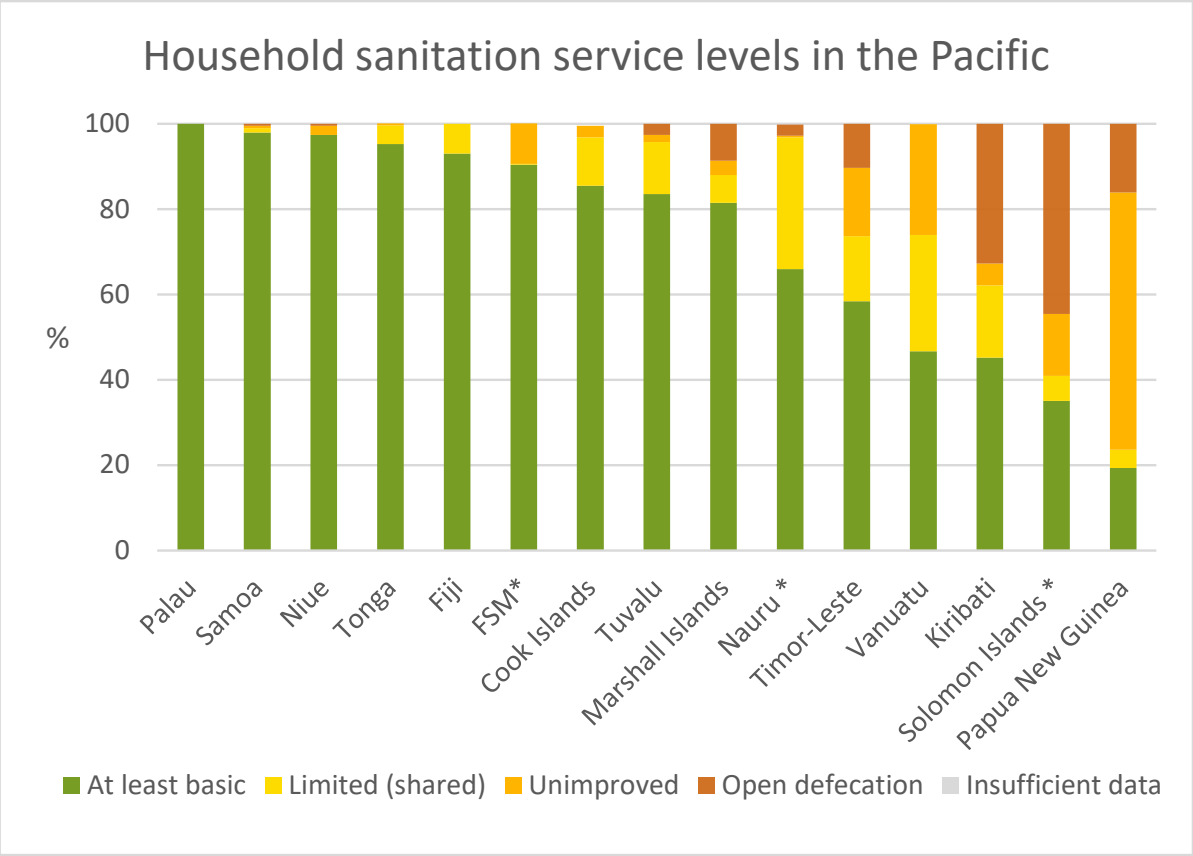


Figure 6 – Household sanitation service levels from JMP data 2022 (WHO & UNICEF, 2023)
** Data from the Federated States of Micronesia (FSM) is from 2020 and data from Nauru and Solomon Islands is from 2021*

Historic trends in JMP data show that the Pacific region is off-track for SDG 6.2. Between 2000 and 2020 over half a million people gained access to basic sanitation, however the sanitation gains were outpaced by population growth; the population practicing open defecation in the region increased by almost 50,000 people (UNICEF, 2021a). Only Tokelau (a dependent territory of New Zealand) and Samoa are on track to achieve universal safely-managed sanitation services by 2030. Basic sanitation coverage is decreasing in Vanuatu and Niue, while Kiribati, Papua New Guinea and Solomon Islands are not yet on track to eradicate open defecation by 2030 (UNICEF, 2021a). Open defecation rates are increasing in PNG faster than any other country in the world. Between 2000 and 2022, the proportion of population practicing open defecation in PNG increased by 3 percentage points per annum – increasing from 703,446 people in 2000 to 1,632,186 people in 2022 – as sanitation service improvements fail to keep pace with population growth.

Urban populations in the Pacific are much more likely to have access to basic sanitation services than rural populations (Figure 6 and Figure 7). This is particularly pronounced in Kiribati, Solomon Islands and Papua New Guinea. In PNG as few as 15% of rural households (one in seven households) are accessing basic sanitation. Urban households in Kiribati, Vanuatu, Nauru, Timor-Leste and Solomon Islands report high rates of latrine sharing (limited services), with up to 44% of

urban households in Vanuatu using shared sanitation facilities. In Kiribati, Vanuatu and the Solomon Islands this partly reflects the high proportion of urban residents who live in informal settlements, characterised by insecure land tenure and limited essential services (UN-Habitat, 2020). Tuvalu is an exception to the urban/rural Pacific trends, with higher rates of open defecation and lower basic sanitation access among urban households than rural households.

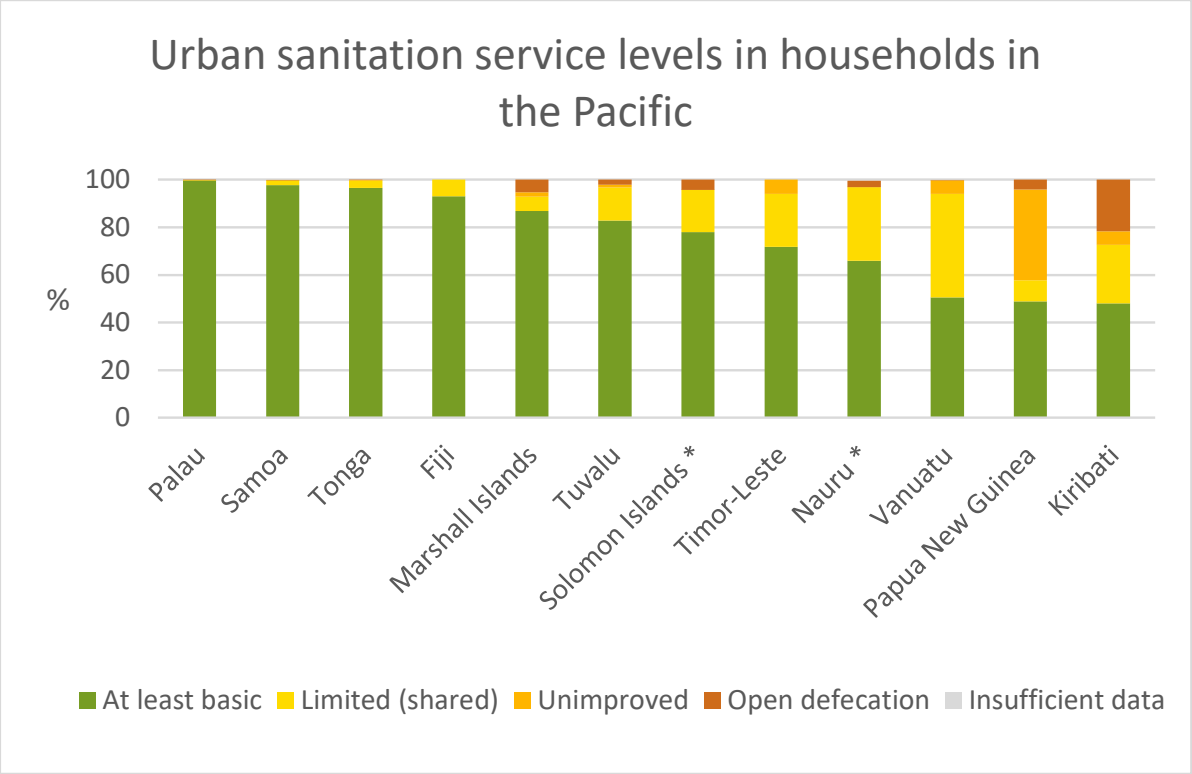


Figure 7 – Urban household sanitation service levels from JMP data 2022 (WHO & UNICEF, 2023)
** Data from Nauru and Solomon Islands is from 2021. Urban/rural disaggregated data is not available for Cook Islands, the Federated States of Micronesia or Niue.*

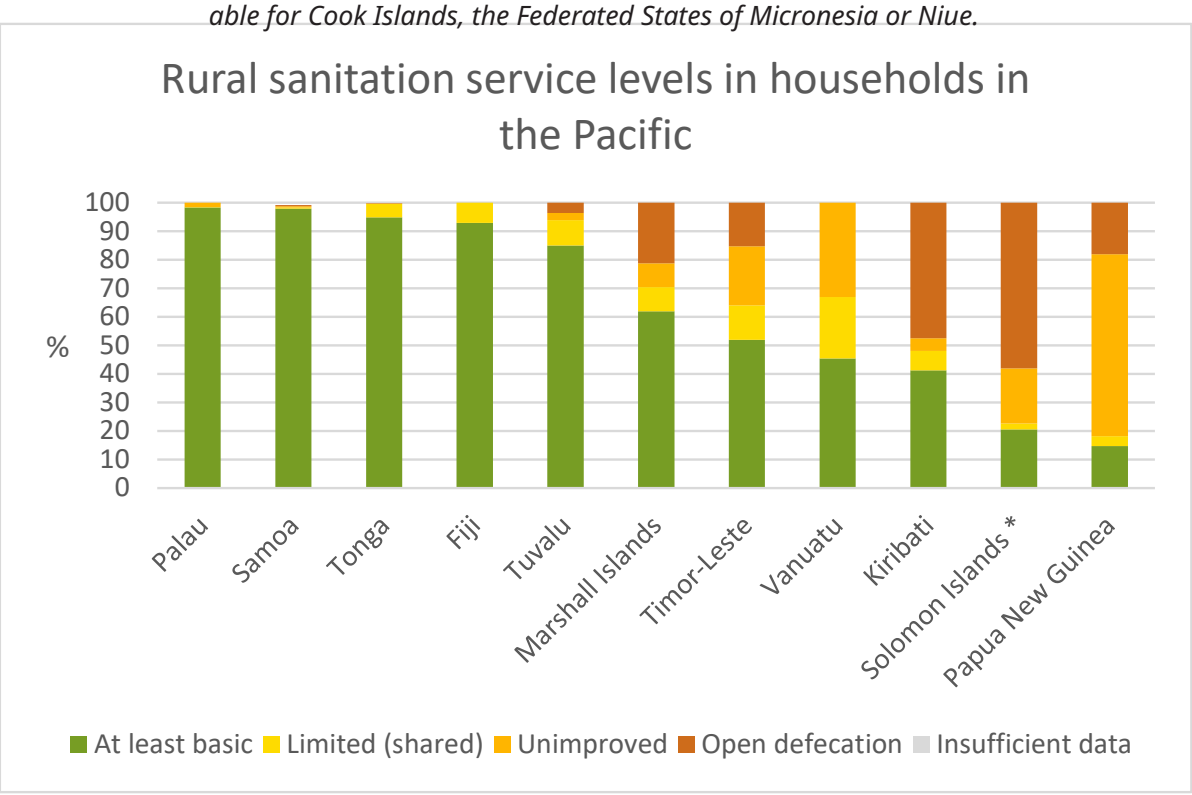


Figure 8 – Rural household sanitation service levels from JMP data 2022 (WHO & UNICEF, 2023)
** Data from Solomon Islands is from 2021. Nauru does not have rural population. Urban/rural disaggregated data is not available for Cook Islands, the Federated States of Micronesia or Niue.*

As households progress up the sanitation service ladder, especially when households use sewered sanitation services, water supply access becomes increasingly important. Figure 8 shows that many of the Pacific countries which face the lowest household sanitation service levels also have the lowest quality household water services.

In most Pacific countries, the most common technology for household sanitation containment and treatment is on-site sanitation systems using septic tanks (Figure 9, Box 3). In most countries septic-tanks are more prevalent in rural areas, with the exception of Vanuatu and Timor-Leste. Only in two countries, Palau and Marshall Islands, do the majority of households access sewered sanitation services.

Country-level data on safely-managed sanitation in the Pacific is limited. Faecal flow diagrams completed for some urban centres estimate safely managed sanitation services of 11% in Port Moresby (University of Leeds, 2021), 33% in South Tarawa (Dutton, 2022) and 69% in Port Vila (Toaliu, 2022).

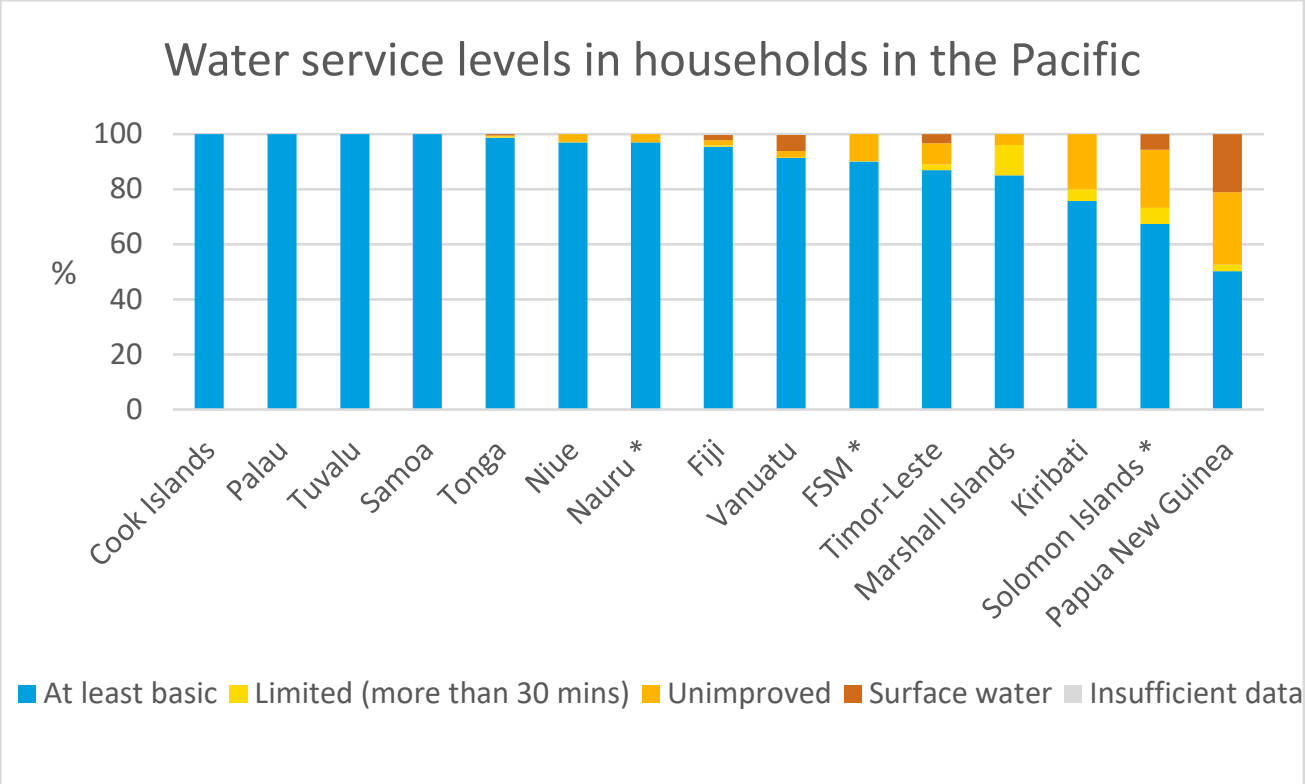


Figure 9 – Household water service levels from JMP data 2022 (WHO & UNICEF, 2023)
** Data from Nauru is from 2019, data from the Federated States of Micronesia is from 2020 and data from Solomon Islands is from 2021.*

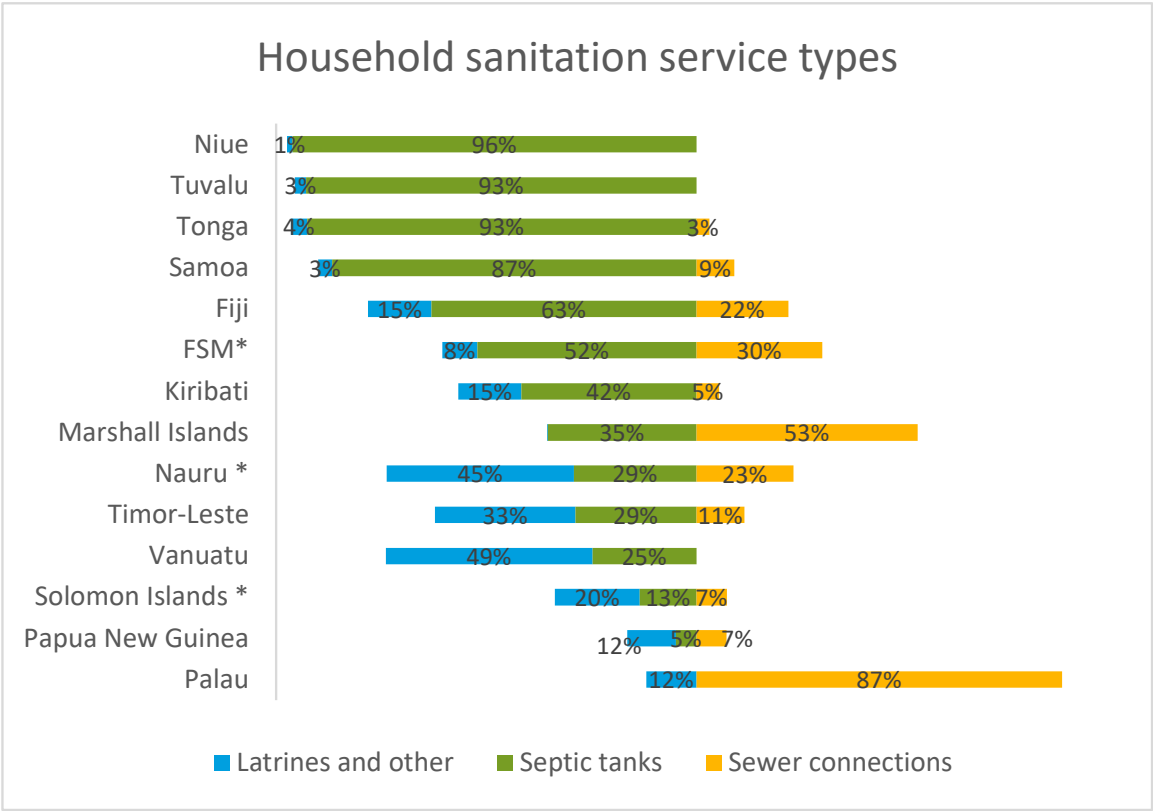


Figure 10 – Household sanitation service technologies from JMP data 2022 (WHO & UNICEF 2023). Visualisation credit to Mark Ellery and ADB

** Data from the Federated States of Micronesia is from 2019 and data from Nauru and Solomon Islands is from 2021*

Box 3: Different types of sanitation systems (based on Mikhael et al., 2021)

The technologies, infrastructure, behaviours, services and service providers required to safely operate and maintain sanitation systems may be defined in several ways.

Based on the location of treatment. Onsite/non-sewered systems contain waste onsite for a certain period. The containment structures – pits, septic tanks or containers – generally require emptying and transporting for treatment but can also in some cases be sealed and safely abandoned in-situ. Offsite/sewered systems include flush-toilets connected to a piped sewer network, which takes the faecal waste away from the households to treatment and discharge. To function effectively and meet safely managed criteria, onsite/non-sewered systems require a skilled workforce to either treat and dispose in site or empty and remove waste for treatment off-site, while offsite/sewered systems are dependent on sufficient water supply to transport waste, a properly maintained network of sewers, appropriate treatment infrastructure, a reliable energy supply and a skilled workforce.

Based on the geography served. Urban systems service cities, rural systems service rural populations and peri-urban systems service the peripheral areas of cities characterised by their transition from rural to urban forms, and which often include informal or unplanned development.

Based on the scale/configuration of treatment facilities. In centralised systems waste from across a region is transported to one treatment facility, whereas decentralised systems feature

multiple, smaller treatment systems. Greater centralisation typically enables greater oversight of design, operation and service quality and economies of scale which favour resource recovery, however they are typically less flexible and more energy and transport dependent.

Why does it matter? Different sanitation systems present different hazards to human and environmental health. For example, well-maintained, onsite systems pose health risks to a few individuals when waste is emptied and disposed, whereas sewered, centralised systems concentrate pollution hazards from a larger population at a single outfall. Sanitation systems differ in their vulnerability to climate change. For example, sewered systems may be more vulnerable to drought and water scarcity than some onsite systems such as dry pit latrines. Centralised systems are often less resilient to climate extremes and disasters than decentralised systems due to risks being geographically concentrated and greater severity of failure.

