RESEARCH BRIEF

Methods and key findings from 2023-2024 Research Project:

Inclusive and climate-resilient urban WASH in Melanesian informal settlements

JANUARY 2025

International WaterCentre · Griffith University Queensland, Australia · USP The University of the South Pacific · The University of Papua New Guinea · UACS urban analytics & complex systems · WaterAid · Water For Women · Australian Aid

Key findings and recommendations

As reported in the following sections, our research presents the following key findings:

WASH services in informal settlements are inadequate and highly vulnerable to hazards. Many urban informal settlements (UIS) residents access water and sanitation services that is not safe and not meeting their needs, which is having impacts on their lives every day. Often, these services more exposed to climate and local hazards than those in formal urban areas. Official data underestimates these gaps, as UIS realities are often hidden in urban averages.

Climate impacts are exacerbated in urban informal settlements by local (onsite) hazards and substandard water and sanitation infrastructure. In urban informal settlements, the effects of climate-linked hazards are exacerbated because of the presence of additional local hazards, and the reliance on sub-standard water / sanitation infrastructure.

UIS residents require different service models than formal urban or rural populations. Due to land tenure constraints and infrastructure challenges, UIS tend not to be served through traditional urban utilities or rural community-managed systems. Services in informal settlements typically consist of a hybrid service chain comprising formal, recognised elements and informal, self-managed systems.

Lack of UIS-specific data hinders effective planning and service delivery. The absence of disaggregated data for UIS makes it difficult to assess the true scale of WASH challenges and design appropriate responses. Without targeted monitoring, UIS communities remain invisible in policy and planning.

Several factors influence the resilience of water and sanitation systems, including but not limited to:

- Backup water sources are critical during disruptions, but their quality and accessibility vary.
- Proximity to Infrastructure: Distance from roads and services affects maintenance and resilience.
- Facility type: Pit toilets and external water sources are particularly vulnerable to extreme weather damage.

Based on our research, our key recommendations for policymakers, utilities and those with decision-making powers with regards to WASH in urban informal settlements include:

1. Improve WASH data collection and monitoring for UIS communities.
2. Develop climate-resilient water and sanitation services tailored to UIS realities.
3. Advance the planning support systems that take advantage of latest technologies, datasets and ability to integrate diverse information are required for climate resilient water and sanitation.
4. Recognize UIS residents as a distinct customer group in utility service models.
5. Strengthen engagement between utilities, UIS communities, and support organizations.

These recommendations are detailed further at the end of this report.

Project overview

The ***Planning for Climate-resilient Water, Sanitation and Hygiene (WASH) in Urban Informal Settlements*** research aimed to strengthen WASH and interrelated governance systems – particularly, planning support systems such as spatial models, decision-support-schemas, local knowledge and community participation – used to make decisions about which WASH service delivery models (SDMs) will be climate resilient, socially inclusive and suited to the local context. Irrespective of the tenure status of urban residents across Melanesia, everyone has the right to access adequate and inclusive WASH services. Increasingly, adequate WASH services must be resilient to the effects of climate change and shocks in order to maintain ongoing access.

The overarching research question was *"How can the climate resilience and social inclusion of WASH services in urban informal settlements be strengthened with locally adapted climate science and knowledge, planning support systems and champions?".*

This study provides regionally contextualised evidence about what kinds of processes, tools and systems could be explored within different urban contexts in Fiji, Vanuatu, and Papua New Guinea (PNG).

Through the research, we aimed to understand what WASH resilience in informal settlements in these Melanesian contexts looks like, who can contribute to this resilience and in what effective ways through urban planning and WASH planning.

Water for Women Fund

Water for Women supported improved health, gender equality and well-being in Asian and Pacific communities through climate-resilient and socially inclusive water, sanitation and hygiene (WASH) projects and research.

Water for Women was the Australian Government's flagship WASH international development program and was delivered in 16 Asia Pacific countries, investing AUD159.9 million over seven years from 2018 to 2024.

Water for Women partnered with civil society organisations to deliver 20 WASH projects across South Asia, South East Asia, and the Pacific. Fifteen of these projects pivoted for the last two years of the Fund to focus on identifying and responding to climate risks to strengthen community climate resilience through WASH.