School sanitation service access in the Pacific

JMP data from 2021 shows the Pacific is the worst performing global region for sanitation access in schools, with 40% of schools in Oceania[10] having no sanitation service at all (UNICEF & WHO, 2022). This is particularly influenced by two of the most populous Pacific countries, the Solomon Islands and Papua New Guinea which have the highest (64%), and seventh highest (42%) proportion of schools in the world without any sanitation service respectively. In Solomon Islands in 2021 only 17% of schools had basic sanitation services. At the opposite extreme, the Cook Islands, Niue and Palau report universal basic sanitation coverage in schools, and 98% of schools in Tonga have access to a basic sanitation service (Figure 10). Sanitation in schools also requires continuously available water supply; Nauru's WASH policy notes that schools are frequently forced to close because they do not have sufficient water to flush toilets. The global benchmark for sanitation services in schools is defined in the JMP (Table 3).

Table 3 – JMP service level definitions for sanitation in schools (WHO and UNICEF, 2017)

Service Level	Definition
Basic Service	Improved sanitation facilities* at the school that are single-set and use-able** (available, functional and private) at the same time as survey
Limited Service	Improved sanitation facilities at the school that are either not single-sex or not usable at the time of survey
No Service	Unimproved sanitation facilities or no sanitation facilities at the school

** Improved facilities include flush/pour-flush toilets, ventilated improved pit latrines, composting toilets and pit latrines with a slab or platform. Unimproved facilities include pit latrines without a slab or platform, hanging latrines and bucket latrines.*

*** Pre-primary schools must have improved sanitation facilities that are usable, but they do not need to be single-sex. Facilities are considered usable if they are available to students (doors are unlocked or a key is available at all times), functional (the toilet is not broken, the toilet hole is not blocked and water is available for flush/pour-flush toilets) and private (there are closable doors that lock from the inside and no large gaps in the structure).*

10 The Oceania region for SDG reporting includes all countries referenced in this paper except Timor-Leste, and additionally American Samoa, French Polynesia, Guam, New Caledonia, Northern Mariana Islands, Tokelau, Wallis and Futuna Islands.

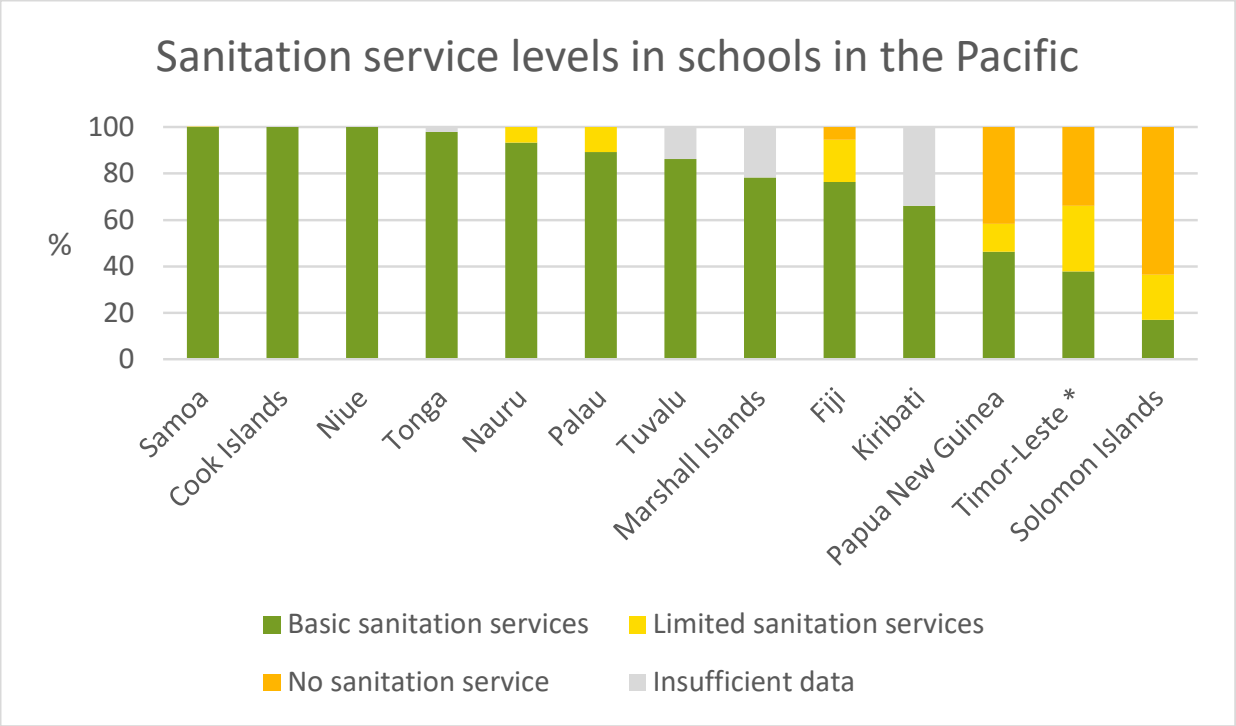


Figure 11 – School sanitation service levels from 2020 JMP data (WHO & UNICEF, 2022)

* Data from 2019

Health care facility sanitation service access in the Pacific

The sanitation situation in HCFs in most countries in the Pacific is dire, with less progress than for household and school sanitation (Figure 11). Few Pacific countries have national data available for sanitation in HCFs, but among those countries reporting data, only Cook Islands achieves at least basic sanitation in the majority of its HCFs. PNG is ranked seventh-worst in the world for sanitation services in health care facilities: 32% of HCFs had no sanitation service in 2019. The global benchmark for sanitation services in HCFs is defined in the JMP (Table 4).

In addition to JMP data, some countries collect sanitation data as part of their health monitoring systems and processes which use different criteria for sanitation access in health care settings. Relevant statistics on sanitation in HCFs from the Pacific include (WHO & UNICEF, 2022):

- In Fiji in 2017, 62% of health care facilities had doors which can lock and no major damage.
- In the Solomon Islands in 2020, while 75% of health care facilities had a toilet on premises, only 5% of these were functioning, could be locked and were without major damage.
- In Vanuatu in 2020, only two-fifths (40%) of hospitals had sex-separated toilets, and less than 1 in 8 (12%) non-hospital health care facilities had sex-separated toilets.
- In the Federated States of Micronesia, a 2021 national survey of healthcare facilities found that three fifths (61%) of health care facilities had functioning on-site wastewater treatment infrastructure and approximately one quarter (24%) had no on-site treatment facilities for wastewater.

Table 4 – JMP service level definitions for sanitation in health care facilities (WHO and UNICEF, 2017)

Service Level	Definition
Basic Service	Improved sanitation facilities* are useable, with at least one toilet dedicated for staff, at least one sex-separated toilet with menstrual hygiene facilities, and at least one toilet accessible for people with limited mobility
Limited Service	At least one improved saniation facility is available, but not all requirements for basic service are met
No Service	Toilet facilities are unimproved (eg. pit latrines without a slab or platform, hanging latrines, bucket latrines) or there are no toilets.

*Improved sanitation facilities are those designed to hygienically separate human excreta from human contact. These include wet sanitation technologies – such as flush and pour-flush toilets connecting to sewers, septic tanks or pit latrines – and dry sanitation technologies – such as dry pit latrines with slabs, and composting toilets.

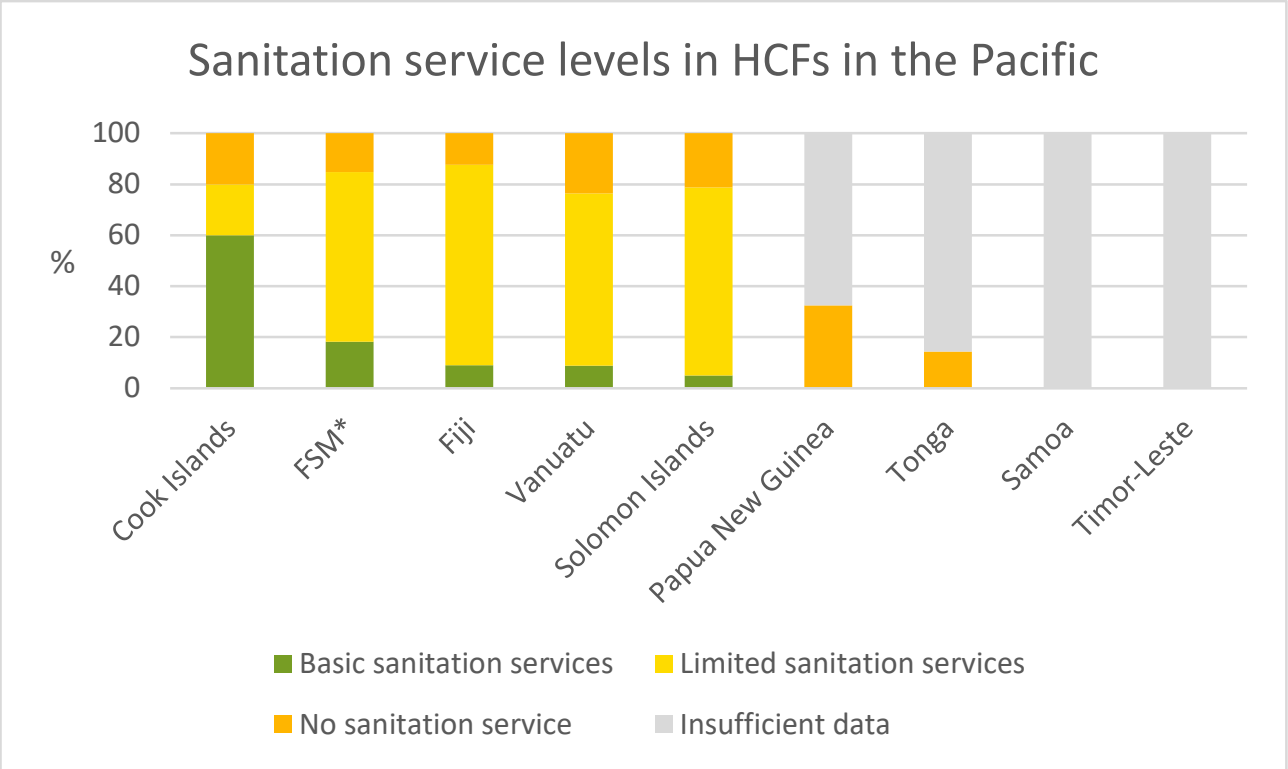


Figure 12 – Health care facility sanitation service levels from JMP data (WHO & UNICEF, 2022)

5. Sanitation: an essential foundation for sustainable development and climate resilience

The links between sanitation and the rest of the SDG agenda are often overlooked within governance and financial systems, and seldom play a prominent role in sustainable development planning. Even within the water, sanitation and hygiene (WASH) sector, sanitation is often neglected and overlooked, further pushing progress backwards. In the past nine years, sanitation has never exceeded 15% of official development assistance (ODA) for WASH and water resource management (WRM) reported through the OECD (2020). Globally there is also very little private development assistance and direct foreign investment in sanitation (WaterAid, 2021).

The impacts of climate change on sanitation services have several ripple effects across financial, social and environmental systems. These include increased costs of repair and maintenance of an already under-resourced sanitation sector, ecosystem level concerns including the transport of pathogens through the environment, pollution of waterbodies that provide critical services for communities and biodiversity, as well as significant human health risks due to disease. The critical interlinkages across the entire SDG agenda (Figure 12) also highlight sanitation as a key entry point for achieving safe, equitable and sustainable communities. The following section provides a deep dive into each of these interlinkages and how they translate to a Pacific context.

The links between sanitation and the rest of the SDG agenda are often overlooked within governance and financial systems, and seldom play a prominent role in sustainable development planning. Even within the water, sanitation and hygiene (WASH) sector, sanitation is often neglected and overlooked, further pushing progress backwards. In the past nine years, sanitation has never exceeded 15% of official development assistance (ODA) for WASH and water resource management (WRM) reported through the OECD (2020). Globally there is also very little private development assistance and direct foreign investment in sanitation (WaterAid, 2021).

The impacts of climate change on sanitation services have several ripple effects across financial, social and environmental systems. These include increased costs of repair and maintenance of an already under-resourced sanitation sector, ecosystem level concerns including the transport of pathogens through the environment, pollution of waterbodies that provide critical services for communities and biodiversity, as well as significant human health risks due to disease. The critical interlinkages across the entire SDG agenda (Figure 12) also highlight sanitation as a key entry point for achieving safe, equitable and sustainable communities. The following section provides a deep dive into each of these interlinkages and how they translate to a Pacific context.

Figure 13: Sanitation and its interlinkages across the 17 SDGs

Social dimension

Sanitation and safe and equitable communities

Initiatives to strengthen sanitation services are closely linked with issues of gender, power and equality.

A review of the impact of WASH on key health and social outcomes (Mills & Cumming, 2016) found evidence that globally, many women, girls and people with a disability who have poor sanitation access links were exposed to violence and psychosocial stress. Women and girls are especially vulnerable to gender-based violence when practicing open defecation and household access to a toilet improves women and girls' sense of privacy and safety when using toilets at night (Arnold et al., 2010). People with a disability and caregivers who do not have accessible toilets may be forced to wait until dark to defecate, placing them at risk of abuse and exacerbating their discrimination (Devendas-Aguilar, 2015).

Community cohesion, social inclusion and Do No Harm approaches are key considerations for implementing sanitation programmes. The success of community-led sanitation initiatives, such as community-led total sanitation (CLTS), is closely linked with social cohesion, social connectivity and women's ability to participate and be heard (Kar & Chambers, 2008). Guidance documents for CLTS and community sanitation promotion often highlight the risk of perpetuating harm, inequality and discrimination which already exists within a community.

Sanitation service improvements are a potential entry point to shift power and improve social cohesion and equality. In Melanesia, social customs such as kastom, wantok and vanua which intertwine social capital with economic capital through systems of payment and reciprocity mean that social relationships are an integral mechanism through which people invest in household sanitation and inform household decision-making processes (Barrington et al., 2016). The social influence of churches and religious leaders in the Pacific, and their role in many countries as education and healthcare providers, mean they can also play a significant role in community sanitation behaviours (Barrington et al., 2016; UNICEF 2021b). Participatory and community-empowerment approaches to WASH in peri-urban locations in Fiji, Solomon Islands and Vanuatu have demonstrated that when community identify and lead WASH initiatives they can leverage a range of social capital and informal networks to improve their sanitation situation (Shields et al., 2022).

The risk of climate variability and change affects sanitation users unequally, and the capacity to prepare for climate-related risks to health and sanitation varies significantly across individuals and social groups. For example, following Tropical Cyclone Winston in Fiji, a government post-disaster needs assessment found that women and girls were among the most affected by the disaster and were left with limited resources to withstand and respond to the crisis. Poverty and marginalisation are primary determinants of increased vulnerability, where climate change can exacerbate poverty and contribute to people becoming trapped in socio-economic disadvantage (Kohlitz & Iyer, 2021). For example, due to structural barriers disadvantaged households may not have access to financial or hardware subsidies they need to construct climate-resilient household toilets, or emphasis on short-term benefits in low-income areas may increase long-term risk to climate change (e.g. installing or expanding sewerage services in a low-income area without considering future water scarcity may cause the system to fail) (Kohlitz et al. 2019). Good practice hazard assessment and planning adaptive responses should identify vulnerable hotspots and target support accordingly (UTS-ISF et al., 2023).

Sanitation, health care and childhood development

In health care settings, access to sanitation is vital to the delivery of high-quality and safe care by reducing spread of infectious diseases, combating antimicrobial resistance, building trust in healthcare services, improving patient satisfaction and upholding the dignity of vulnerable populations. This is particularly true for health services during labour, delivery and postnatal care periods,

when poor WASH services can threaten the health of mothers and newborns (WHO and UNICEF, 2015b). Despite the importance of sanitation to protecting the health of patients and health professionals at the point of healthcare, in 2022 WHO and UNICEF found that 780 million people worldwide had no sanitation service at their health care facility (HCF) (WHO and UNICEF, 2022). Figure 11 highlights that sanitation in HCFs is almost universally inadequate in the Pacific, and that there are large gaps in national data which prevent governments from targeting resources to the HCFs that need them most. This is compounded by a lack of standards; few Pacific countries have guidelines detailing minimum WASH facilities required for different health care settings (see Table 5). Without enforcement of accessibility standards for toilets in HCFs, people with a disability, pregnant women and women who have recently given birth experience significant barriers to sanitation and hygiene when attending essential health services.

Cristiano, a nurse at the Bubususu Health Post, with his colleague Estanislau at the new accessible toilet constructed through WaterAid's programming in Manufahi, Timor-Leste.

Case study 4 provides one example of how Papua New Guinea's WASH in HCF technical working group is applying the WHO's eight practical steps (WHO, 2019) to begin to drive systemic change by identifying and addressing barriers to sanitation in HCFs.

Children are especially vulnerable to diarrhoea, leading to increased morbidity and mortality as well as long-term chronic health conditions such as stunting[11], which has long-term, irreversible effects on children's development and thus their lifelong wellbeing, educational attainment and economic opportunities. While stunting is caused by a complex array of social biological, environmental and economic factors, inadequate sanitation contributes to stunting through several mechanisms (MacIntyre & Strachan, 2021):

- Exposure of children to harmful pathogens from human waste causes gastrointestinal illness and poor absorption of nutrients from food.
- Sanitation-related enteric illness diverts nutrients to fight illness rather than using them for growth and development.
- Household incomes which must be redirected to health-related costs reduce the available budget for nutritious food.

Stunting rates in several Pacific countries exceed the global average (Figure 13). In Timor-Leste and PNG, almost half of all children under five years old experience stunting. These factors are likely to be exacerbated by climate change, with decreased reliability of crop yields and fisheries, and climate-related disasters and food and water insecurity placing additional strain on some families' already limited resources.

Safe disposal of child faeces has been noted in global literature as a particular challenge, with the faeces of children aged under three less likely to be safely disposed of than those of the general population in almost every country (Rand et al., 2015). Despite a common belief that children's faeces are less harmful, there is evidence that children's faeces could pose greater risks to human health than adult faeces (Rand et al., 2015). Child faeces management practices in the Pacific are not well

11 A child is considered stunted if they are two standard deviations below the mean height for their age

documented, although one study in Solomon Islands found open defecation by children was common and almost half of respondents disposed of faeces to unsafe locations (Biran et al., 2022) and a study from Timor-Leste found that less than half of children's faeces in ODF areas was disposed of via latrine (Neely et al., 2021).

Climate change is expected to increase health burdens. Many of the increased risks of ill health through malnutrition, changing geographic ranges of vector borne diseases and increased prevalence of airborne and waterborne diseases are linked to inadequate sanitation (WHO, 2013). Impacts of climate extremes on public health infrastructure including HCFs and sanitation infrastructure, and movements of displaced populations, will jeopardise human health and place increased strain on already under-resourced health systems. It is thus vital that efforts to adapt and improve the resilience of health systems to climate change include universal safe sanitation services as a pillar of healthy and resilient populations.

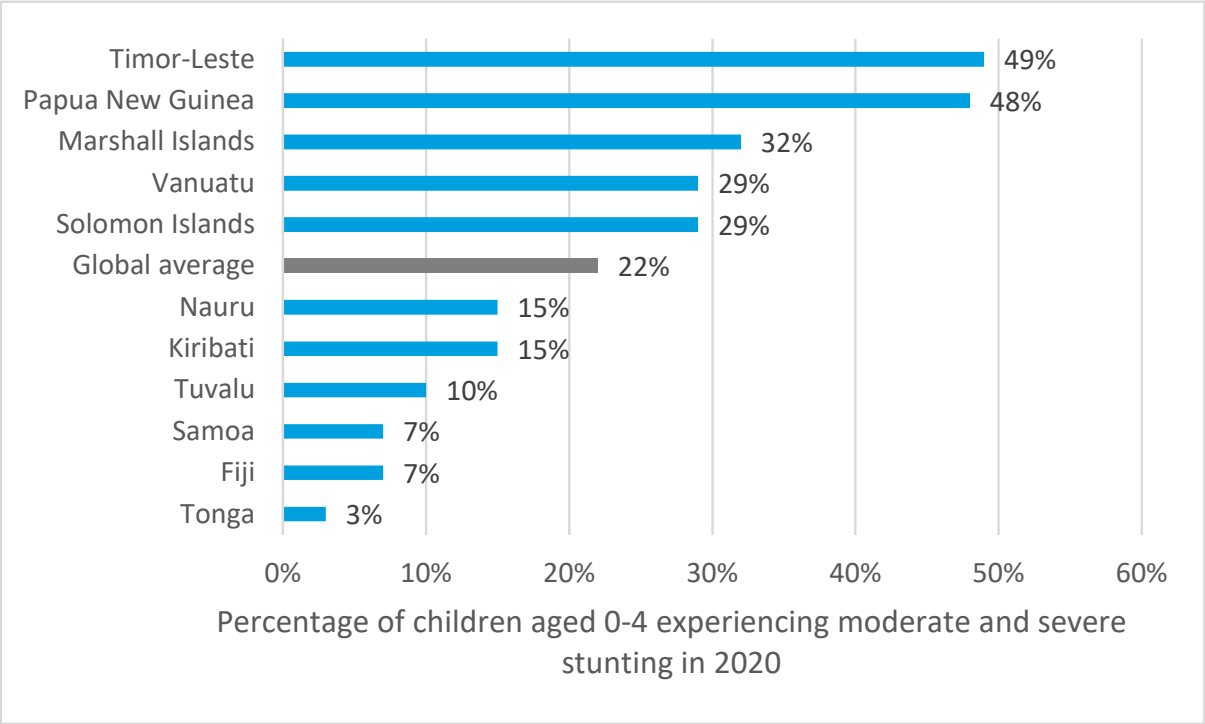


Figure 14 – Available data on stunting among children in Pacific countries (UNICEF, 2023)

Recommendations

Pacific Island Governments and donors should promote integrated approaches to address childhood stunting, and enable children to thrive through the foundational elements of sanitation, maternal and child healthcare, food security, nutrition, education and household disaster risk resilience in order to enable children to thrive. This is especially relevant in **Papua New Guinea, Timor-Leste, Marshall Islands, Vanuatu and Solomon Islands.**

Pacific Island Governments and non-government health care providers in all Pacific countries should urgently rectify the dire state of sanitation in the region's health care facilities.