Research was also an important element of Water for Women. Water for Women partnered with research organisations to undertake a total of 20 research projects over the course of the Fund, which addressed knowledge and evidence gaps for inclusive WASH service provision and strengthened climate resilience. They aimed to raise the bar for gender and socially inclusive research, analysis, design, and program delivery in WASH, and in doing so, to inform practice globally.

Research partnership & purpose

This research brought together a multidisciplinary team of local and international researchers and analysts, and consulted with CSOs, FBOs and government actors who combined expertise from WASH, environmental science, anthropology, data science, and community engagement, particularly in the Pacific. The research was led by a partnership of International WaterCentre at Griffith University and The University of the South Pacific in Fiji and Vanuatu, with professionals and academics from the University of Papua New Guinea, WaterAid PNG, and UACS Consulting.

Research approach and methods

The climate-related hazards that pose the greatest risks to safe and inclusive WASH services for urban informal settlements vary by location. In Suva, Fiji, and Port Vila, Vanuatu, the primary climate hazards identified in this study include flooding, landslides, cyclones, storms, and coastal inundation caused by rising sea levels. In contrast, Port Moresby faces a different challenge, with drought—driven by reduced rainfall and with impacts on water security—being the most significant climate-related hazard.

Using a mixed-methods approach, with the key methods listed in Figure 1, the research activities were designed to understand existing WASH services and preferences, urban planning approaches and the existing political economy of the provision of urban WASH.

Settlements (case study locations)

Objectives

- Water & sanitation services
- Impacts of WASH services
- Local knowledge and experiences with respect to service and resilience
- Local and climate hazards

Methods

- Household survey
- Focus Groups – targeted issues
- Water quality monitoring
- Participatory GIS mapping of hazards
- Mapping and risk assessments - piped water inside settlements

Spatial data (remote sensing, open sources)

- Settlement locations and exposures
- Local and climate hazards (flooding, sea level rise)

Planning tools

- GIS to integrate and understand w/s services and resilience
- Localised framework of resilience of different water and sanitation services
- Participatory / collaborative planning (case study application – Fiji)

Political economy

- Public media content analysis – what are people in society saying, what are leaders saying?

FIGURE 1: METHODS AND KNOWLEDGE SOUGHT

Rationale for the research

Urban populations are growing across Melanesia, with migration into cities increasing as people pursue economic, educational, healthcare and recreational opportunities. High population growth, combined with rural to urban migration, has seen high urban growth rates in most countries, even though in percentage terms the proportion of urban population is low, with the exception of Fiji which was 57% in 2021 (World Bank, 2021a). Although data are limited The World Bank estimates urban growth rates for PNG, Solomon Islands and Vanuatu are between 2.7 and 4.3% annually (World Bank, 2021b).

In the absence of, or where limited supply of affordable housing exists, much of this urban growth will occur in informal settlements, though there are some examples of identified areas of housing growth, such as in Luganville, Vanuatu. Informal settlements are defined by the United Nations as lacking secure land or housing tenure, generally non-compliant with planning and land use regulations, often on marginal or hazardous land, and lacking access to infrastructure and service (UN Habitat, 2015).

While conditions vary amongst informal settlements both within cities and across cities in Melanesia, water, sanitation, and hygiene (WASH) services and access in urban and peri-urban settlements has historically been less adequate than other urban dwellers (Souter & Orams, 2019). There has been some progress made: Fiji is currently formalising 46 settlements across the country including service provision, Solomon Water has connected over 2,800 households in settlements to piped water in the last year, PNG's 2021 Port Moresby Urban Development Plan describes their ongoing settlement upgrade process, and Vanuatu's urban wastewater taskforce is considering sanitation in urban settlements (Sanderson et al., 2022) Notwithstanding, attention and priority of public investments and external funded projects (e.g. ADB) for on-site or pro-poor projects in sanitation, in particular, remains very low (Schrecongost, Pedi, Rosenboom, Shrestha, & Ban, 2020)

Addressing the inaccessibility of safe water and sanitation services for residents of urban informal settlement in Melanesia has become increasingly urgent both due to their rapid growth as a proportion of city populations, and because of increasing vulnerability of existing unsafe services to climate change impacts. In some cases, growth in informal settlements is directly the result of climate change effects; people seek to escape an environmental hazard including disasters, slow-onset climate-related changes like sea level rise, or degradation of the natural resources of an area (French, Trundle, Korte, & Koto, 2021).