Sanitation and education

Sanitation is a critical factor in providing a safe and clean learning environment which enables students and teachers to focus on education and learning, yet globally 539 million children are estimated to attend a school lacking basic sanitation services. Without functioning, private and clean toilets, students are more likely to miss class time to return home or seek a discrete location for open defecation and urination. A global analysis of 38 peer-reviewed studies of the impacts of school WASH interventions found widespread evidence that improvements in WASH facilities and behaviours in schools was associated with reduced diarrhoeal disease and other hygiene-related illness, and reduced student absenteeism (McMichael, 2019). Numerous studies have shown that girls are particularly impacted by inadequate sanitation facilities in schools; alongside stigma, lack of a clean and private location to change menstrual materials contributes to missed classes and school days (Hennegan et al., 2019). Some studies estimate girls miss as much as four days of schooling every four weeks, a pre-cursor to dropping out of school (UNESCO, 2014).

However, the construction of school toilets alone is not effective at improving student health outcomes; holistic interventions should improve water access, change hygiene behaviours and ensure toilets are kept clean to minimise student absenteeism. Providing and sustaining WASH in schools is often especially challenging due to the intersecting responsibilities across Ministries of Education, Health and service providers such as utilities. Case study 3 provides one practical example of a simple, scalable and sustainable method – the Three Star Approach – that improved sanitation access in schools in Fiji. Climate change-related extreme weather will impact children's development and education opportunities through direct impact on housing and education facilities, and via reduced or lost crop yields and depletion of fisheries exacerbating food insecurity. Household coping strategies in these instances are also likely to interrupt children's education (GCA, 2022). Integrated approaches to holistically improve children's development and wellbeing must consider sanitation alongside disaster risk resilience, maternal and child healthcare, nutrition and education.

Recommendations

Governments should urgently accelerate access to basic sanitation service in schools to provide healthy and safe learning environments and remove barriers to educational attainment. This is especially relevant in **Papua New Guinea, Timor-Leste and Solomon Islands.**

Environmental dimension

Coastal ecosystem health

Coastal ecosystems are particularly vulnerable to poor wastewater management practices and open defecation. Most coral reefs are located along the shorelines of developing countries, especially in the Pacific, where advanced nutrient removal during sewage treatment is rare. Global estimates indicate almost half (48%) of wastewater is discharged to the environment without any treatment (Jones et al., 2021) and approximately 55% of coral reefs and 88% of seagrass beds are exposed to wastewater pollution (Tuholske et al., 2021). Increased nutrients and pathogens can cause coral disease, increase algal growth, and reduce coral growth rate and reproductive success. This in turn, reduces coral reef cover and the ability of reef ecosystems to recover from disturbances, leading to reduced coastal protection and fisheries services for coastal communities (Wakwella et al., 2022). Nutrient pollution from wastewater discharge also makes coral reefs and mangrove forests more vulnerable to extreme weather events brought on by climate change (Wenger et al., 2023).

The degradation of coastal ecosystems will

make coastal communities less resilient to climate change, due to loss of ecosystem services like coastal protection and food provisioning. Many coastal regions, particularly Small Island Developing States in the Pacific, are highly dependent on the health of coral reef ecosystems to support their economies through fisheries and tourism, including food security and coastal protection (Wakwella et al., 2022). Coral reefs provide food and habitat for 550,000 to 1,330,000 species, as well as provide valuable services for humans including shoreline protection, livelihoods from eco-tourism (Wear and Thurber, 2015). The value of these services varies globally but is estimated to amount to over US$14.7 trillion per year (Wenger et al., 2023). Polluted coastal ecosystems affect coastal communities through fisheries decline or ingestion of contaminated fisheries products. For example, a primary concern for mangrove health in assessed areas of Samoa was the discharge of untreated wastewater from village, households and hotels. Leachate from poorly maintained septic tanks was also believed to contribute to high nutrient loading which causes algal blooms (Saifaleupolu & Elisara-La'ulu, 2013). As a result, harvests of mangrove crabs have reduced significantly. Nutrients from wastewater also reduce the ability of mangroves to store carbon, leading to increased emissions and undermining blue carbon initiatives (Santos-Andrade et al., 2021).

In Tonga, high nutrient loadings in marine areas have also contributed to coral and seagrass degradation and mangrove diebacks (Kaly, 1998; Prescott, 2001; TEMPP, 2001). In the Federated States of Micronesia, waste from piggeries going into waterways has caused algal blooms affecting fisheries. As such, the safe management of wastewater and changes on community sanitation behaviours is essential to safeguard these critical ecosystems to address food security, coastal protection from storm surges and the biodiversity they support.

Human health linkages

In addition to the human health challenges posed by a lack of access to sanitation facilities in healthcare centres and schools, there is also ample evidence that points to additional human disease burdens linked to poor ecosystem health and water quality (Jenkins et al., 2016; WHO, 2016; Herrera et al., 2017). These impacts are likely to be exacerbated by climate change, compounding existing healthcare burdens that communities already face across the Pacific.

One of the main contributors to water pollution is unsafe access to sanitation services. Evidence from in situ studies has linked contaminated surface water to diarrhoeal disease, pointing to watershed degradation as a global environmental development concern. Communities that are reliant on surface and groundwater sources for their drinking, bathing and household cleaning water are at most risk of water-related diseases such as diarrhoeal disease, cholera and typhoid, and water-washed diseases such as roundworm, trachoma and scabies (Bonnaerdeaux, 2012). Globally, more than one in four deaths of children under 5 years is attributable to unhealthy environments, where diarrhoeal disease is the second leading cause of death among children due to poor access to clean water, sanitation and hygiene in the local environment and unsafe sanitation practices in upstream catchments (Herrera et al., 2017). Typhoid fever infection risks are also highest in environments that have poor standards of living and lack access to basic sanitation and clean water (Jenkins et al., 2016). A lack of adequate sanitation facilities supports the cycle of soil-transmitted helminths (worms) that infect more than 1 billion people around the world (Edmond et al., 2013), pointing to the increasingly complex and connected nature of ecosystems, sanitation and human health.

Significant proportions of the population in the Pacific rely on rivers, lakes and ponds as their main source of drinking water. Sanitation policies and reports from the Federated States of Micronesia, Kiribati, Marshall Islands and Solomon Islands have documented outbreaks of cholera and diarrhoeal diseases linked to water supplied contaminated by insufficiently-treated faecal waste. In 2019, the Solomon Islands and Kiribati were respectively ranked 11th and 13th in the world for deaths per capita from diarrhoeal disease (IHME, 2021).

These impacts are likely to be exacerbated by climate change causing more frequent release of pathogens into the environment from flooding and heavy rainfall. For example, in Fiji, typhoid outbreaks have been reported to occur following shortly after the rainy season including during cyclones and flooding suggesting considerable interlinkages to climate change (Jenkins, 2010). Surveillance data shows that typhoid is becoming increasingly common in rural areas (Thompson et al., 2014) where communities often lack access to safe sanitation services leading to increased open defecation and environmentally unsafe sanitation practices. Many environmental determinants of typhoid fever risk, including erosion and sediment deposition in catchments, road and river connectivity, riparian forest fragmentation and soil characteristics (Jenkins et al., 2016) are also likely to be further exacerbated by climate change, highlighting the cascading impacts across catchments that climate change can cause.

Management challenges

Besides the human right to safe water and sanitation, communities also have the right to a healthy environment, of which sanitation is a key enabler. Sanitation systems must be designed to protect natural capital for the key provisioning, regulating, cultural and supporting ecosystem services they provide (Millennium Ecosystem Assessment, 2005). Often, water pollution impacts on ocean health or terrestrial ecosystems are not enough to motivate action and leverage adequate funding for management, however linking these impacts to human health and climate resilience can unlock new opportunities. Furthermore, drinking water interventions often tend to receive more attention and funding compared to sanitation initiatives, creating an imbalance in resource allocation. This overshadowing of sanitation efforts has slowed down progress and exacerbated the challenges faced by the sector.

Better management of sanitation systems, especially upstream human activities, can not only protect coastal and marine ecosystem health, including mangroves, seagrass meadows, coral reefs, but also provide clean water and safely managed sanitation services to humans. This increases community resilience to climate change and reduces social vulnerabilities. For example, forests can often have positive effects on human wellbeing through reduced childhood diarrhoeal disease by displacing human activities that can pollute the catchment or by filtering or diluting pollutants from areas of human activity. In rural areas, the effect of a 30% increase in upstream tree cover is significant and is similar to the effect of an improved sanitation facility. These results highlight the potential of natural ecosystems to benefit human health outcomes as well as the importance of protecting them from human activities.

Effective collaboration, and social-ecological systems approaches, are essential to achieving joint outcomes across biodiversity and human health. This includes integrated, risk-based approaches that consider long-term climate change and encourage multi-sectoral collaboration across the environmental conservation, water resource management and sanitation sectors. Useful guidance for undertaking coastal climate impact analysis and sanitation hazard assessments has been demonstrated in Fiji and Indonesia by UTS-ISF, Universitas Indonesia and Habitat for Humanity Fiji (2023). An example of one programme is included in Case study 6.

Social-ecological systems approaches can include:

- The development of predictive risk maps at the sub-catchment scale to guide proactive interventions including improvement of sanitation systems and upstream ecological water quality improvements to reduce the risks of disease (Jenkins et al., 2016). This could also include areas where flood risks from climate change are the greatest.
- WASH interventions that focus on protecting or enhancing ecosystem health and water-related ecosystem services including the use of natural infrastructure to complement built infrastructure (Edmond et al., 2013), thereby increasing the resilience of catchments and ecosystems to climate change.
- Strengthened dialogue about the connections between water, nature,

resilience to climate change and a community's health and wellbeing. These topics offer more points of engagement between relevant stakeholders compared to traditional WASH or conservation interventions and messaging.

- Applying safe 'Ecological Sanitation' approaches which focus on climate adaptation and protecting environmental health, providing economic benefits and improving human health by closing the loop on human excreta and using them as resources in an ecological loop such as waste diversion and recycling practices (IRC, 2006).

Recommendations

NGOs and research organisations should partner with complementary organisations on joint conservation and sanitation programs utilising integrated, nexus approaches. This can also strengthen gaps in stakeholder engagement, and lead to holistic decisions that can increase the resilience of communities to climate change through multi-pronged approaches.

Economic dimension

Sanitation for resilient economies

Sanitation is critical to enable strong and resilient economies. Potential economic benefits from sanitation investments are well-documented. The World Health Organisation estimated that economic losses in Oceania due to inadequate water and sanitation, at 1.6% of GDP, were above the global average of 1.5% of GDP (Hutton & WHO, 2012). WaterAid and Vivid Economics analysis of benefit-cost ratios (BCR) calculated that every dollar invested in basic sanitation in East Asia and the Pacific generates economic returns of $10 (WaterAid & Vivid Economics, 2021) through improved health, education and productivity. WaterAid and Vivid Economics (2021) analysis highlights that adequate sanitation provides a range of economic benefits, including:

- **Improved health**. Safely managed sanitation reduces illness and improves quality of life, including reduced stress from practicing open defecation or using unclean toilets. This leads to improved wellbeing, healthier citizens and lower healthcare expenditure.
- **Environmental benefits**. Safe human waste treatment and disposal leads to healthier ecosystems and reduced environmental degradation which provide livelihood and income opportunities, while cleaner environments encourage recreation and leisure for people's wellbeing.
- **Socioeconomic opportunities.** Healthier workforces have increased productivity. Reaching households with at least basic sanitation can save up to 30 hours per year for each household member. This time saved can be invested in livelihoods, stronger familial and community relationships and leisure. Healthier children and access to sanitation in schools improve education participation and reduce parents' time spent on caring responsibilities.
- **Resilience.** Sanitation services and effectively-designed sanitation infrastructure contribute to community preparedness, responsiveness and recovery from health and climate-related shocks and stressors.

Sanitation access is also critical to unlocking economic returns across other development outcomes. Some of the sanitation-related SDG outcomes identified as high return on investment by the Copenhagen Consensus Center (2016) are provided in Figure 14.

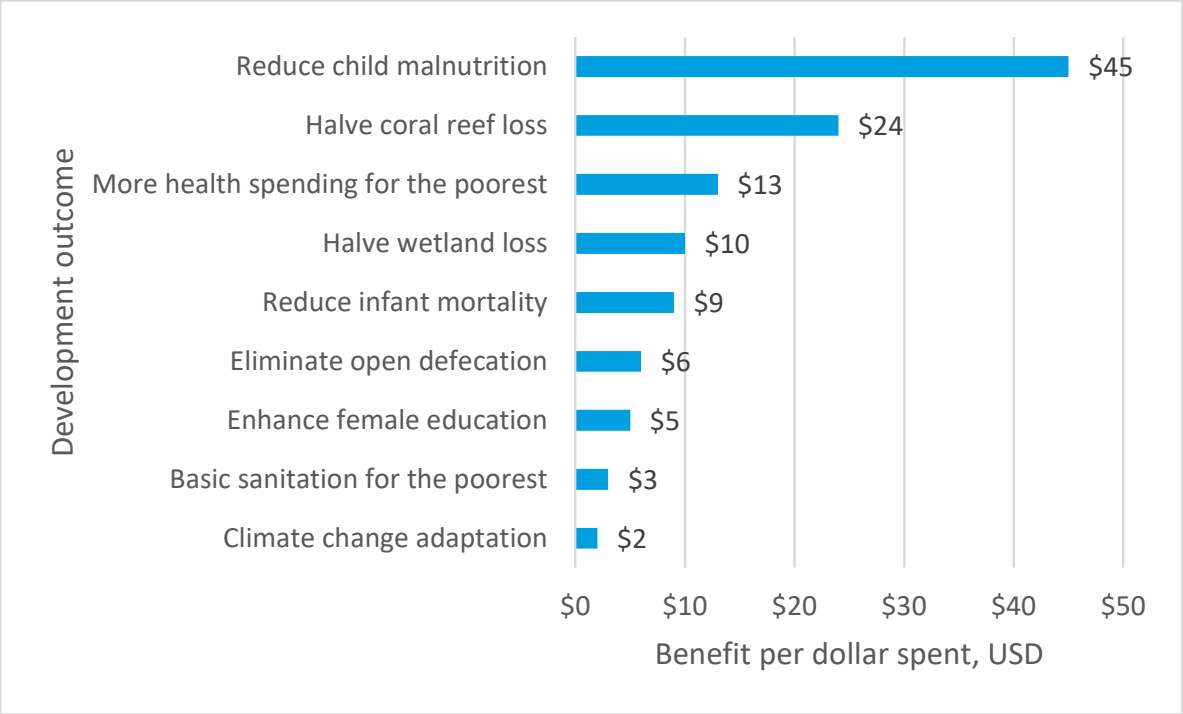


Figure 15 – Global estimates of return on investment in development outcomes relevant to sanitation (Copenhagen Consensus Center, 2016)

Sanitation for income generation and livelihoods

As well as an essential public service, sanitation provides business opportunities and crucial livelihoods to millions of people worldwide. The number of people working in sanitation is difficult to quantify due to the invisibility and informality of many sanitation roles and the intersectoral responsibilities of many departments and utilities in sanitation, water, solid waste and electricity provision, but globally there are millions of sanitation workers (World Bank et al., 2019). The Pacific Water and Wastewater Association's (PWWA) 2020 benchmarking report identified 4,171 staff at PWWA utilities across the Pacific (PWWA, 2020). Other sanitation workers in the Pacific include latrine suppliers and masons and the staff of septic sludge tanker operators; such as the eight trucks operated by five companies in Port Moresby, PNG (Ellery, 2019) and nine companies in Dili, Timor-Leste (World Bank, 2019). Toilets can also provide an income source for entrepreneurial communities; in some informal settlements in Port Vila pay-for-use public or shared toilets provide income to their owners, while one community in Maubara, Timor-Leste, constructed toilets at a popular beach to generate income from tourists.

The growing awareness of sanitation's contributions to greenhouse gas emissions (Box 4) is opening new revenue streams for service providers who can manage and dispose of human waste in less emission-intensive ways. A methodology has been developed and tested in Guatemala for quantifying the reductions in greenhouse gas emissions through container-based sanitation services with the aim of enabling sanitation service providers to sell carbon credits (Andriessen, et al. 2023). There is also momentum towards re-envisioning the linear sanitation chain as part of a circular economy in which the waste from sanitation (wastewater, faecal sludge) are converted to resources for reuse (biogas for electricity, compost and fertiliser from faecal sludge, and treated wastewater for industrial reuse). Global experience indicates that viable and sustainable models remain challenging. Some of the challenges include (Mallory et al., 2020):

- **Availability and quality of waste.** Lower volumes of faecal waste are typically received than expected during design, and the cost of removing contaminants like plastic mean treatment plants often run below capacity, reducing profitability and disincentivising repairs and maintenance investment.
- **Reliance on other systems.** Circular economy models typically co-compost human waste with food or agricultural waste which require adequate volumes

and coordination of supply with multiple sources and actors.

- **Policies and subsidies.** Political will and government promotion of sanitation and of circular economy approaches are required, and in many cases government subsidy is necessary to make organic fertilisers competitive against chemical fertilisers.
- **Perceptions of potential customers.** While generally supportive of the product, farmers may be wary of using fertiliser from human waste due to social norms and perceptions, limited understanding about the benefits of organic fertilisers, and laws which prohibit the export of agricultural products grown with such fertiliser. Sales of electricity to the grid are less likely to face these challenges.
- **Balancing scale and public health risks.** Some large-scale sanitation circular economy models processing waste from millions of residents have still not achieved financial viability as a standalone business. On the other hand, potentially profitable small-scale entrepreneurs producing fertilisers from human waste have not demonstrated that risks to human health can be adequately addressed at scale.

While it may be challenging to turn sanitation resource recovery into a profitable standalone business, integrating elements of circular economy into sanitation operations can represent new income streams for existing utilities operating wastewater and faecal sludge treatment plants serving larger urban centres in the Pacific (see Case study 5).

Box 4: Sanitation's contribution to climate change

Globally, sanitation is a major contributor to greenhouse gas emissions. A city-wide study of Kampala, Uganda, found that sanitation may be responsible for more than half of the city-level greenhouse gas emissions (Johnson et al., 2023). Sanitation's greenhouse gas emissions also vary by technology and usage practices. Inadequate and unsafe sanitation services result in higher than necessary emissions, especially from production of methane, from long periods of storage of faecal waste in anaerobic conditions in pit latrines in non-sewered systems. Pit latrines that are used as pour flush latrines, or which are inundated by high groundwater or flooding, contribute up to six time more greenhouse gas emissions per capita than dry-pit latrines (Doorn et al., 2006).

Recommendations

Donors, Pacific governments and utilities should co-fund upgrades to wastewater and faecal sludge treatment plants serving urban centres in the Pacific such as Port Moresby, Suva, Honiara, Port Vila, Koror and Apia to integrate elements of resource recovery to increase their revenue streams and reduce their waste production.

6. Towards a roadmap for climate-resilient sanitation in the Pacific

Ama Isabel with her husband and granddaughter next to their toilet in Leotela, Timor-Leste

Achieving climate-resilient communities requires a step change in access to safe sanitation services. Focusing solely on water will not solve the significant challenges that climate change presents to communities in the Pacific who are already falling behind in their SDG commitments. All sanitation systems need to become climate-resilient sanitation systems and be able to withstand the impacts that both acute and long-term climate hazards present. It is necessary to adapt sanitation services now to ensure functionality under a changing climate (UTS-ISF, 2022). This includes systems and services that:

- Consider exposure, vulnerability and capacity to respond to both acute and slow-onset climate hazards
- Are robust and can withstand disasters and climate extremes
- Are designed in a way that can be repaired quickly and with locally sourced materials if the risks of frequent destruction are high
- Incorporate contingency plans to anticipate and cope with climatic shocks whilst ensuring minimal disruption to services
- Reduce emissions where possible including low-carbon technologies, nature-based solutions and resource recovery principles
- Embed climate change into life-cycle costs and long-term operations and maintenance plans

WaterAid defines climate-resilient sanitation as:

> ***Strong sanitation systems, services, and behaviours that are ecosystem-aware, build community resilience and can be appropriately restored or maintained to reduce vulnerabilities, despite slow onset or acute climate hazards.***

Climate change considerations must increasingly be embedded as part of the foundation and enabling environment of a resilient system through various entry points. This must be backed by multi-sectoral collaboration to leverage complementary expertise, as well as sustainable financing

models that consider long term climate risk to infrastructure governance and social systems. This also includes considering the economic and non-economic risks of loss and damage that climate disasters and long-term climate change present to sanitation systems.

Entry points to drive climate-resilient sanitation in the Pacific

The step change to achieve universal, climate-resilient sanitation will not happen without concerted effort and investment. Based on the literature reviewed for this paper, we propose that three critical dimensions of governance, environmental, and social aspects must be considered to progress climate-resilient sanitation in the Pacific (Figure 15). Across these dimensions, change should: build on foundations of knowledge, data and conducive norms and mindsets; strengthen national and local enabling environments; and develop context-specific and appropriate services which engage and empower sanitation users. The foundational knowledge and attitudes required to drive climate-resilient sanitation services – such as projections of the impact climate change will have on sanitation; political will; community engagement and behaviour change approaches; and evidence of the social, environmental and economic incentives for prioritising sanitation – exist at a global level but are not often well documented at a local level in different Pacific contexts.

The enabling environment for sanitation – the institutional arrangements; policies and strategies; sector financing; planning monitoring and review processes; and capacity development – requires strengthening in many Pacific countries. And while some elements of the sanitation service chain are well established, key gaps in services and technologies mean that the full benefits of sanitation for human and environmental health and economic resilience are yet to be realised. Progress can be catalysed by fostering collaboration and collective action and facilitating coordinated financing.

Drawing on frameworks for climate resilient sanitation systems (UTS-ISF, 2022; Willetts et al., 2022), five key entry points have been identified to catalyse the step change required for climate-resilient sanitation in the Pacific. Entry points for driving change are highlighted in Figure 15 and explained in more detail, in the following sections.

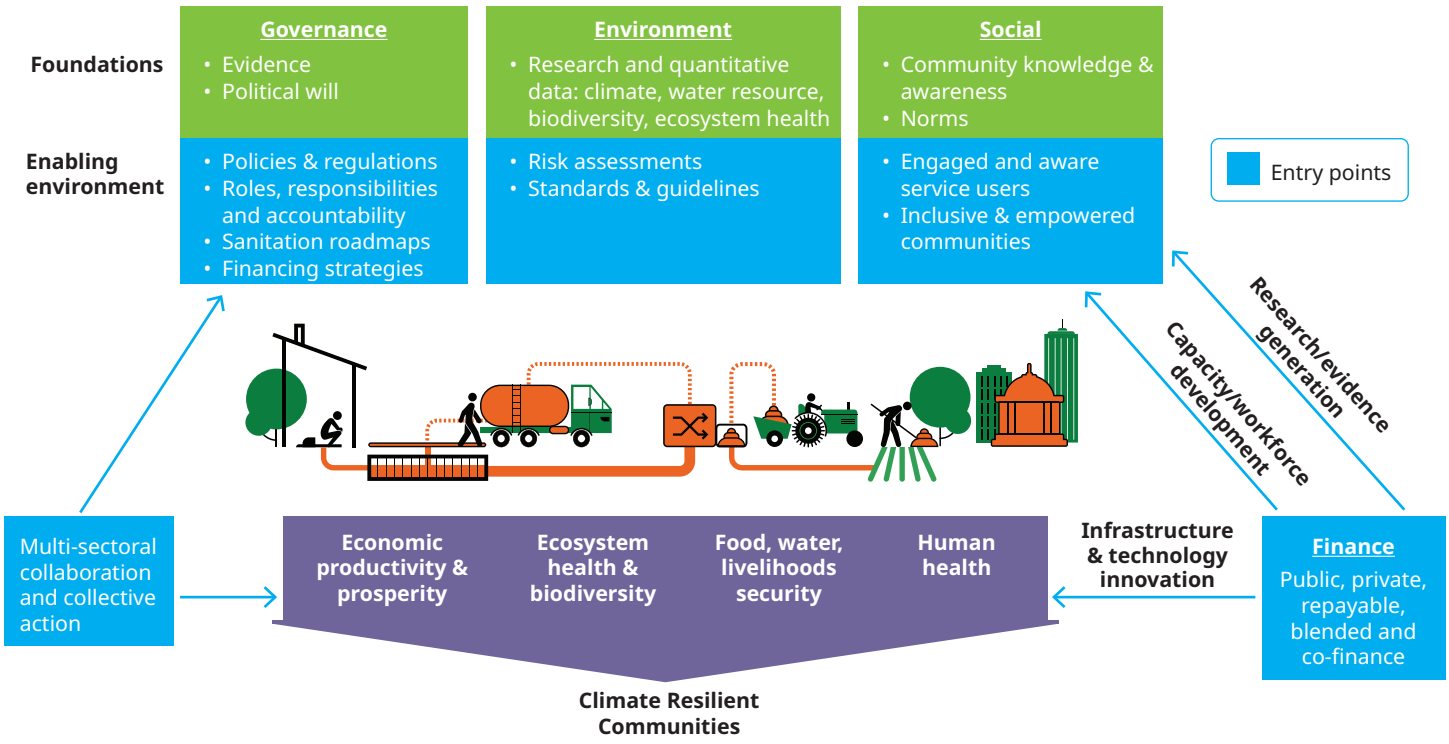


Figure 16 – Foundations, enabling environment and entry points for catalyzing climate resilience sanitation services in the Pacific (author analysis)

WaterAid/Tariq Hawari

Policies and plans that prioritise climate resilient sanitation

Policies, strategic plans, legislative frameworks and National Adaptation Plans (NAPs) for climate resilience provide the foundations to coordinate various sanitation stakeholders, incorporate sanitation within climate adaptation initiatives and build the case for increased funding. Having appropriate standards in place for human waste disposal, as well as wastewater treatment can drive sustainable and innovative industry practices and hold stakeholders accountable including ensuring that processes are in place for when regulations are breached. While such documents are only effective when supported by clear roles and responsibilities, sufficient workforces and capacity, budgets and leadership, they provide a snapshot of the sanitation system's progress to improve sanitation services and indicate a level of political willingness and prioritisation of sanitation which is essential to achieving universal sanitation access (Northover et al., 2015).

In preparing this paper, the authors undertook a desk review of the status of select policies, plans and legislation for sanitation in each of the study countries using documents publicly available online. The results of this analysis are presented as a summary 'scorecard' in Table 5 with further detail in Annex 1. The scorecard shows that most Pacific countries have at least one national policy for sanitation. The right to sanitation is likewise widely enshrined in national legislations or constitutions, typically in public health acts. However, few countries have comprehensive sanitation plans or strategies for both urban and rural contexts; where plans do exist they are often specific to rural/urban contexts only and are frequently out of date. Specific policies or guidelines for management of faecal sludge and wastewater, sanitation in health care facilities and inclusion of sanitation in NAPs are also common gaps. The national policies which do exist usually note the motivating factors driving national sanitation policy development, which include:

Public health concerns. The Kiribati, Marshall Islands, Solomon Islands and the Federated States of Micronesia all reference diarrhoeal disease outbreaks as a reason for improving sanitation services. Public health systems which are already stretched or under-resourced will likely struggle to maintain or expand sanitation services against competing financial and human resource

Table 5 – Sanitation policy scorecard for the Pacific (author analysis)

Country	National sanitation policy	Sanitation plan/strategy	Right to sanitation enshrined in national consitution or legislation	Policy/plans address wastewater management and/or Faecal sludge management	WASH in Schools guideline outlining minimum sanitation standards	WASH in health care facility guideline outlining minimum sanitation standards	National Adaptation Plan or equivalent includes sanitation-specific actions
Cook Islands	Y	P	Y	Y	NA	NA	P
Federated States of Micronesia	N	P	Y	NA	NA	NA	NA
Fiji*	Y	Y	Y	Y	Y	Y	Y
Kiribati	Y	P	NA	NA	Y	NA	Y
Marshall Islands*	Y	P	Y	NA	NA	NA	NA
Nauru	Y	Y	NA	N	NA	NA	NA
Niue	NA	NA	Y	P	NA	NA	NA
Palau	Y	NA	Y	Y	NA	NA	NA
Papua New Guinea*	Y	P	Y	Y	Y	N	N
Samoa	Y	P	NA	Y	Y	Y	NA
Solomon Islands*	P	Y	N	N	Y	Y	P
Timor-Leste*	Y	P	Y	N	Y	P	P
Tonga	N	N	Y	NA	N	NA	N
Tuvalu*	P	Y	Y	N	NA	NA	NA
Vanuatu	Y	Y	Y	NA	N	N	NA

Note: Y = Yes, policy exists, P = Partially exists (e.g. draft form, rural only, out of date), N= No, policy does not exist, NA = No publicly available information, * indicates countries reporting some indicators via GLAAS.

priorities introduced by climate change.

Freshwater resource protection. Protection of scarce freshwater resources has been a primary motive for development of sanitation policy, particularly in low-lying states like Kiribati. Reduced availability or reliability of freshwater resources due to climate change impacts will amplify the need to protect the quality of such water resources.

Tourism and economy. The importance of tourism to national income in some countries, such as the Cook Islands and Fiji was a primary reason for developing sanitation policies. With the potential for climate change to impact tourism industries through more frequent climate-related disasters, negative media coverage of such disasters and through loss of attractions such as beaches and coral reefs due to rising and warming seas, sanitation services must be included as one part of integrated strategies to maintain the attractiveness of tourism in such locations.

Environmental health. Countries including the Cook Islands and Samoa highlighted the impact of sanitation on environmental health and the subsequent impacts on national economies and livelihoods, as a reason for developing sanitation policies. As they become stressed by changing climates, coastal and estuarine ecosystems will be increasingly vulnerable to the impacts of untreated wastewater.

Among Pacific countries with current National Adaptation Plans for climate resilience, only Fiji and Kiribati include sanitation-specific actions, while countries such as Cook Islands and Solomon Islands included sanitation actions in their now out-of-date Join National Action Plans or National Adaptation Programmes of Action. Examples of sanitation-related actions included in Pacific NAPs include:

- Conduct a comprehensive assessment of all sanitation infrastructure and resources needed to meet climate change projections.
- Eliminate open defecation for improved human and environmental health.
- Develop and enforce minimum standards and management plans for sanitation services.
- Research appropriate sanitation for locations at risk of climate change-related weather extremes.
- Form village water and sanitation committees and develop incentives for protecting community water sources.
- Stock emergency sanitation units for use in emergencies and disaster response.
- Strengthen sanitation infrastructure to address health, environmental and climate related risks,
- Integrate monitoring of water-borne pollution from poor sanitation into environmental monitoring programmes.

Recommendations

Pacific Island Governments should lead the development of national sanitation roadmaps that set standards and strategies to provide climate-resilient sanitation services in community, school and health-care settings.

Pacific Island Governments should include sanitation-specific actions in National Adaptation Plans and operationalise those commitments to improve sanitation services' preparedness and resilience to climate change and disasters. This includes ensuring the right technical and financial support is provided to municipal and district focal points at sub-national levels to translate policies to local implementation.

Donors, NGOs and research organisations should partner to generate relevant and high-quality evidence and data that governments need to inform sanitation planning and investment. Evidence gaps include appropriate technology and service model designs for different contexts, good sanitation governance and models and political leadership, culturally sensitive community behaviour change approaches and reliable data on climate and sanitation access.

Adequate and appropriate financing

Increased investment is required to expand and improve sanitation services through constructing and renovating infrastructure, scaling effective technologies and innovating new services and service models. However, realising a holistic and coherent sanitation service chain also requires investment in the enabling environment through investing in capacity development of actors involved across the dimensions of governance, environment and society, and the creation of a skilled and resourced workforce to design and implement the service chain. Even more immediately, investing in research, evidence generation and funding the collective action mechanisms can catalyse the strong foundations to drive sanitation services. A coordinated financing approach between governments, donors, banks and investors can catalyse the holistic change needed for sanitation services.

Achieving climate-resilient sanitation services requires not only additional investment, but more strategic coordination of funding from the diverse sources of public finance (e.g. national governments), private investors (e.g. private service providers), donors, banks and service users themselves via tariffs and household investments. Climate financing from donors is an increasingly important source of WASH financing and yet globally, only US$12 billion of US$681 billion in climate financing has gone to WASH, and only 0.1% of that has prioritised basic WASH (Water for Women, 2023a). Access to climate financing for WASH in the Pacific is often challenging due to limited number of accredited recipients, the technical rigour and data required to delineate climate projects from development projects, rigid design processes which deprioritise bespoke or community-led project approaches, and the tendency for climate financing to fund large infrastructure projects which are not relevant to many small Pacific islands (Water for Women, 2023b).

Sanitation is underfunded globally. The current funding gap for achieving universal safely-managed water and sanitation services is estimated to be roughly three times the current spending in low- and middle-income countries (Blended Finance Taskforce, 2022).

US$16 billion
Investment required to achieve universal basic sanitation by 2030 (WaterAid & Vivid Economics, 2021)

2.7%
Proportion of global overseas development assistance which is currently directed to water supply and sanitation (WaterAid, 2023)

<1/3
Proportion of WASH overseas development assistance directed to sanitation (WaterAid, 2020)

US$74 billion
Annual cost for achieving climate-resilient WASH in low income countries (End Water Poverty & WaterAid, 2021)

Figure 17 – Global financing estimates for water supply and sanitaiton

Sanitation is similarly under-resourced by many Pacific governments, especially those with the biggest gaps in sanitation service provision. A recent UNICEF Pacific (2023) study identified that approximately US$230-270 million is spent on water, sanitation and hygiene (WASH)[12] combined across 14 Pacific countries[13] , or US$20-150 per person. In Papua New Guinea and Timor-Leste, two of the most populous and most off-track Pacific countries for sanitation but which were not included in the UNICEF study, government spending on WASH is also very low at 0.09% of GDP per capita (WHO, 2023b) and 1.8% of annual budget (La'o Hamutuk, 2023) respectively. Public WASH funding in the Pacific is heavily skewed towards water services; for example, only 3% and 6.5% of government WASH budget expenditure was directed to sanitation in Vanuatu and Solomon Islands respectively (UNICEF Pacific, 2023). In Timor-Leste, as in Kiribati and Samoa, about twice as much public funding is spent on water as on sanitation. The countries with the lowest sanitation service coverage, apart from Kiribati, are those with the lowest public investment in WASH (Figure 18).

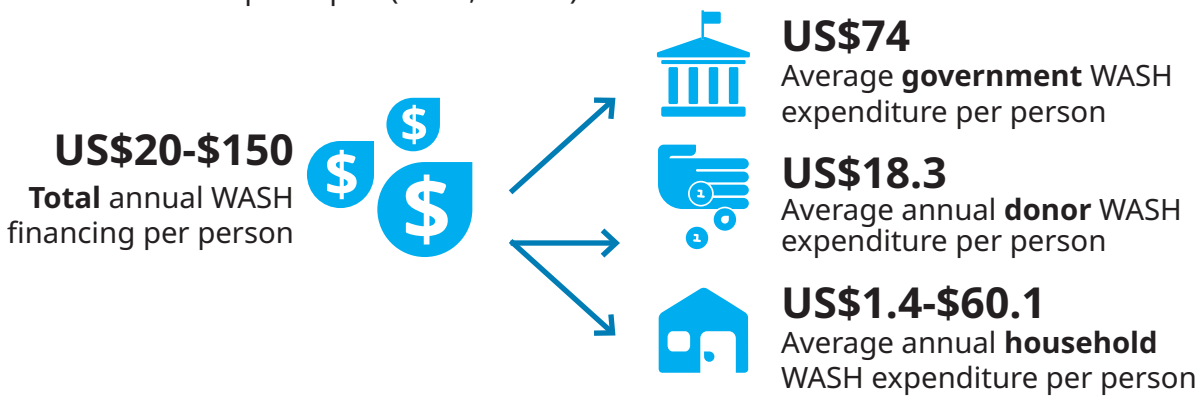


Figure 18 – Key financing figures from 14 countries in the Pacific (UNICEF Pacific, 2023)

12 Budgets and expenditure are often reported differently across countries and between funders and are not always disaggregated between water supply and sanitation. As sanitation-specific finance figures are often challenging to obtain, much of this analysis considered both water supply and sanitation.

13 The countries included in the UNICEF study vary slightly from those in this study: UNICEF excluded Papua New Guinea and Timor-Leste and included Tokelau.

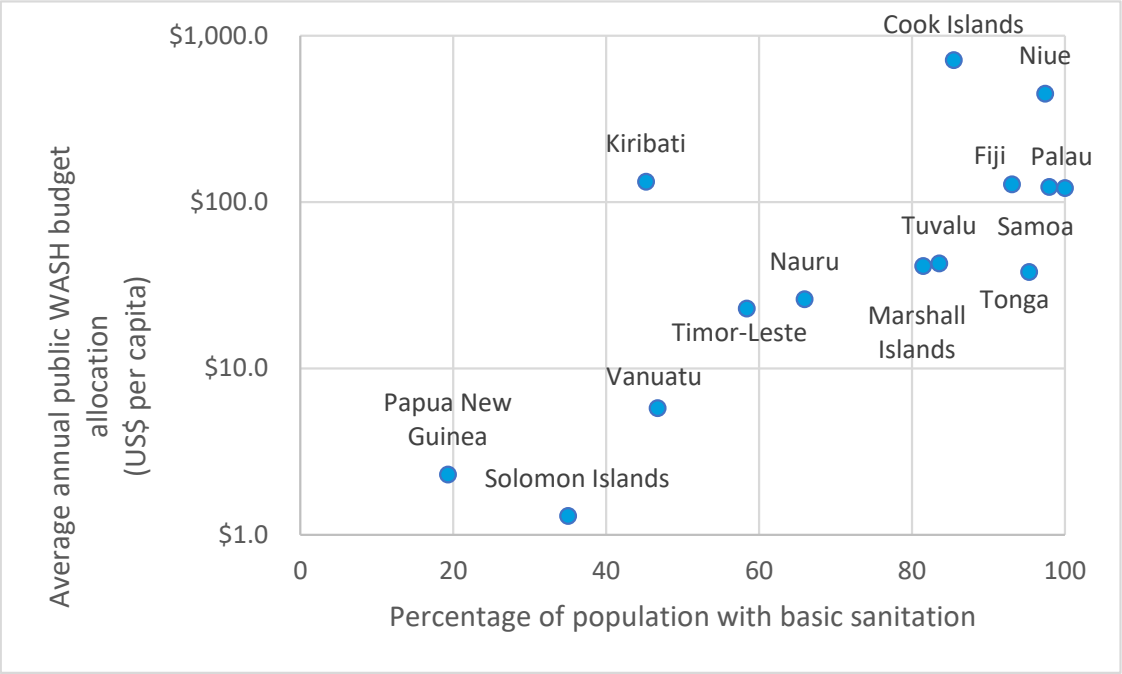


*Figure 19 – Household sanitation service levels from JMP data 2022**

* Graph produced by authors. Sanitation access data is the same as for Figure 5. Public budget data is from UNICEF Pacific (2023), with the exception of PNG (WHO, 2023b) and Timor-Leste (La'o Hamutuk, 2023). Public budget data for WASH from the Federated States of Micronesia was not available.

Donor financing for sanitation in the Pacific is not currently well-aligned with sanitation needs. The five largest recipients of donor WASH funding in the past ten years include some countries with the lowest sanitation coverage (Solomon Islands and Kiribati) but also several countries with the highest sanitation access rates (Samoa, Fiji and Palau). Donor funding to WASH in the Pacific is more evenly distributed between water and sanitation than public funding, however it is more often directed at large systems such as water and wastewater treatment plants in urban areas than basic service systems (UNICEF Pacific, 2023).

Household payments are also an important financing source for sustainable sanitation services. UNICEF's analysis showed large variations in average annual household payment to utilities for water and sanitation services, from about US$1.4 per capita in Niue to US$60.1 in Palau. These tariff variations reflect the differences in household service levels – with utility-provided sewers usually concentrated in urban areas – as well as the costs of providing these services.

Recommendations

Pacific Island Governments should increase per capita invest ments in sanitation to maximise economic, health and environmental outcomes for Pacific peoples. This is especially relevant for **Papua New Guinea, Solomon Islands, Vanuatu and Timor-Leste** which have the lowest basic sanitation access rates in the Pacific.