One of the identified contextual differentiators for settlements in the Pacific compared to other areas of the world are the prevalence of settlements that occurs on customary owned land. In general, settlements on State owned land have the potential to be addressed in a more systematic and straightforward manner (since it is the State who would set policy and also be the key for engagement). The State can, in essence, decide on a set of standards for service delivery that they want to support/enforce on their land, and then go through an in-situ upgrading process. However, settlements on customary or Church land have an added layer of 'governance' or influence/power. Additionally, at times there can exist a perverse incentive against enforcing standards or upgrading conditions, as once this is done there are examples of the existing settlement residents being evicted in favour of more formalised, or higher-paying residents.

Research Activities

Literature review - Integrating urban planning with urban WASH in settlements

Planning policy and context

Several critical gaps in planning systems and the political economy for climate-resilient WASH in urban informal settlement are emerging from current research. In Melanesian cities, urban planning processes are generally outdated, fragmented and reactive, and fail to address WASH service delivery. WASH and climate resilience are often overlooked in planning for informal settlements (when that does occur), and challenges with responsible entities having access to sufficient and timely data, as well as political constraints, can hinder thorough policy that is implemented. Urban WASH services are typically managed by commercial or state-owned enterprises, leading national and municipal governments to see their role as limited. Most national WASH policies prioritize rural and peri-urban areas, often excluding urban informal settlements. As a result, commercial enterprises may avoid expanding services into these areas due to perceived non-commercial viability, compounded by challenges related to land tenure and rights, leaving informal settlements underserved. Stakeholders in Suva and Port Vila frequently highlight the fragmented roles and responsibilities in providing water and sanitation services to urban informal settlements. However, interviews reveal that collaboration and inter-agency consultations are taking place, including discussions related to these settlements.

There is evidence and growing support globally for the urgent need to better integrate WASH into urban planning, and for shifting the focus from hardware options to how a city's service delivery system functions and the resulting outcomes (Schrecongost et al., 2020). City-wide Inclusive Sanitation (CWIS) is one framework for this, however in the context of Melanesian informal settlements, approaches must be adaptive, mixed and incremental.

What do we mean by urban planning?

Generally, urban planning is about managing urban land, infrastructure and services to achieve the desired goals of stakeholders (Healey & Hillier, 2010). It is a future-focused practice of public action to bring together knowledge, with values, to choose land uses and activities across the urban footprint (Friedmann, 1987; Selman, 2005). Key to planning are processes of social learning, integration and situated justice (Morgan et al., 2022). More broadly, planning processes can be applied to a wide range of different subject matters involving diverse stakeholders, inviting crossover and interplay of planning for different purposes within urban areas to achieve common objectives (Figure 3).

Figure 2: Interplay of planning for different outcomes

Informal planning

Informal planning is collective decision-making over land use, made outside of the government. Communities in urban areas often work together, perhaps through customary protocols or informally engaging with formal systems, to achieve their desired outcomes; in developing countries these can be formalised through international donor programs (Healey & Hillier, 2010; Miraftab, 2009; Thorpe, 2017).

Informal planning often takes place at a community level, and in response to either a perceived failure of, or weak presence, of formal planning. Community decision making on land use is common in rural areas across the Pacific where customary land ownership and *Kastom* requirements determine land uses, even though these are usually not in the form of formalised rules (Farran, 2017; Jupiter, 2017). In rapidly expanding urban areas with poorly regulated development, a 'free-for-all' unplanned approach can emerge, and commonly, informal settlements.

A further expansion of informal planning is more active informal planning, which can be a way to empower communities to make decisions about land uses outside of government requirements (Miraftab, 2009; Thorpe, 2017). In underserved urban areas, such an approach could help communities identify and secure their chosen WASH service.

Participatory and collaborative planning

Land use planning has seen a shift from highly technocratic and government centralised process towards more participatory and collaborative planning (De Leo & Forester, 2017; Forester, 2007; Friedmann, 2011; MacCallum, 2008; Whittemore, 2015). The aim of this is to increase legitimacy, encourage compliance, and to achieve better outcomes by including a wider range of values and knowledge. Participatory and collaborative approaches recognise the complexity and uncertainty involved in decisions, as well as power relations – which can easily lead to control of planning systems by one or more special interests.