Pacific Island Governments should advocate for increased donor funding to be directed towards sanitation systems, including within financing commitments and Loss and Damage funding.

Donors and private sector should increase the proportion of funding dedicated to basic sanitation service systems, including within climate financing commitments and Loss and Damage funding. Basic sanitation is foundational for national development and community climate resilience.

Donors and private sector should prioritise funding to strengthen sanitation enabling environments. Donor investments in policies, regulations, community engagement, capacity and workforce development can leverage financing from government, the private sector and service users and create conditions for sanitation service models which are more financially sustainable in the long term.

Contextually-appropriate and regulatable service models

Delivery of safely-managed and climate-resilient sanitation services requires a holistic and systematic approach that considers entire sanitation chains from containment through to disposal or reuse. Issues related to the selection, design, construction and operation of technologies in the common service models in the Pacific (summarised in Annex 3) mean people and the environment continue to be exposed to hazards from human waste. While many utilities and departments responsible for sanitation in the Pacific may seek one-size-fits-all solutions for efficiency and simplicity, different service models and service chains must be designed for different climatic, geographic and social contexts – such as urban, peri-urban, rural, coastal, mountainous, remote, soil conditions and areas affected by high groundwater tables. Technologies which can respond to these contexts exist elsewhere in the world, and some are already applied in parts of the Pacific (with exceptions of twin pits, biogas generation and solids-free sewers). However, there are often practical challenges to delivering these services: finding skilled and willing contractors (see Case study 6); limited documented evidence of which service models work best in different Pacific contexts; and limited local guidance for designing and delivering services appropriately. Technologies and infrastructure used in the sanitation chain should also be robust or repairable in the face of climate change-related impacts and hazards (Willetts et al., 2022).

Addressing technology and service delivery challenges requires change at multiple levels:

- **Strategic sanitation planning of service models and responsibilities.** Setting and documenting clear expectations of which service models Pacific sanitation authorities and utilities aspire to in different contexts would help all stakeholders involved to understand their roles and responsibilities.
- **Changed perceptions.** One informant interviewed for this report noted the mistaken perception by community and authorities across the Pacific that septic tanks remove pathogens is one of the primary reasons that septic tanks are proliferating in inappropriate settings, such as areas with high groundwater or non-absorptive soils.
- **Workforce capacity and regulation.** Many on-site systems are constructed by households or masons with limited training, and without adequate regulation. This contributes to poor siting and construction of on-site sanitation facilities (septic tanks and leach fields/soak pits) and leads to significant health hazards.
- **Strengths-based user engagement and awareness.** Effective, culturally-sensitive community engagement and behavior change approaches have been documented in some Pacific contexts but in other contexts there is limited evidence of effective ways to shift community sanitation perceptions. While good practices are not necessarily transferable to other contexts because of cultural, social and geographic differences, greater cross-country sharing of experience could help to inspire new approaches to changing community behaviours. Increasing community awareness of the potential impacts of climate change and helping them develop capacity to respond and support most marginalised groups in times of disaster is also essential for community adaptation and resilience (Kohlitz & Iyer, 2021; Willetts et al., 2022)
- **Development and demonstration of new service options.** Some technologies that present sustainable or climate-resilient

options – including twin pits, solids-free sewers and biogas generation – are yet to be demonstrated in the Pacific. Other technologies such as constructed wetlands and low-cost faecal sludge drying beds for treatment have been used in some Pacific countries but present opportunities for similar contexts elsewhere. Stronger evidence and documentation of what technologies work in different Pacific contexts, guidance for improving resilience or adaptability of different technologies to various climate change impacts, criteria for selecting service models, and guidance notes for different service systems would enable decision-makers to develop better strategies and plans.

- **Affordability and accessibility** must be key considerations in service design. Technological and financial support may be needed to ensure the poorest households can afford safe and resilient sanitation, while facilities in schools, HCFs, public spaces and the households of people with a disability must include accessible designs.

Recommendations

Pacific Island Governments should convene sanitation actors in their country to clarify and document the appropriate sanitation service models for relevant contexts, including technologies, roles and responsibilities.

Pacific Island Governments should urgently accelerate access to basic sanitation services in schools and health care facilities. This is especially relevant for **Papua New Guinea, Solomon Islands and Timor-Leste.**

Donors and private sector should support capacity development of government and sanitation service providers to enable sustainable service chains that prioritise operation and maintenance and community-level ecosystem-based approaches.

Donors and private sector should invest in private sector innovation to demonstrate contextually-appropriate sanitation service models for rural, low resource settings across the Pacific.

Multi-sectoral collaboration and collective action

Universal, climate-resilient sanitation in the Pacific cannot be solved by one actor: national governments, civil society, private sector, donors and academia must work together. Active sanitation sector working groups and communities of practice in some countries in the Pacific, such as the wastewater taskforce in Vanuatu, already demonstrate collective action between government, civil society, research organisations and sanitation businesses. Such collaboration is key to establishing the sanitation enabling environment: developing and operationalising policies and plans, clarifying responsibilities, bringing experience and voices from communities to the national-level decision-making table and sharing good practice.

Pacific solidarity and collective regional efforts are key commitments made by Pacific leaders in the 2050 Strategy for the Blue Pacific Continent (PIFS, 2022). Regional mechanisms are also essential to sharing evidence and data, collective advocacy to political leaders and spreading innovations in service delivery. Women's representation in leadership and decision-making roles in Pacific countries is exceptionally low, resulting in a lack of prioritisation of women's rights and needs; collaborative sanitation efforts could adopt good practice from regional coalitions like the Shifting the Power Coalition (see Case study 2), which strengthened women's involvement and leadership in disaster preparedness and emergency response.

Recommendations

Pacific Island Governments should champion collaborative and collective regional platforms for sanitation. Regional platforms such as Pacific Water and Wastewater Association and the Pacific Resilience Partnership technical working group can enable regional capacity development, sharing of good practice and collective negotiation of environmental standards.

Donors and private sector should Fund a Pacific sanitation coalition to facilitate Pacific-wide access to technical expertise, policy development support, capacity development and knowledge exchange. The coalition could be housed within an existing organisation like SPC.

Donors and private sector should prioritise partnership-based models between sanitation and other sectors such as conservation, agriculture, nutrition and disaster risk resilience in future programs to jointly improve climate adaptation and address nexus issues such as childhood stunting, coastal ecosystem health and food security.

NGOs and research organisations should play a critical brokering role between communities, governments, the private sector and international donors. In remote low-resource settings such as the Pacific NGOs can provide a play a longer-term role by progressively strengthening sanitation service systems, facilitating knowledge exchange between actors internationally and between national and sub-national levels, providing a sense of stability and maintaining sector institutional memory.

Engaged and aware sanitation service users

Sanitation service users are not only customers or passive recipients of sanitation services. Users and community members have essential roles to play in holding service providers and authorities accountable for the human rights to sanitation and a healthy environment to which they are entitled. In many Pacific contexts – especially rural areas – community leaders such as cultural and church leaders already champion sanitation behaviours and households fund and maintain their own on-site sanitation services. However, in other contexts – such as urban and peri-urban areas, and in schools and health care facilities – the need to collectively manage sanitation services can place unreasonable burdens on community service users, volunteer committees, teachers and health care workers. In all contexts, inclusive and empowering mechanisms which encourage users to understand their rights and responsibilities, engage with decision-making and service improvement processes and utilise traditional and scientific knowledge to improve their sanitation services, represent valuable contributions to service sustainability and resilience.

Community service users are usually at the frontline of disaster response; noticing changes that indicate slow-onset hazards, preparing facilities to withstand extreme weather or repairing and cleaning up after disasters. However, users' knowledge and awareness of sanitation, climate change and disaster preparedness is often limited, and the most marginalised groups who have increased vulnerability to the impacts of climate change, often require additional targeted support to respond to disasters (Kohlitz & Iyer, 2021; Willetts et al. 2022). Strengthening the capacity and empowerment of users in climate change and disaster response has two-way benefits for climate-resilient sanitation; the provision of information to service users can improve sanitation behaviours and facility management, while utilising the knowledge of communities can inform adaptations of services to changing climate and socio-economic contexts.

Recommendations

Pacific Island Governments should consult widely and identify vulnerability hotspots to climate change risks. Social and climate vulnerability indexes can enable targeted, differentiated support to the unique vulnerabilities climate hazards present to different social groups.

NGOs and research organisations should work with communities to shift social norms and community behaviours to address sanitation-related taboos and drive equitable community-level decision making.

NGOs and research organisations should support community capacity and awareness building of the links between climate change and sanitation, disaster preparedness and response and the rights and responsibilities of sanitation users, service providers and decision-makers.

Pacific communities should hold service providers and service-providers accountable for the provision of safe and sustainable, climate-resilient services.

Pacific communities should ensure that community-level decision making is inclusive. Decision-making regarding sanitation and conservation should consider the needs of different groups, and utilise traditional knowledge and understanding of the natural environment.

The entry points and recommendations presented above also support the Pacific High-level Dialogue on Water and Sanitation's call to action from 2019 (Box 5).

Box 5: Pacific High-level Dialogue on Water and Sanitation Call to Action

In November 2019, discussions convened by the Director General of the Pacific Community (SPC) between representatives of Pacific Island countries and partner agencies prompted a call to action to:

1. Strengthen leadership on water and sanitation.
2. Increase support to strengthen local capacity for resilience.
3. Invest in evidence-based decision-making.
4. Harness advocacy for change.
5. Coordinate efforts across sectors.
6. Establish effective frameworks for action.

The call to action noted that:

- The Pacific is home to significant rural, dispersed and isolated populations that face serious water and sanitation challenges compared to their urban counterparts.
- The region's 2030 population projection would require drinking-water facilities for approximately an additional 7 million people and sanitation facilities for an additional 12 million people.
- Much of the region relies on limited and fragile water resources that require careful management and protection from human impacts.
- Pacific communities are disproportionately vulnerable to the water-related impacts of climate change and natural hazards.
- Government and community capacity to anticipate, respond to and minimise these impacts is key to community resilience.
- Despite improvements, information on access to water and sanitation across the Pacific remains relatively poor compared to other regions.

7. Summary of recommendations

A step change in sanitation access for the Pacific is only possible through collaborative, multi-sectoral approaches that set up the foundations and enabling environment for climate resilient communities and in turn, mobilise the right resources in the right places through targeted efforts. This section provides a summary of priority recommendations aimed at various stakeholder groups to accelerate climate resilient sanitation in the Pacific

Pacific Island Governments should:

Policy and Planning

- **Lead the development of national sanitation roadmaps** that set standards and strategies to provide climate-resilient sanitation services in community, school and health-care settings.
- **Include sanitation-specific actions in National Adaptation Plans** and operationalise those commitments to improve sanitation services' preparedness and resilience to climate change and disasters. This includes ensuring the right technical and financial support is provided to municipal and district focal points at sub-national levels to translate policies to local implementation.

Finance

- **Increase per capita invest ments in sanitation** to maximise economic, health and environmental outcomes for Pacific peoples. This is especially relevant for **Papua New Guinea, Solomon Islands, Vanuatu and Timor-Leste** which have the lowest basic sanitation access rates in the Pacific.
- **Advocate for increased donor funding** to be directed towards sanitation systems, including within financing commitments and Loss and Damage funding.
- **Fund initiatives to drive household investment in sanitation** through behaviour change, sanitation market development and user-pays services for wastewater and faecal sludge transport and treatment.

Service Delivery

- **Convene sanitation actors in their country** to clarify and document the appropriate sanitation service models for relevant contexts, including technologies, roles and responsibilities.
- **Urgently accelerate access to basic sanitation services in schools** to provide healthy and safe learning environments and remove barriers to educational attainment. This is especially relevant for **Papua New Guinea, Timor-Leste and Solomon Islands.**
- **Urgently rectify the dire state of sanitation in the region's health care facilities.**

Partnership

- **Prioritise sanitation in funding requests to donors especially for basic sanitation services.** Basic sanitation is foundational for national development and community climate resilience.
- **Champion collaborative and collective regional platforms for sanitation.** Regional platforms such as Pacific Water and Wastewater Association and the Pacific Resilience Partnership technical working group can enable regional capacity development, sharing of good practice and collective negotiation of environmental standards.
- **Promote integrated approaches to address childhood stunting,** across sanitation, maternal and child healthcare, food security, nutrition, education and household disaster risk resilience. This is especially relevant in **Papua New**

Guinea, Timor-Leste, Marshall Islands, Vanuatu and Solomon Islands.

User Engagement

- **Consult widely and identify vulnerability hotspots to climate change risks**. Social and climate vulnerability indexes can enable targeted, differentiated support to the unique vulnerabilities climate hazards present to different social groups.

Donors, development banks and the private sector should:

Policy and Planning

- **Fund projects to generate evidence** of effective sanitation technologies and service models in different Pacific contexts. Evidence is needed to enable better decision-making and strategic planning, and develop guidance for climate resilience of sanitation services.

Finance

- **Increase the proportion of funding dedicated to basic sanitation service systems, including within climate financing commitments and Loss and Damage funding.** Basic sanitation is foundational for national development and community climate resilience.
- **Prioritise funding to strengthen sanitation enabling environments including collaborating around co-financing approaches.** Donor investments in policies, regulations, community engagement, capacity and workforce development can leverage financing from government, the private sector and service users and create conditions for sanitation service models which are more financially sustainable in the long term.

Service Delivery

- **Support capacity development of government and sanitation service providers** to enable sustainable service chains that prioritise operation and maintenance and community-level ecosystem-based approaches.
- **Invest in innovation** to demonstrate contextually-appropriate sanitation service models for rural, low resource settings across the Pacific. This could include innovative, climate resilient technologies, circular economy approaches including waste to energy mechanisms, as well as sustainable sanitation business models.
- **Fund upgrades to wastewater and faecal sludge treatment plants,** serving urban centres in the Pacific such as Port Moresby, Suva, Honiara, Port Vila, Koror and Apia to integrate circular economy principles and resource recovery. These upgrades should be co-financed by governments and utilities where possible.

Partnership

- **Fund a Pacific sanitation coalition** to facilitate Pacific-wide access to technical expertise, policy development support, capacity development and knowledge exchange. The coalition could be housed within an existing organisation like SPC.
- **Prioritise partnership-based models** between sanitation and other sectors such as conservation in future climate adaptation programs.

NGOs and research organisations should:

Policy and Planning

- **Generate relevant and high-quality evidence and data to inform sanitation planning and investment.** Evidence gaps include appropriate technology and service model designs for different contexts, good sanitation governance and models and political leadership, culturally sensitive community behaviour

change approaches and reliable data on climate and sanitation access.

Partnership

- **Play a critical brokering role** between communities, governments, the private sector and international donors. In remote low-resource settings such as the Pacific NGOs can provide a play a longer-term role by progressively strengthening sanitation service systems, facilitating knowledge exchange between actors internationally and between national and sub-national levels, providing a sense of stability and maintaining sector institutional memory.
- **Partner with complementary organisations** (e.g. practitioners from sanitation, conservation, agriculture, nutrition) on joint programs to address nexus issues such as childhood stunting, coastal ecosystem health and food security.

User Engagement

- **Work with communities to shift social norms and community behaviours** to address sanitation-related taboos and drive equitable community-level decision making.
- **Support community capacity and awareness building** of the links between climate change and sanitation, disaster preparedness and response and the rights and responsibilities of sanitation users, service providers and decision-makers.

Pacific communities should:

Policy and Planning

- **Engage with information on climate change and community and environmental health.** Communities can use information and their own experiences to advocate to service providers and decision-makers for the investments needed to improve their community's resilience.

Service Delivery

- **Practice and promote sanitation behaviours.** Community leaders can play important roles in driving household sanitation behaviours and advocating for sanitation service improvements.

User Engagement

- **Hold service providers and service-providers accountable** for the provision of safe and sustainable, climate-resilient services.
- **Ensure that community-level decision making is inclusive.** Decision-making regarding sanitation and conservation should consider the needs of different groups, and utilise traditional knowledge and understanding of the natural environment.

8. Case studies

The following case studies provide examples of good sanitation practices, failures and lessons learnt from the Pacific and beyond. They have been selected for the insights and lessons they contain which may be useful to sanitation stakeholders in the Pacific.

Case study 1: Achieving open defecation free status in Manufahi Municipality, Timor-Leste

Key challenges: open defecation, poor sanitation behaviours

Approach: government-leadership, area-wide sanitation campaigns, community behaviour change.

Outcomes: Municipality open defecation free status

Context/Problem statement
Almost half of children under five years old in Timor-Leste are stunted (UNICEF, 2023), with diarrhoeal disease and its impact on nutrition absorption considered a key contributing factor. In Manufahi Municipality, the 2016 Demographic and Health Survey (General Directorate of Statistics, 2018) showed that only 81.2% of households had access to any type of toilet. In the two weeks prior to the survey, 6.5% of children under five years old in Manufahi had experienced diarrhoea.

Solution
Manufahi Municipality began focusing on area-wide sanitation in 2015 through an initiative to eliminate open-defecation in Holarua, the largest suco (village) in the municipality. In 2018, in consultation with the national Ministry of Health, Manufahi established an Open Defecation Free (ODF) Secretariat to coordinate municipality-wide sanitation with the Municipal Administrator – the most senior municipality authority – as the secretariat president. A representative from civil society was selected as co-vice-president of the secretariat alongside the Department of Health and the Municipal Water and Sanitation Authority. Other members of the Secretariat included Department of Agriculture, community-based organisations, Sub-district administrators, police, sub-district facilitators, suco leaders and sub-village (aldeia) leaders.

The Secretariat set a target for achieving ODF, supported by a coordinated multi-sectoral plan defining approaches, roles and responsibilities of various actors, and budgets. The Administrator publicly announced the initiative and encouraged people to prioritise sanitation, and 'institutional triggering' sessions were held with key government staff and local leaders to motivate a whole-of-government approach. Implementation of the municipal-wide sanitation initiative demonstrated the principles of the Rural Sanitation Programming Guidance (WaterAid, Plan International & UNICEF, 2019), with urban, peri-urban, well-connected rural and remote rural communities receiving contextually-targeted interventions. Activities the secretariat coordinated included:

- **Community-based behaviour change activities.** Community-led total sanitation approaches were applied in the villages with lowest sanitation coverage. Community behaviour change events linked used videos and materials from the Ministry of health's

national sanitation campaign, and government and civil society asked households to consider how the cost of a toilet compared to the household's monthly cigarette budget.
- **Market-based sanitation activities.** Sanitation supply chains and community promotion events introduced the lightweight and water-efficient SaToPan to communities which previously had no available sanitation products.
- **Monitoring and evaluation, and use of data for planning.** The secretariat established a logbook system using indicators from the national sanitation policy for sub-village leaders to track household toilet access. This data was consolidated by village chiefs and entered into a digital system at community health centres. A municipal team used this data to identify and conduct ODF verifications.
- **Gender and social inclusion activities.** Village chiefs mobilised community groups and youth groups to support the most vulnerable households to construct low-cost pit latrines. In some areas, WaterAid piloted smart subsidies for the most vulnerable households to purchase SaToPans. Community CLTS processes involved women's NGOs and included gender dialogues between women and men to discuss the sanitation burden and roles of women and men.
- **Use of incentives and sanctions.** The Administrator awarded a prize of sporting equipment to the first village to achieve ODF as a motivator. In urban areas, senior municipal department leaders actively led community engagement to convince less receptive communities. Some village leaders withheld signing of official documents for households until they constructed a toilet.

As a result, within one and a half years of beginning the sanitation initiative, Manufahi declared open defecation free. The final data showed 90.8% of households had their own toilet, with the remainder sharing their neighbour's toilet.

Lessons learnt from Manufahi's ODF achievement include:
- Strong leadership of sanitation programmes and ownership from key municipal leaders is essential.
- Involvement of all levels and departments of sub-national government is a key driver of success, but requires strong coordination and definition of stakeholders' roles and responsibilities.
- Approaches to influence community behaviour change and establish sanitation markets should be contextualised to different geographical, economic, social and cultural contexts.
- A well-functioning monitoring system and strategy can provide evidence to drive progress, planning and adaptation.
- Strong commitment from leaders and stakeholders needs to be accompanied by financial and human resources.
- A strong national policy was useful to guide the Municipal government's approach.

Case study 2: Pacific regional networks for empowerment

Key challenges: Community climate and disaster risk resilience, limited women's representation in decision-making

Approach: Network building, training, documentation and advocacy

Outcomes: empowered women leading emergency response; strengthened regional networks of women working on emergency response and disaster preparedness

Context/Problem statement
Following Tropical Cyclone Winston in Fiji, a government post-disaster needs assessment found that women and girls were among the most affected by the disaster and were left with limited resources to withstand and respond to the crisis. Women's representation in leadership and decision-making roles in Pacific countries is exceptionally low, resulting in a lack of prioritisation of women's rights and needs. The Shifting the Power Coalition (StPC) has emerged as a regional alliance seeking to strengthen the collective power, influence and leadership of Pacific women in responding to disasters and climate change.

Solution
The StPC recognises that women have the knowledge, skills and capacity to articulate their needs, lead disaster planning and increase the effectiveness and responsiveness of humanitarian action for women and girls. The StPC uses training, network building and research to empower women to lead humanitarian action and emergency response. The coalition takes a multifaceted approach to capacity building and strengthening activities, including training and peer learning opportunities, advocacy dialogues with government officials and humanitarian actors, documentation of women's experiences in disaster situations, and financial support provided through rapid response grants. The result of these efforts has seen:

- Outreach to over 40,000 women, with over 200 diverse women leaders 13 Pacific women's civil society organisations engaged across six countries through localization of good practice;
- National workshops in the six countries to develop capability and preparedness plans for emergency response that put women at the centre; and
- A regional hub established with national focal points to strengthen women's influence in regional humanitarian and disaster resilience spaces.
- Members of the coalition have taken diverse approaches to strengthen the role of women in disaster response in their countries.

Lessons learnt from the StPC that are relevant to sanitation include:

- **Peer-peer sharing and regional coalitions in the Pacific are an effective means of sharing good practice and finding context-appropriate solution.** The StPC's regional network and member-led coalition empowers members to identify and share ideas and approaches to challenges that are relevant to their contexts.
- **Resourcing women's leadership and empowerment can catalyse action at community and national level.** Women empowered and resourced by participating in StPC have developed their own visions for inclusive women's leadership in humanitarian action and emergency response. They have put their skills and leadership into action through advocacy, policy, planning and capacity-building initiatives for women involved in disaster preparedness in their own countries.
- **Coalitions should have strong and diverse leadership, representative of the organisations' values.** The StPC steering committee, as the coalition's decision-making body, includes young women, a representative of women with disabilities, and is primarily women from the Pacific region.
- **Establishing a culture of learning and providing regular training opportunities can ensure coalition members have strong technical skills.** By ensuring diverse membership, the coalition attracts a range of expertise, experience and capabilities.

Note: This case study is based on existing documentation from Shifting the Power Coalition (2019; 2021).

Case study 3: Sanitation in schools: Three Star approach to WASH in schools in Fiji

Key challenges: lack of suitable WASH infrastructure and awareness in schools.

Approach: Three Star Approach, strengthen the capacity of schools to identify needs and empowering children. Enabled through government policy, legislation and financing for effective WASH in schools.

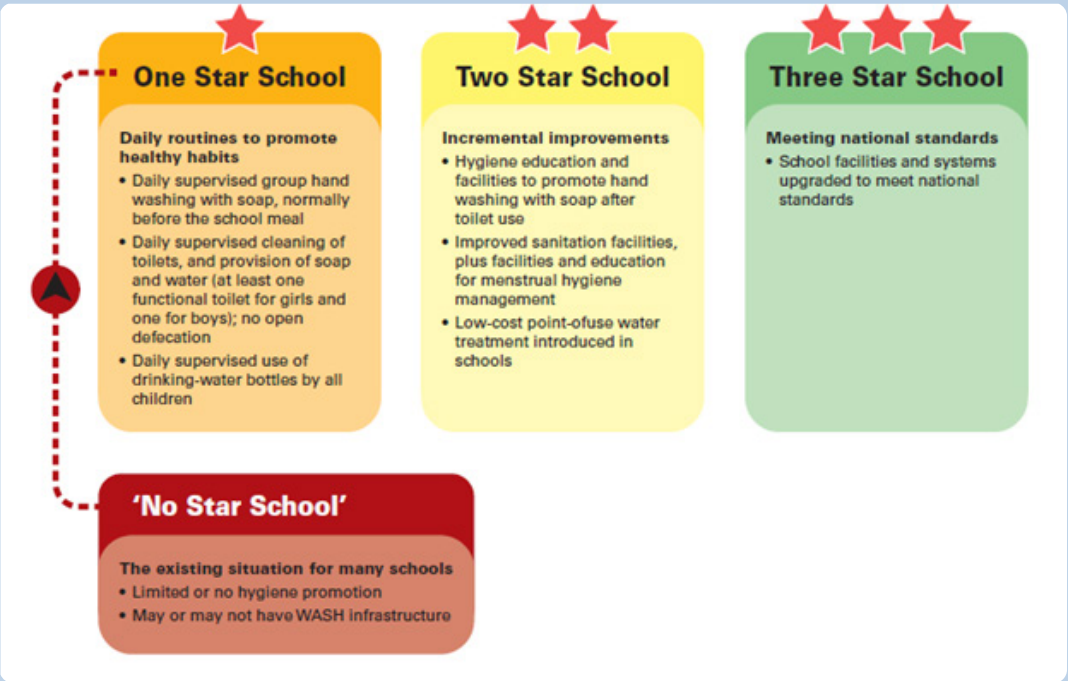
Outcomes: increased access to sanitation in schools, improved hygiene awareness and practices.

Context

Water, sanitation and hygiene related diseases are a significant challenge in Fiji. Many Fijian schools, particularly those in rural and remote areas, have insufficient sanitation facilities and poor sanitation and hygiene conditions which place children and staff at risk of disease (Fiji MoENHCA, 2012).

Solution

Fiji was the first country to implement UNICEF and GIZ's Three Star Approach for WASH in Schools (2013) in 2014. The Three Star Approach to WASH in schools is a strength-based approach designed to enable schools to deliver improvements to WASH facilities and behaviours through creating a supportive policy environment, programme design and institutionalisation of daily hygiene activities. A fundamental principle behind the approach is that expensive WASH infrastructure is not necessary to meet health goals. The three stars are designed to be low-cost so that poor communities are able to achieve hygiene, sanitation and water milestones using their own resources and progressively improve to meet national standards.



The Three Star Approach has improved WASH behaviours and practices in Fijian schools:

- Fiji exceeded their target to move 100 schools from 0 to 1 star within three years, with

212 schools achieving this improvement in WASH.
- There was evidence that students' WASH behaviours catalysed behaviour change in their families and communities.
- Some WASH in Schools indicators and data have been integrated into the Fiji Education Management Information System. Schools must report against these indicators to receive their education grants.

Lessons learnt from Fiji's WASH in Schools program include:

- **Engaging government is critically important in supporting the development and application of this approach.** Linking the Three Star Approach to government policies and plans and incorporating key indicators on WASH in Schools into national monitoring systems increases the relevance of this approach.
- **Effective community engagement increases the success of community fundraising initiatives for WASH facilities needed to achieve a two/three-star status and increases local ownership and sustainability.** Teachers, parent teacher associations and other school community-based groups can be used to push initiatives and collect and respond to feedback. For example, by employing the Three Star Approach training in conjunction with other school events the likelihood of parent attendance can be increased.
- **Provision of maintenance budgets is essential to maintain progress.** Whilst there have been substantial improvements to WASH in schools, the limited budget for ongoing maintenance of WASH facilities and infrastructure is a major challenge. Some schools in the evaluation had regressed or failed to maintain functioning sanitation facilities in the absence of adequate budget.
- **Communities should consider methods of maintaining standards between assessment periods when momentum and energy may drop.** The assessment process and associated rating scale of the Three Star Approach can promote considerable interest at the community level and drive competition between schools. However, many schools struggle to maintain the momentum and energy between assessment periods.
- **A holistic view should be taken when considering children with disabilities, including when monitoring and reporting on projects.** The Three Star Field Guide exclusively pictures people in wheelchairs when referring to inclusive WASH. There has not been sufficient consideration of the needs of children with other types of disability (for example, vision impairment or cognitive or psycho-social).
- **Planning for the impacts of climate change and natural disasters is vital to the successful maintenance of WASH improvements.** Tropical cyclones such as Cyclone Harold in 2020 illustrated the vulnerabilities of Fiji's physical infrastructure and the need to prepare for a changing climate.

Note: This case study is based on existing documentation from UNICEF (2021b).

Case study 4: A system approach to sanitation in healthcare settings in PNG

Key challenges: Limited sector momentum, absence of data on WASH in HCF

Approach: Government-led technical working group, WHO's eight practical steps to improve and sustain WASH in HCF (funded through the Australian Government's Water for Women Fund).

Outcomes: Development of national roadmap/plan to improve WASH in HCF, improved understanding

Problem statement
PNG promulgated its Water, Sanitation and Hygiene Policy in 2015, and established a national WASH coordination group to provide secretariat and administrative support to WASH implementation. However, sector collaboration and prioritisation of WASH in health care facilities was limited and for several years no progress was made.

Solution
In 2021, a technical working group (TWG) for WASH in HCF was re-formed and empowered to coordinate at the national level between the National Department of Health, Department of Planning and Monitoring, and other multi-sector stakeholders including WHO, UNICEF, WaterAid, Plan International and World Vision. The technical working group set priorities for developing national standards for WASH in health care facilities, creating monitoring and accountability mechanisms, improving workforce development and integrating WASH into healthcare planning and services.

With support from WaterAid, the National Department of Health led the TWG to write and implement a terms of reference to implement the first three steps in the WHO and UNICEF eight practical steps for WASH in HCF. The TWG meets every two months for sector coordination and to progress the national WASH in HCF agenda within the health system.

A situation analysis of WASH in HCFs in PNG (practical step 1) was conducted in 2022. Results of the analysis were used to advocate to government ministers and potential investors. Findings from the situation analysis highlighted that sanitation represented one of the biggest gaps; only 4% of HCFs in PNG had a basic sanitation service while 43% of HCFs had no sanitation service at all. The analysis identified barriers including water shortages during the dry season, limited funding and resources for the Provincial Health Authorities to improve WASH services, insufficient definition in relevant plans and policies for WASH in HCF and a lack of comprehensive WASH service standards and guidelines for HCFs.

The TWG has developed a country road-map (practical step 2) as a plan to improve WASH in HCF. It includes five priorities:

- **Governance and leadership:** improve governance, management and coordination of WASH in HCF.
- **Health facilities:** Increase the number of healthcare facilities with reliable and inclusive WASH services and strengthen the maintenance and management of WASH services and practices.
- **Workforce:** Empower healthcare workers, users and the community to maintain WASH facilities, services and practices and improve capacity of HCFs for WASH operation and maintenance, cleaning and IPC.
- **Financing:** Increase capital investment in WASH facilities that are inclusive and equitable and sufficient for needs and consider climate change.
- **Information, Research & Innovation:** Strengthen WASH in HCF information and research

The TWG is now working to develop guidelines on minimum requirements for WASH in HCF in the PNG context and supporting the inclusion of WASH in HCF data into the national WASH monitoring system. Following the practical steps has enabled the TWG to take a structured approach to identify and tackle the barriers to sanitation in HCFs. The collaborative effort has improved sector understanding on the need for sanitation in HCF, improved the sector's focus and led to tangible outcomes in a short period of time.

Lessons learnt from PNG's system approach to sanitation in HCF include:

- **With the right support, momentum for WASH in HCF can build quickly.** Key contributors to the TWG's momentum in PNG included:
    - An approved Terms of Reference which clearly defines the roles and responsibilities of WASH in HCF actors under the leadership of relevant government departments;
    - A secretariat to support the TWG's function with roles shared between government and a sector partner;
    - Funding to the secretariat to support logistics, meeting arrangements and agenda-setting;
    - Fostering personal relationships and mutual respect between sector actors;
    - Meeting documentation and regular follow-up;
    - TWG members keeping one another accountable for their responsibilities.
- **Consistency and connection are key to obtaining senior political support.** In PNG, influential political leaders were engaged by regularly inviting them to meetings and workshops, showing value by linking the work of the TWG to their departments' roles and responsibilities, and partners demonstrating practical support to implement policies and strategies at all levels
- **Plans for improving WASH in HCF must be grounded in evidence.** A situation analysis is a useful first step for understanding the status and gaps.
- **All levels of the health system should be considered.** The TWG consulted with patients and frontline health workers, provincial and national level government staff as well as staff of faith-based HCFs which service many rural areas of PNG. Consulting widely enables deeper understanding of challenges, issues and concerns throughout the health system.

Note: This case study is based on documentation from Water for Women (2023c) and WaterAid (2023).

Case study 5: Urban circular economy in Dakar, Senegal

Key challenges: water insecurity.

Approach: co-locating wastewater treatment plant, faecal sludge treatment plant and biogas generation facility near to market gardens to maximise resource recovery and reuse.

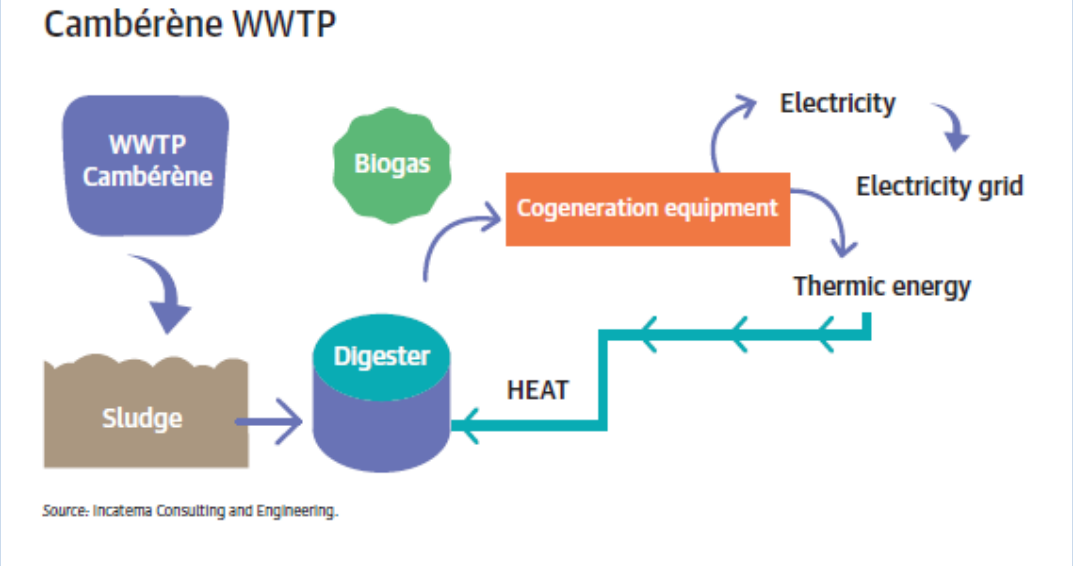
Outcomes: recovery of resources from wastewater in the form of energy (biogas), recycled wastewater, fertiliser and soil.

Context/Problem statement
Water insecurity has driven Senegal's national sanitation office (ONAS, from French) to invest in resource recovery and reuse from their wastewater and sanitation processes in the capital city, Dakar. While Dakar's population is approximately six million, only 32% of the city's population is connected to the sewerage system (122,258 connections). Wastewater is treated at 12 treatment plants and untreated wastewater continues to represent risks to human and environmental health through discharge to groundwater and the sea. Some freshwater aquifers are already so contaminated by domestic and industrial pollution that they cannot be used for drinking water.

ONAS oversees a sanitation chain serviced largely by the private sector (responsible for operation of sewered sanitation system, pit emptying, transport of waste and operation of faecal sludge treatment plants - FSTP). ONAS generates demand for connections, coordinates service issues and customer reporting, and operates wastewater treatment plants (WWTP). Sanitation policy and regulations in Senegal explicitly allow for wastewater to be reused for irrigation if it meets WHO criteria. While use of treated faecal sludge for fertilizer is not yet authorized, ONAS is working with the Ministry of Water and Sanitation to create a decree defining the terms under which this may be permitted.

Solution
The largest sanitation system in Dakar is at Cambérène, where a WWTP operated by ONAS is co-located with a FSTP operated by a private company. The Cambérène WWTP was designed to receive 19,200m3/day[14] , but currently receives about double this amount. The resource recovery operation at Cambérène includes the following:

- **Treated wastewater** from the WWTP is sold to market gardeners who grow produce near the facility. Each day 3,000m3 of the 5,700m3 of tertiary-treated wastewater from the plant is sold to farmers.
- **Biogas** produced from the wastewater sludge generates heat and power in a cogeneration system. The plant treats 480 m3 of sludge daily, and uses the biogas to reduce the plant's energy use by 28%, saving around 12% of the plant's production costs. Upgrades to the biogas and electricity generation at the plant will soon increase these savings to 60%.
- **Faecal sludge** from the facility is sold in two forms – as inert fill for green spaces, and as fertilizer for farmers and flower growers.



Although the sales of fertilizer do not yet cover costs, contracting arrangements allow the private company that operations the FSTP to keep the revenues to incentivise sales and resource reuse.

The example from Cambérène shows that there are multiple benefits from taking a circular economy approach in sanitation. ONAS obtains additional revenue from sales of products from the plant and reduces its operating costs, contributing to greater financial stability and efficiency. Local farmers gain cheaper water and soil products. The city and

14 For comparison, the Kila Kila WWTP in Port Moresby, PNG has a design capacity of 18,400 m3/day, while the Kinoya WWTP in Fiji has a design capacity of 2,400 m3/day.

environment benefit from reduced pollution and contamination of groundwater, reduced emissions and reduced reliance on chemical fertilisers.

Lessons learnt from Dakar's circular sanitation economy include:

- **Circular sanitation systems should consider the entire service chain.** The role ONAS takes to oversee the whole sanitation service chain enables it to identify and troubleshoot issues with efficiency, supply chains and private sector investment and customer experience.
- **Enabling environment and institutional willingness are essential to successful reuse projects.** National policies, political leadership and institutional leaders play roles to encourage innovation and investment in circular sanitation models.
- **Policy makers should take a holistic approach to infrastructure planning.** Financial viability of sanitation circular economies depends on suitable land area/sizing, and access to potential markets such as agriculture and industry, which are not always primary considerations for locating WWTPs.
- **Stakeholders should be engaged early to ensure reuse products from circular sanitation processes respond to expectations.** Public perceptions of reuse, product suitability, price and market stimulation require engagement beyond the sanitation sector.
- **Development Banks and ODA funding play a role to catalyse sanitation resource recovery and reuse.** By reducing the investment risks, World Bank funding enabled the pilot and start-up phases of this innovative service model.

Note: This case study is based on existing documentation from World Bank (2021).

Case study 6: Practical challenges implementing sanitation services in Fiji

Key challenges: securing contractors to implement on-site sanitation projects

Approach: open market tenders

Outcomes: on-site sanitation was not improved but useful lessons about procurement were learnt.

Context/Problem statement

In Fiji, unsafe sanitation was identified as a contributor to poor human and environmental health, causing risks to populations through typhoid fever, and harming both freshwater and coastal marine ecosystems. Water safety and sanitation planning had identified that across 29 communities, only 11-21% of sanitation services were safely managed, with poorly sited and overflowing or leaking latrines posing particular hazards.

Solution and challenges

The Watershed Interventions for Systems Health in Fiji (WISH Fiji) project aims to improve human and environmental health by improving on-site (non-sewered) sanitation services. When WISH Fiji sought tenders for contractors to construct new septic tanks across the project's communities, valued at about US$100,000, they were unable to secure contractors to complete the work and the facilities were not implemented. The project team identified several reasons that contractors were not interested: the scope of work was too small to attract large contractors; smaller contractors (e.g. plumbers) felt unable to meet the specifications to construct the tanks to national standards; the country was experiencing

a skills shortage due to outmigration for labor schemes in Australia and New Zealand; and supply chain constraints meant materials were in short supply.

Lessons learnt from WISH Fiji's experience include:

- Anticipate challenges in procuring contractors for smaller-scale sanitation projects. As Fiji is one of the larger and more economically developed countries in the Pacific, even greater challenges in finding skilled and willing contractors to engage in sanitation projects may be expected in other Pacific Island Countries.
- Training and workforce development programs are needed in countries with limited numbers of contractors who are willing and able to take on sanitation projects. Training needs to emphasise a basic understanding of sanitation infrastructure design and purpose, and technical capacity to construct infrastructure that meets minimum national standards.

Note: This case study is based on existing documentation from Wenger et al. (2023).

References

AMCOW, African Ministers' Council on Water (2021). African Sanitation Policy Guidelines. AMCOW: Abuja, Nigeria

Andriessen, N., Seitz, D., Anisie, R., Mijthab, M., Strande, L. (2023). 'Quantifying greenhouse gas savings from container-based sanitation'. Sandec News. No. 23. https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/news/news_23.pdf

Arnold, B. F., Khush, R. S., Ramaswamy, P., London, A. G., Rajkumar, P., Ramaprabha, P., ... & Colford, J. M. (2010). Causal inference methods to study non-randomized, pre-existing development interventions. Proceedings of the National Academy of Sciences, 107(52), 22605-22610.

Asian Development Bank (2013). The Economics of Climate Change in the Pacific, accessed 16 October 2022. https://www.adb.org/publications/economics-climate-change-pacific

Barrington, D. J., Sridharan, S., Saunders, S. G., Souter, R. T., Bartram, J., Shields, K. F., ... & Hughes, R. K. (2016). Improving community health through marketing exchanges: A participatory action research study on water, sanitation, and hygiene in three Melanesian countries. Social Science & Medicine, 171, 84-93.

Biran, A., Sanderson, R., Gonzalez, D., Bugoro, H., Kadir, M., Gegeo, D., Keboy, J., et al. (2022). Formative Research Using Settings and Motives to Explore Child Faeces Disposal and Management in Rural Solomon Islands. International Journal of Environmental Research and Public Health, 19(16), 9815. MDPI AG. Retrieved from http://dx.doi.org/10.3390/ijerph19169815

Blended Finance Taskforce (2022). Mobilising Capital for Water: Blended Finance Solutions to Scale Investment in Emerging Markets. https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/mobilising-capital-for-water-blended-finance-solutions-to-scale-investment-in-emerging-markets.pdf

CIA, Central Intelligence Agency (2021). The World Factbook 2021: Kiribati. Washington, DC. https://www.cia.gov/the-world-factbook/countries/kiribati/#people-and-society

Copenhagen Consensus Center & Australia Consensus Centre (2016). Post-2015 Consensus The Smartest Targets for the World 2016-2030. https://copenhagenconsensus.com/post-2015-consensus

CSIRO (2021). 'Climate change information for the Pacific'. https://www.csiro.au/en/research/environmental-impacts/climate-change/pacific-climate-change-info

Devandas-Aguilar, C. (2015). Report of the Special Rapporteur on the rights of persons with disabilities. UN General Assembly

Doorn, M., Towprayoon, S., Vieira, S., Irving, W., Palmer, C., Pipatti, R., Wang, C. (2006). IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 6: Wastewater Treatment and Discharge. IPCC.

Dutton, P. (2022). What is CWIS?. Asian Development Bank. https://events.development.asia/materials/20220223/citywide-inclusive-sanitation-vanuatu

Ellery, M. (2019). Faecal Sludge Management in Port Moresby. ADB https://www.adb.org/sites/default/files/project-documents/tacr-en.pdf

End Water Poverty & WaterAid (2021). Blueprint: financing a future of safe water, sanitation and hygiene for all. https://washmatters.wateraid.org/publications/blueprint-financing-a-future-of-safe-water-sanitation-and-hygiene-for-all

Fiji MoENHCA, Fiji Ministry of Education, National Heritage, Culture & Arts (2012). Minimum Standards on Water Sanitation and Hygiene (WASH) in Schools Infrastructure. Government of Fiji

Fleming, L., Anthonj, C., Thakkar, M. B., Tikoisuva, W. M., Manga, M., Howard, G., ... & Bar-

tram, J. (2019). Urban and rural sanitation in the Solomon Islands: How resilient are these to extreme weather events?. Science of the total environment, 683, 331-340.

Fujita, M., Inoue, R., Sato, D., Kuwahara, Y., & Yokoki, H.. (2012). Run-off Mechanism of Domestic Wastewater into Lagoon-side Coast on Funafuti Atoll, Tuvalu. Journal of Japan Society of Civil Engineers, Ser. G (Environmental Research). 68. I_121-I_125. 10.2208/jscejer.68.I_121.

Fujita, M., Suzuki, J., Sato, D. et al. (2013). Anthropogenic impacts on water quality of the lagoonal coast of Fongafale Islet, Funafuti Atoll, Tuvalu. Sustain Sci 8, 381–390. https://doi.org/10.1007/s11625-013-0204-x

GEF Pacific (n.d.). Tuvalu International Waters Ridge to Reef Project: results and lessons learned report, Pacific Community. https://www.pacific-r2r.org/sites/default/files/2022-05/Tuvalu%20IW%20R2R%20Lessons%20Learned.pdf

General Directorate of Statistics, Ministry of Finance/Timor Leste, and ICF. (2018). Timor-Leste Demographic and Health Survey 2016. Dili, Timor-Leste: GDS and ICF. Available at http://dhsprogram.com/pubs/pdf/FR329/FR329.pdf

GCA, Global Center on Adaptation (2022). State and Trends in Adaptation Reports 2021 and 2022: Executive Summaries and Syntheses. Rotterdam and Abidjan.

Government of Timor-Leste (2022). 'Timor-Leste Population and Housing Census 2022 Preliminary Results'. https://timor-leste.unfpa.org/en/publications/timor-leste-population-and-housing-census-2022-preliminary-results

Harper, J., Abdel Sattar, R., Kozole, T., Toeur, V., Rogla, J., Ross, M., Ives, N., Pruitt, H., Soneja, P., & Capone, D. (Preprint). (2023a). 'Microbial Hazards in Real-world Alternating Dual-Pit Latrines Treated with Storage and Lime in Rural Cambodia', Journal of Water, Sanitation and Hygiene for Development

Harper, J., Abdel Sattar, R., Kozole, T., Toeur, V., Rogla, J., Ross, M., Ives, N., Pruitt, H., Soneja, P., & Capone, D. (Preprint). (2023b). 'Household Perceptions, Practices, and Experiences with Real-world Alternating Dual-Pit Latrines Treated with Storage and Lime in Rural Cambodia', Journal of Water, Sanitation and Hygiene for Development

Hennegan, J., Shannon, A.K., Rubli, J., Schwab, K.J., & Melendez-Torres, G.J. (2019). Women's and girls' experiences of menstruation in low- and middle-income countries: A systematic review and qualitative metasynthesis. PLoS Med. 2019 May 16;16(5):e1002803. doi: 10.1371/journal.pmed.1002803. PMID: 31095568; PMCID: PMC6521998.

Herrera, D., Ellis, A., Fisher, B., Golden, C. D., Johnson, K., Mulligan, M., Pfaff, A., Treuer, T., & Ricketts, T. H. (2017). Upstream watershed condition predicts rural children's health across 35 developing countries. Nature Communications, 8(1), 811.

House, S., Ferron, S., Sommer, M., & Cavill, S. (2014). Violence, Gender & WASH: A Practitioner's Toolkit – Making water, sanitation and hygiene safer through improved programming and services. London, UK: WaterAid/SHARE. https://violence-wash.lboro.ac.uk/toolkit/

Hutton, G. & WHO (2012). Global costs and benefits of drinking water supply and sanitation interventions to reach MDG target and universal coverage, WHO, Geneva, 2012

IHME, Institute for Health Metrics and Evaluation (2021). Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2019 Results. Seattle, United States. Institute for Health Metrics and Evaluation (IHME), (2021). https://ourworldindata.org/diarrheal-diseases

IPCC, Intergovernmental Panel on Climate Change (2022). 'Summary for Policymakers'. H.-O. Pörtner, et al. (eds.). In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. H.-O. Pörtner, et al. (eds.). Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–33

IRCWASH (2022). 'Pay the price: what does Loss

and Damage mean for WASH?'. https://www.ircwash.org/blog/pay-price-what-does-loss-and-damage-mean-wash

Jenkins A. P., Jupiter, S., Mueller, U., Jenney, U., Vosaki, G., Rosa, V., Naucukidi, A., Mulholland, K., Strugnell, R., Kama, M., & Horwitz, P. (2016). Health at the Sub-catchment Scale: Typhoid and Its Environmental Determinants in Central Division, Fiji. EcoHealth, 13(4), 633-651

Jenkins, K. (2010). Post Cyclone Tomas Support to Typhoid fever control in Fiji March 2010, Fiji Health Sector Improvement Program: Suva

Jenkins, M. & Sugden, S. (2006). Rethinking Sanitation – Lessons and Innovation for Sustainability and Success in the New Millennium. UNDP Human Development Report.

Johnson, J., Zakaria, F., Nkurunziza, A.G. et al. (2022). Whole-system analysis reveals high greenhouse-gas emissions from citywide sanitation in Kampala, Uganda. Commun Earth Environ 3, 80 (2022). https://doi.org/10.1038/s43247-022-00413-w

Kaly, U.L. (1998). 'Monitoring training and lagoon baseline survey manual: case study – monitoring of Fanga'uta-Fangakakau Lagoon System'. Nuku'alofa, Tonga, Department of Environment.

Kar, K., & Chambers, R. (2008). Handbook on Community-Led Total Sanitation. Brighton: IDS. https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/872

Kohlitz, J., Carrard, N., & Willetts, J. (2019). 'Support Mechanisms to Strengthen EQUALITY AND Non-discrimination (EQND) in Rural Sanitation (Part 2 of 2)', Frontiers of CLTS: Innovations and Insights 13, Brighton: IDS

Kohlitz, J. & Iyer, R. (2021) 'Rural Sanitation and Climate Change: Putting Ideas into Practice' Frontiers of Sanitation: Innovations and Insights 17, Brighton IDS, DOI: 10.19088/SLH.2021.002

Kory, R., & Montgomery, I. (2020). Container-Based Sanitation Implementation Guide 1st Edition. Container-Based Sanitation Alliance, London, UK. 2020. https://cbsa.global/wp-content/uploads/2020/11/CBSA-implementation-guide-1st-edition_compressed.pdf

La'o Hamutuk (2023). 2022 General State Budget. https://www.laohamutuk.org/econ/OGE22/21OGE22.htm#PN

Macintyre, A. & Strachan, C. (2021). 'Sanitation, Hygiene and Environmental Cleanliness for Child Development' Frontiers of Sanitation: Innovations and Insights 19, Brighton IDS, DOI: 10.19088/SLH.2021.022 https://doi.org/10.19088/SLH.2021.022

Mallory, A., Akrofi, D., Dizon, J., Mohanty, S., Parker, A., Rey Vicario, D., Prasad, S., Welivita, I., Brewer, T., Mekala, S., Bundhoo, D., Lynch, K., Mishra, P., Willcock, S., & Hutchings, P. (2020). Evaluating the circular economy for sanitation: Findings from a multi-case approach. Science of The Total Environment, 744, 140871. https://doi.org/https://doi.org/10.1016/j.scitotenv.2020.140871

McMichael C. (2019). Water, Sanitation and Hygiene (WASH) in Schools in Low-Income Countries: A Review of Evidence of Impact. International journal of environmental research and public health, 16(3), 359. https://doi.org/10.3390/ijerph16030359

Mikhael, G., Hyde-Smith, L., Twyman, B.,Sánchez Trancón, D., Jabagi, E., & Bamford, E. (2021). Climate Resilient Urban Sanitation: Accelerating the Convergence of Sanitation and Climate Action. GIZ: Bonn, Germany. https://www.susana.org/_resources/documents/default/3-4343-7-1624432507.pdf

Mills, J. E., & Cumming, O. (2016). The impact of water, sanitation and hygiene on key health and social outcomes. Sanitation and Hygiene Applied Research for Equity (SHARE) and UNICEF, 112. https://www.researchgate.net/profile/Joanna-Esteves-Mills/publication/319503296_The_impact_of_water_sanitation_and_hygiene_on_key_health_and_social_outcomes_review_of_evidence/links/59afa924458515150e4b0a73/The-impact-of-water-sanitation-and-hygiene-on-key-health-and-social-outcomes-review-of-evidence.pdf

Ministry of Lands and Natural Resources (2019). National Land Subdivision Policy. Republic of Vanuatu. https://mol.gov.vu/images/

docs/Land-policy/Vanuatu_Subdivision_Policy_English_April__2019.pdf

Nasim, N., El-Zein, A., & Thomas, J. (2022). A review of rural and peri-urban sanitation infrastructure in South-East Asia and the Western Pacific: Highlighting regional inequalities and limited data. International Journal of Hygiene and Environmental Health, 244, 113992.

Nasim, N., Anthony, S., Daurewa, T., Gavidi, S., Horwitz, P., Jenkins, A., Jupiter, S., Liu, S., Mailautoka, K., Mangubhai, S., Naivalu, K., Naivalulevu, T., Naivalulevu, V., Naucunivanua, S., Negin, J., Ravoka, M., Tukana, A., Wilson, D., & Thomas, J. (2023). Understanding on-site sanitation in rural Fiji: where definitions of sanitation back-ends differ [10.1039/D2EW00685E]. Environmental Science: Water Research & Technology, 9(7), 1913-1931. https://doi.org/10.1039/D2EW00685E

Neely, K., Tam, T., Tyndale-Biscoe, P., (2021). Country-Led Formative Evaluation of Community-Led Total Sanitation in Timor-Leste (2012 – 2020). Timor-Leste Ministry of Health, UNICEF and FH Designs.

Newland, E. (2021). Technical Report: Water Quality Assessment of Fongafale Lagoon, Funafuti, Tuvalu. GED Pacific International Waters Ridge to Reef Regional Project, Pacific Community (SPC), Suva Fiji https://www.pacific-r2r.org/sites/default/files/2021-08/Tuvalu_Water%20Quality%20Assessment%20of%20Fogafale%20Lagoon.pdf

Northover, H., Kue Ru, S., & Brewer, T. (2015). Achieving total sanitation and hygiene coverage within a generation – lessons from East Asia. WaterAid.

OECD (2020). 'Creditor Reporting System', OECD, Paris, <https://stats.oecd.org/Index.aspx?DataSetCode=crs1>

OHCHR, Office of the High Commissioner for Human Rights (2015). Right to sanitation, a distinct human right – Over 2.5 billion people lack access to sanitation. 18 December 2015. https://www.ohchr.org/en/press-releases/2015/12/right-sanitation-distinct-human-right-over-25-billion-people-lack-access

OHCHR (2023) About water and sanitation. [online] https://www.ohchr.org/en/water-and-sanitation/about-water-and-sanitation Accessed 2023-02-14

PACCSAP, Pacific-Australia Climate Change Science and Adaptation Planning Program (2014). Climate extremes in the western tropical Pacific. https://www.pacificclimatechangescience.org/wp-content/uploads/2015/11/PACCSAP-factsheet_Climate-extremes.pdf

Pacific Climate Change Science (2010). Climate variability and change in the Pacific Islands and East Timor. Australian Government. https://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/PCCSP-_Climate-VariabilityChange.pdf

Pacific IWRM (2013). GEF Pacific IWRM Project Results Note, Tuvalu Public Works Department. https://archive.iwlearn.net/pacific-iwrm.org/www.pacific-iwrm.org/rsc/Pacific-IWRM-Results-Note-Tuvalu-2013.pdf

Parikh, P., Bobbins, K., Oko-Williams, A., Diep, L., Hofmann, P., Campos, L.C., Steenmans, I., Mate-Kodjo, D.W., Tomei, J., Mulugetta, Y., and Lakhanpaul, M. (2022). Cross-sectoral benefits of action in sanitation: Policy brief, WaterAid/University College London: London

Perin, J., Mulick, A., Yeung, D., Villavicencio, F., Lopez, G., Strong, K. L., Prieto-Merino, D., Cousens, S., Black, R.E., & Liu, L. (2022). 'Global, regional, and national causes of under-5 mortality in 2000–19: an updated systematic analysis with implications for the Sustainable Development Goals'. The Lancet Child & Adolescent Health, 6(2), 106-115.

PIFS, Pacific Islands Forum Secretariat (2022). 2050 Strategy for the Blue Pacific Continent. Pacific Islands Forum

Prescott, N., (2001). Environmental management plan for Fanga'uta Lagoon system. Nuku'alofa Tonga., Department of Environment, Government of Tonga.

PWWA, Pacific Water and Wastewater Association (2021). PWWA Annual Benchmarking Report 2021. https://www.ib-net.org/docs/PWWA_2021_A4s.pdf

Rand, E.C., Loughnan, L., Maule, L., & Reese, H. (2015). Management of Child Feces: Current Disposal Practices. World Bank and UNICEF. https://sanitationlearninghub.org/resource/management-of-child-feces-current-disposal-practices/

Saifaleupolu, S., & Elisara-La'ulu, F.M. (2013). Biodiversity Audits for Mangrove Wetlands in Vaimoso, Lepea, Fugalei/Sogi/Mulinu'u and Moata'a. O Le Si'osi'omaga Society Inc.

Sanitation Learning Hub (2023). Market-based approaches. https://sanitationlearninghub.org/approaches/market-based-approaches/

Santos-Andrade, M., Hatje, V., Arias-Ortiz, A., Patire, V. F., & da Silva, L. A. (2021). Human disturbance drives loss of soil organic matter and changes its stability and sources in mangroves. Environmental Research, 202, 111663–111663. https://doi.org/10.1016/j.envres.2021.111663

Shields, K.F., Barrington, D.J., Meo, S., Sridharan, S., Saunders, S.G., Bartram, J., & Souter, R.T. (2022). Achieving development outcomes by building practical authority in WASH participatory collectives in Melanesia. Water Alternatives 15(2): 363-412

Shifting the Power Coalition (2019). Pacific Case Study. https://gblocalisation.ifrc.org/wp-content/uploads/2019/09/PacificCaseStudy2019.pdf

Shifting the Power Coalition (2021). Impact Assessment Report. November 2021
SPC, The Pacific Community (2023). Population Dashboard. https://pacificdata.org/population-dashboard

TEMPP, (2001). Status of Fanga'uta Lagoon, Tonga: monitoring of water quality and seagrass communities 1998-2000. Fakatava, T., Lepa, S. T., Matoto, L., Ngaluafe, P. F., Palaki, A., Tupou, S. (Authors) Kaly, U. (Ed). Tonga National Monitoring Team, Scientific Monitoring Report #1.

Thompson, C.N., Kama, M., Acharya, S., Bera, U., Clemens, J., Crump, J.A., Dawainavesi, A., Dougan, G., Edmunds, W.J., Fox, K. & Jenkins, K. (2014). Typhoid fever in Fiji: a reversible plague?. Tropical Medicine & International Health, 19(10), 1284–1292

Tilley, E., Ulrich, L., Lüthi, C., Reymond, Ph., Schertenleib, R. & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies. 2nd Revised Edition. Swiss Federal Institute of Aquatic Science and Technology (Eawag). Dübendorf, Switzerland. https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/schwerpunkte/sesp/CLUES/Compendium_2nd_pdfs/Compendium_2nd_Ed_Lowres_1p.pdf

Toaliu, H. (2022). 'Citywide inclusive Sanitation in Vanuatu'. Asian Development Bank. https://events.development.asia/materials/20220223/citywide-inclusive-sanitation-vanuatu

Tuholske, C., Halpern, B. S., Blasco, G., Villasenor, J. C., Frazier, M., & Caylor, K. (2021). Mapping global inputs and impacts from of human sewage in coastal ecosystems. PloS one, 16(11), e0258898.

UN, United Nations (2010). The Human Right to Water and Sanitation—Resolution No. 64/292. In Proceedings of the United Nations General Assembly, New York, NY, USA, 28 July 2010; A/RES/64/292

UNDP, United Nations Development Programme (2023). 2023 Global Multidimensional Poverty Index (MPI): Unstacking global poverty: Data for high impact action. New York. https://hdr.undp.org/content/2023-global-multidimensional-poverty-index-mpi#/indicies/MPI

UNESCO (2014). Puberty Education & Menstrual Hygiene Management. https://unesdoc.unesco.org/ark:/48223/pf0000226792

UN-Habitat (2020). NATIONAL URBAN POLICY: Pacific Region Report https://unhabitat.org/sites/default/files/2020/06/pacific_nup_report_web.pdf

UNICEF (2021a). Progress on Household Drinking Water, Sanitation and Hygiene: Pacific Region and Pacific Islands 2000-2020

UNICEF (2021b). Formative Evaluation of UNICEF Three Star Approach for WASH in Schools in the Pacific. https://www.unicef.org/

pacificislands/media/3051/file
UNICEF (2023). State of the World's Children. https://www.unicef.org/media/108161/file/SOWC-2023-full-report-English.pdf

UNICEF Pacific (2023). Financing Water, Sanitation & Hygiene in the Pacific.

UNICEF & GIZ (2013). Field Guide: The Three Star Approach for WASH in Schools. http://globalhandwashing.org/wp-content/uploads/2015/03/UNICEF_Field_Guide-3_Star-Guide1.pdf

UNICEF, United Nations Children's Fund & WHO, World Health Organization (2022). Progress on drinking water, sanitation and hygiene in schools: 2000-2021 data update. New York

University of Leeds (2021). SFD Lite Report: Port Moresby, Papua New Guinea. https://www.susana.org/_resources/documents/default/3-5102-7-1666774862.pdf

UN-Water (2021). SDG 6 Summary Progress Update 2021

UTS-ISF, University of Technology Sydney – Institute for Sustainable Futures (2022). Urban sanitation and climate change: A public service at risk - Landscape study. Prepared for the Bill and Melinda Gates Foundation by University of Technology Sydney - Institute for Sustainable Futures. Authors: Juliet Willetts, Avni Kumar and Freya Mills.

UTS-ISF, Universitas Indonesia and Habitat for Humanity Fiji (2023). Coastal Climate Impact Analysis and Sanitation Hazard Assessment Framework. Prepared for the Bill and Melinda Gates Foundation. Published by University of Technology Sydney - Institute for Sustainable Futures

Wakwella, A., Wegner, A., Jupiter, S., Lamb, J., Kuempel, C., Jenkins, A., Claar, D., Corbin, C., Falinksi, K., Rivera, A., & Grantham, H. (2022). Managing Watersheds for Coral Reefs and Public Health: A Vibrant Oceans Initiative Whitepaper. Wildlife Conservative Society, 1-21.

Water for Women. (2023a). Accelerating adaptation finance for climate resilient WASH in Asia and the Pacific. https://www.waterforwomenfund.org/en/resources/en/resources-General/news/2022/Water-for-Women-BC-CRAIW-WASH-Financing-Brief-for-Donors.pdf

Water for Women. (2023b). Climate Finance for WASH: Pacific Region. https://www.waterforwomenfund.org/en/news/climate-finance-for-wash-in-asiapacific.aspx

Water for Women. (2023c). Quality, Accessible and Safe Healthcare: Lessons on Strengthening WASH in Healthcare Facilities. https://www.waterforwomenfund.org/en/news/quality-accessible-and-safe-healthcare-lessons-on-strengtheningwash-in-healthcare-facilities.aspx

WaterAid (2020). Troubled wastewaters: A review of the functionality of wastewater treatment plants in low and middle-income countries. Policy brief. London: WaterAid. https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/troubled-wastewaters-policy-brief_0.pdf

WaterAid (2023). Essential Element: Aid's continuing and critical role in financing water, sanitation and hygiene.

WaterAid & Vivid Economics (2021). Mission-Critical: Invest in water, sanitation and hygiene for a healthy and green economic recovery.

WaterAid, Plan International, UNICEF (2019). Guidance on Programming for Rural Sanitation. https://washmatters.wateraid.org/sites/g/files/jkxoof256/files/guidance-on-programming-for-rural-sanitation.pdf

Wear, S. L., & Thurber, R. V. (2015). Sewage pollution: mitigation is key for coral reef stewardship. Annals of the New York Academy of Sciences, 1355(1), 15-30.

Wenger, A.S.; Gómez-Juárez, E.; Thomas, J.; Amaya, T.; Corbin, C.; Edmond, J.; Falinski, K.; Hill, J.; Jenkins, A.; Jupiter, S.D.; Kuempel, C.D.; Lamb, J.B.; Nalley, E.M.; Omwenga, S.; Oza, T.; Perez, E.N.; Tuttle Raz, L.J.; Sarkozy-Banoczy, S.; Wakwella, A. (2023). A guide for integrated conservation and sanitation programs and approaches. Wildlife Conservation Society.

Willetts, J., Priadi, C., Ombasta, O., et al. (2022).

Co-developing evidence-informed adaptation actions for resilient citywide sanitation: Local government response to climate change in Indonesia. Environment and Planning B: Urban Analytics and City Science. May 2022. doi:10.1177/23998083221098740

WHO, World Health Organization (2013). Protecting health from climate change: vulnerability and adaptation assessment. World Health Organization https://www.who.int/publications/i/item/protecting-health-from-climate-change-vulnerability-and-adaptation-assessment

WHO, World Health Organization (2016). Protecting surface water for health: identifying, assessing and managing drinkingwater quality risks in surface-water catchments. World Health Organization https://www.who.int/publications/i/ item/9789241510554

WHO, World Health Organization (2018). Guidelines on Sanitation and Health. Geneva. https://www.who.int/publications/i/item/9789241514705

WHO, World Health Organization (2019). Water, sanitation and hygiene in health care facilities: practical steps to achieve universal access, WHO, Geneva. https://www.who.int/publications/i/item/9789241515511

WHO, World Health Organization (2023a). Burden of disease attributable to unsafe drinking-water, sanitation and hygiene, 2019 update. Geneva: World Health Organization; 2023

WHO, World Health Organization (2023b). GLAAS Data Portal. https://glaas.who.int/glaas/data

WHO & UNICEF (2015a) 25 Years Progress on Sanitation and Drinking-Water: 2015 Update and MDG Assessment. WHO and UNICEF Joint Monitoring Programme: Geneva

WHO and UNICEF (2015b). Water, sanitation and hygiene in health care facilities: status in low- and middle-income countries and way forward, WHO/UNICEF, Geneva. https://apps.who.int/iris/handle/10665/154588

WHO & UNICEF (2017). Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. Geneva. Licence: CC BY-NC-SA 3.0 IGO.

WHO & UNICEF (2020). State of the World's Sanitation: An urgent call to transform sanitation for better health, environments, economies and societies. New York: United Nations Children's Fund (UNICEF) and the World Health Organization (WHO), https://www.unicef.org/reports/state-worlds-sanitation-2020

WHO & UNICEF (2021). Progress on Household Drinking Water, Sanitation and Hygiene: Pacific Region and Pacific Islands 2000-2020. Joint Monitoring Programme. https://washdata.org/reports/unicef-2021-regional-snapshot-pacific

WHO & UNICEF (2022). Progress on WASH in health care facilities 2000–2021: special focus on
WASH and infection prevention and control (IPC). Geneva https://cdn.who.int/media/docs/default-source/wash-documents/wash-in-hcf/jmp-2022-wash-hcf-launch-optimized.pdf

WHO & UNICEF (2023). Joint Monitoring Programme. Geneva https://washdata.org/data/household#!/

World Bank. (2011). Economic impacts of inadequate sanitation in India (English). Water and Sanitation Program Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/820131468041640929/Economic-impacts-of-inadequate-sanitation-in-India

World Bank (2019a). Timor-Leste Water Supply and Sanitation Project: Project Information Document. https://documents1.worldbank.org/curated/en/165531564115415434/pdf/Concept-Project-Information-Document-PID-Timor-Leste-Water-Supply-and-Sanitation-Project-P167901.pdf

World Bank (2019b). Water and sanitation services for informal settlements in Honiara, Solomon Islands. World Bank, Washington DC. http://hdl.handle.net/10986/32758 License: CC BY 3.0 IGO

World Bank (2021). Water in Circular Economy

and Resilience (WICER): The Case of Dakar, Senegal. https://documents1.worldbank.org/curated/en/341621631221903660/pdf/Water-in-Circular-Economy-and-Resilience-WICER-The-Case-of-Dakar-Senegal.pdf

World Bank (2023). Urban population (% of total population) https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

World Bank, ILO, WaterAid, and WHO. (2019). Health, Safety and Dignity of Sanitation Workers: An Initial Assessment. World Bank, Washington, DC https://cdn.who.int/media/docs/default-source/wash-documents/health-safety-dignity-of-sanitation-workers.pdf?sfvrsn=1eee5a94_10&download=true

Annexes

Annex 1 – Climate change impacts on sanitation services, users and ecosystems

Key: Impact on sewered system Impact on non-sewered system Impact on both sewered and non-sewered systems

Climate hazard	Examples of impact on sanitation services	Examples of cascadng impact on users and ecosystems
Rising temperatures	• Sewer pipes more susceptible to corrosion • Increased odours, causing a reduction in use especially in non-sewered systems such as latrines • Higher variability in biological processes such as the anaerobic digestion of faecal sludge	• Changes in anaerobic digestion can create gases or other by-products harmful to people and the environment • Increased open defecation leading to increased risk of diarrhoeal disease • Contamination of soil and groundwater
Extreme heat	• Compromised biodegradability in composting toilets due to the lack of sufficient moisture • Threatened health and safety of sanitation workers	• Increased open defecation leading to increased risk of diarrhoeal disease
Saline intrusion	• Sewer pipes more susceptible to corrosion • Coastal cities experience sewage flooding streets as a result of wastewater backflows particularly for combined sewers	• Faecal waste pollutes environment, this can include aquifers • Spread of waterborne diseases like cholera
Sea level rise causing flooding	• Coastline wastewater treatment plants at low elevations at risk of flooding • Collapse of latrines • Faecal sludge becomes exposed • Increased groundwater level may cause pipes or septic tanks to float and then crack or become damaged when water levels are later reduced	• Increased open defecation leading to increased risk of diarrhoeal disease • Increased risk of waterborne diseases like diarrhoea or from diseases spread by insects from exposed faecal waste
Drought	• Decreased use of water-based toilets to conserve water • Decreased flow in sewers and overall functionality of sewered systems given their reliance that on water for transport, treatment, and disposal • Reduced water levels result in less flushing and more accumulation of solids in sewer pipes, resulting in partial of full blockages	• Higher pollution loads in receiving water bodies due to more concentrated sewage and reduced water levels of rivers and lakes

Climate hazard	Examples of impact on sanitation services	Examples of cascadng impact on users and ecosystems
Water supply scarcity	• Decreased use of water-based toilets to conserve water • Decreased flow in sewers and overall functionality of sewered systems given their reliance that on water for transport, treatment, and disposal • De-prioritisation of water for sanitation, as other sectors are prioritised in times of water scarcity	• Higher pollution loads in receiving water bodies due to more concentrated sewage and reduced water levels of rivers and lakes • Increased open defecation leading to increased risk of diarrhoeal disease
Extreme weather events like storms and cyclones	• Damage to wider systems that sanitation relies on, such as electricity, roads used to transport faecal waste to treatment facilities • Damage to infrastructure of sewered and non-sewered systems • Increased need and additional stress on sanitation maintenance and repair services.	• Faecal waste pollutes environment • Spread of waterborne diseases like cholera
Flooding	• Damage to wider systems that sanitation relies on, such as roads that trucks use to transport faecal waste from households to treatment facilities • Damage to infrastructure of sewered and non-sewered systems due to waterlogging and increased groundwater levels that cause unplanned movement of pipes or septic tanks • Flooding of both sewered and non-sewered systems leading to leaked faecal waste • Increased need and additional stress on sanitation maintenance and repair services	• Faecal waste pollutes environment • Spread of waterborne diseases like cholera
Heavy rains	• Increased overflows, for example, combined sewers (for stormwater and sewage) cannot cope with increased volume and either overflow or result in discharge of untreated wastewater • Damage to infrastructure of non-sewered systems • Soakage performance affected in onsite systems when soils are waterlogged • Increased blockages and breakages in sewers and non-sewered connectors	• Faecal waste pollutes environment • Spread of waterborne diseases like cholera

Annex 2 – Pacific sanitation policy scorecard detail

Country	National sanitation policy	Sanitation plan/ strategy	Right to sanitation enshrined in national constitution or legislation	Policy/plans address wastewater management and/or Faecal sludge management	WASH in Schools guideline outlining minimum sanitation standards	WASH in healthcare facility guideline outlining minimum sanitation standards	National Adaption Plan or equivalent includes sanitation-specific actions
Cook Islands	Y	P	Y	Y	N/A	N/A	P
	Cook Islands Sanitation and Wastewater Management Policy	Sanitation three year plan 2013-2016 (outdated)	Public health (sewage) regulations 2008	Public health (sewage) regulations 2008			Latest NAP not yet approved. Outdated JNAP includes specific sanitation actions
Federated States of Micronesia	N	P	Y	N/A	N/A	N/A	N/A
	(policy is a state responsibility)	FSM Infrastructure Development Plan FY2016-FY2025 (infrastructure only)	2011 FSM Govt resolution				Latest NAP not yet approved
Fiji*	Y	Y	Y	Y	Y	Y	Y
	Draft National Water Resources Management and Sanitation Policy, Rural Water and Sanitation Policy	Water Authority of Fiji - 5yrs Master Plan	Section 35. Right to housing and sanitation	National Liquid Trade Standard	Minimum standards on water, sanitation and hygiene (wash) in schools infrastructure		Includes specific sanitation actions
Kiribati	Y	P	N/A	N/A	Y	N/A	Y
	National Sanitation Policy	South Tarawa water and sanitation roadmap 2011			National Infrastructure Standards for Primary Schools, 2011 Also, curriculum for WASH education in primary schools		Includes specific sanitation actions

Marshall Islands*	Y	P	Y	N/A	N/A	N/A	N/A
	RMI National Water and Sanitation Policy	RMI National Water and Sanitation Policy Action Plan 2014 (draft annexed to the policy)					Latest NAP not yet approved
Nauru	Y	Y	N/A	N	N/A	N/A	N/A
	National Water, Sanitation and Hygiene Policy, 2012	National Water, Sanitation and Hygiene Implementation Plan, Draft 2012					Latest NAP not yet approved
Niue	N/A	N/A	Y	P	N/A	N/A	N/A
			Public Health, Ordinance	Some clauses in Environmental Act 2015 and Reg 2017-01 Water Regulations 2017.			Latest NAP not yet approved
Palau	Y	N/A	Y	Y	N/A	N/A	N/A
	Water Policy for the Republic of Palau		Public Health, Safety and Welfare Title 34 1966	Wastewater treatment and disposal regulations, Public Health, Safety and Welfare Title 34 1966			Latest NAP not yet approved
Papua New Guinea*	Y	P	Y	Y	Y	N	N
	National WASH Policy 2015-2030	Rural WASH Sector Development Plan (Draft)			Policy and Standards for WaSH in Schools 2018-2023	Currently in development	Minimal references to sanitation

Samoa	Y	P	N?A	Y	Y	Y	N/A
	Sanitation policy (draft, 2009)	Water and Sanitation Sector Plan 2016-2020 (outdated)		Samoa Water Authority (Sewerage and Wastewater) Regulations	Minimum Service Standards for Primary and Secondary schools in Samoa, National Building Code	National Building Code	Latest NAP not yet approved
Solomon Islands*	P	Y	N	N	Y	Y	P
	RWASH Policy, 2014 (rural only)	National Water and Sanitation Implementation Plan 2017-2033			National Standards for School WASH Facilities		Latest NAP not yet approved. Outdated NAPA includes specific sanitation actions
Timor-Leste*	Y	P	Y	N	Y	P	P
	Timor-Leste National Basic Sanitation Policy, 2012	Timor-Leste water sector assessment and roadmap			WASH in Schools Guidelines for Timor-Leste	Guideline in draft	Sanitation is mentioned as a priority and vulnerable service but listed actions focus on water
Tonga	N	N	Y	N/A	N	N/A	N
			Public Health Act				Does not appear to reference sanitation
Tuvalu*	Y	Y	Y	N	N/A	N/A	N/A
	Tuvalu sustainable and integrated water and sanitation policy 2012-2021	Implementation plan for tuvalu sustainable and integrated water and sanitation policy 2012-2021	Public Health Act	Tuvalu sustainable and integrated water and sanitation policy 2012-2021			Latest NAP not yet approved
Vanuatu	Y	Y	Y	N/A	N	N	N/A
	Sanitation and Hygiene Policy	Sanitation and Hygiene Policy	Public Health Act 1994		Currently in development		Latest NAP not yet approved

Note: Y = Yes, policy exists, P = Partially exists (e.g. draft form, rural only, out of date), N= No, policy does not exist, NA = No publicly available information, * indicates countries reporting these indicators via GLAAS.

Annex 3 – Common sanitation technologies, applications and lessons for the Pacific

This review has focused more on sanitation service systems rather than individual sanitation technologies and their appropriateness in different Pacific contexts, however technology-related insights, concerns and opportunities have consistently emerged. Without attempting to be exhaustive, this table summarises some of the technology-related issues and service models relevant to the Pacific, drawing on a compendium of sanitation technologies and infrastructure systems produced by IWA and EAWAG (Tilley et al., 2014).

Sanitation Service Chain	Relevance in the Pacific	Common Challenges	Opportunities
Single Wet/ Dry Pit Toilet > Human-Powered Emptying > Treatment (?) > Disposal/Reuse	Common in rural areas, especially inland and mountainous areas.	High likelihood that households may empty pits and dispose/reuse waste as fertiliser without sufficient treatment, exposing the community to health hazards. As with pour-flush toilets (below), wet pit toilets are not always an appropriate technology but there is seldom guidance available for selecting and designing locally-appropriate sanitation systems. In Fiji and Timor-Leste, where coral or limestone blocks are commonly added into pits to increase treatment effectiveness and pit lifespan, demand for coral contributes to coral reef destruction.	
Pour-flush Toilet > Septic Tank > Leach Field/Soak Pit + Human/ Motorised Sludge Emptying > Sludge Treatment > Disposal	Pour-flush latrines connected to a single offset soak pit are widespread in rural and peri-urban areas. Common in some urban areas, for example in Kiribati, Solomon Islands, Timor-Leste	Pour-flush toilets are not always an appropriate technology (e.g. soak pits and leach fields require unsaturated and absorptive soil conditions) but there is seldom guidance available for selecting and designing locally-appropriate sanitation systems. Many household systems are not appropriately designed or sized, or do not function as designed. Key reasons include: • Poor design and installation by people who are unfamiliar with septic tank and leach field/soak pit's intended treatment processes. • Poor consideration of local hydrogeology (as above). • Households frequently perforating septic tanks to enable wastewater to soak directly into the soil to reduce tank emptying frequency (Nasim et al. 2023). • The impacts of poorly designed and constructed septic tanks include: • Effluent overflow during heavy rain and high tides in low-lying atolls. • Environmental health hazards on saturated soils around latrines.	Training of masons, standardisation and quality assurance for better system design and construction are primary opportunities. Twin offset pits may represent an alternative treatment technology to septic tanks in some Pacific contexts, and have been widely used in other contexts like Cambodia and India. Studies by iDE on affordable twin pit technology in Cambodia have shown that two thirds of pits which were treated with lime and left in situ for two years achieved E. coli levels which are not considered to pose a public health risk if emptied with specific equipment and technologies (Harper & Abdel Sattar (Preprint), 2023a). However, reliance on household treatment practices and behaviour require ongoing follow-up (Harper & Abdel Sattar (Preprint), 2023b). In the Pacific offset pits are seldom codified and frequently perceived as unsanitary. More data and greater understanding of the local hydrogeological conditions is also often needed.

		• Microbiological contamination of groundwater in Kiribati, Marshall Islands, Tuvalu, Timor-Leste, Tonga and Vanuatu, and algal blooms in Samoa. • In urban areas (e.g. Honiara and Port Moresby), frequent emptying of clogged or overflowing septic tanks and soak pits by vacuum trucks. Without adequate destinations for untreated effluent, there is a risk that it is dumped in locations that endanger human and environmental health. In water-scarce contexts like Funafuti, Tuvalu, toilets have historically represented 30% of national water use and during droughts families frequently return to open defecation to preserve water resources for drinking and cooking (Pacific IWRM, 2013). In many Pacific countries, and especially on outer islands and smaller rural communities there is an absence of dedicated or affordable faecal sludge removal and treatment facilities.	Solids-free sewers could provide conveyance options in urban and peri-urban areas, or areas with high groundwater tables. Following on-site pre-treatment (i.e. well-designed and effective septic tank), a solids-free sewer network can convey wastewater to a centralised treatment facility. Because they do not have a minimum flow velocity and are less prone to clogging, solids-free sewers represent a more climate-resilient technology (Fleming et al. 2019). This technology has been recommended for upgrading informal settlements in Honiara (World Bank, 2019b; Fleming et al. 2019) and may be relevant in other urban contexts such as Port Vila, Port Moresby and Suva. For rural areas, low-cost and low-tech solutions to faecal sludge management for rural areas need to be developed and scaled.
Pour Flush Toilet > Sewer > Centralised Treatment > Disposal	Common in urban areas of the Pacific, especially Fiji, Marshall Islands, the Federated States of Micronesia, Palau and PNG.	Some sewered systems pose environmental health risks due to inadequate treatment. In Marshall Islands and Nauru untreated wastewater is discharged to the open ocean while in the Federated States of Micronesia, PNG and Vanuatu wastewater treatment plants have at times failed to treat all effluent sufficiently.	Expansion of sewer services to other urban areas, and informal settlements or peri-urban areas. Upgrade of larger centralised wastewater treatment plants for resource recovery using biogas electricity generation and fertiliser production.
Urine Diverting Toilet > Composting Chamber > Human-Powered Emptying > Disposal/Reuse	Several trials of composting toilets have occurred in areas with scarce water or groundwater tables, especially in Tuvalu, Kiribati and Vanuatu.	Behavioural and attitudinal barriers (preference for water use, unwillingness to handle compost, burden of collecting organic matter such as leaves) have limited the sustainability of these systems in the Pacific. For example, despite nation-wide roadshows and promotions, community construction training workshops and meetings with community groups, the development of a government-endorsed manual and reaching 5% of the population with composting toilets, one of the longest-running trials – in Funafuti, Tuvalu – was ultimately unsustained due to household preference (GEF Pacific, n.d.). Similar challenges have been observed in Kiribati and Nauru.	Communal composting toilets are currently being piloted in an informal urban area of Port Vila, Vanuatu, by Engineers Without Borders Australia and the Erakor Bridge community. The pilot has overcome some of the barriers to sustainability through strong community ownership and buy-in, patronage from a nearby community hall, and consistent supply of sawdust from local carpenters. Container-based sanitation (CBS) services, used in similar settings to composting systems, are typically designed as a full service. Service providers (rather than households) handle the waste, treat it and use it to produce resources such as compost or briquettes. While CBS may face similar barriers to community acceptance, the role of the individual service provider may overcome some challenges. Adequate treatment by the service provider or at a wastewater/faecal sludge treatment plant would be essential.

WaterAid/Dion Komnbeng

washmatters.wateraid.org

WaterAid