Planning Support Systems and tools

Planning is usually seen as a process, with a classic description of it being a process of turning knowledge into action. To aid the process, a range of planning support systems (PSS) have been developed (Geertman & Stillwell, 2004, 2012). Key to this is the use of spatial data because land use planning is ultimately a spatial approach, and so, growing GIS capabilities and technologies have enabled improved spatial data usage and analysis.

The role of these PSS is usually: (1) to provide a platform to share and communicate (spatial) information and (2) to provide analysis and potential solutions to problems (e.g. through optimisation). PSS can prove useful to share knowledge, both technical and local – using maps can help non-experts link to their urban space with local knowledge. In this context, participatory GIS approaches have become increasingly common (Brown, n.d.; Nackoney et al., 2013). However, spatial tools can require significant expertise and risk being 'black box' approaches that can give an appearance of a scientific solution, especially if they are used with limited knowledge of the analysis. Note they are also always dependent on the quality and accuracy of data input, and this is another reason there is a growing focus on participatory approaches – to ensure the validity if data input to PSS. Development and use of PSS in collaborations can harness both their use in communication and significant analytical capability.

HOUSEHOLD SURVEYS AND INTERVIEWS ON WASH ACCESS, EXPERIENCES WITH HAZARDS, AND IMPACTS

Households in nine urban informal settlements (UIS) in Suva and Port Vila (Figure 4) were surveyed to understand their access to, and experience with water and sanitation services/facilities.

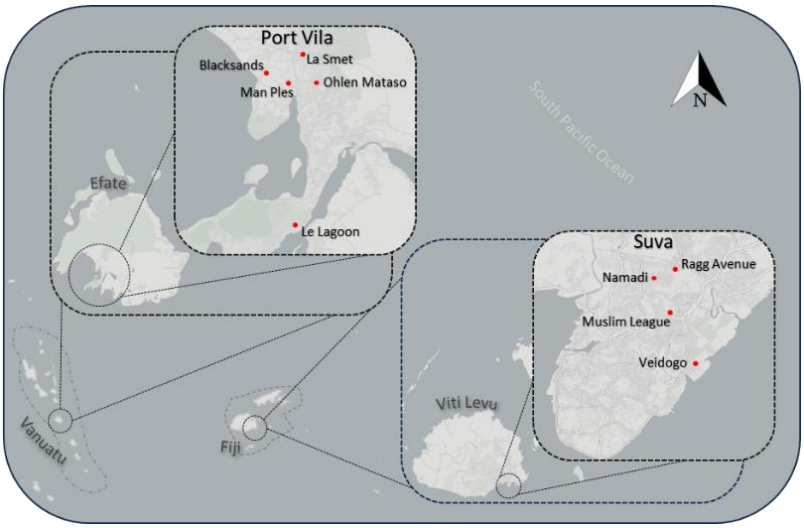


FIGURE 3: SETTLEMENTS IN PORT VILA AND SUVA THAT WERE ENGAGED IN THE RESEARCH

The objectives of the household survey were to:

- understand, quantify, and map the water and sanitation service delivery models within underserved settlements
- explore and record residents' technological preferences, familiarity, and challenges in operating, maintaining, and repairing systems
- discern susceptibilities to hazards intensified by climate change, along with residents' perceptions concerning climate change's impact on water and sanitation systems.

The household surveys were conducted between September and November 2023, during the Spring season, covering 396 households in nine underserved urban areas or informal urban settlements in Suva, Fiji (216), and Port Vila, Vanuatu (179). This represented a variable sample size per settlement, ranging from an (estimated) 20-35% of settlement households.

Survey sites were selected aiming to represent the diversity of natural environmental (e.g., type of terrain, slope, proximity to water resources and coastline), built environment (e.g., land tenure, land ownership), and human (e.g., ethnic groups) characteristics within the urban areas of the Fijian and Vanuatu capital cities. Formal and planned urban areas were not covered in this study. Information about natural and built environment, and human characteristics were acquired through desktop assessments and site visits before location selection.

The survey was conducted by a team of six local research assistants. Ensuring gender parity, team members were proficient in relevant local languages besides English (Bislama, iTaukei, Hindi), and survey questions were translated into these languages prior to conducting fieldwork. The structure of the survey questions is shown in Figure 5. Field researchers underwent comprehensive training in research ethics and water and sanitation systems. The sample design was a clustered random sampling – coverage of the entire settlement area avoiding neighbouring households.

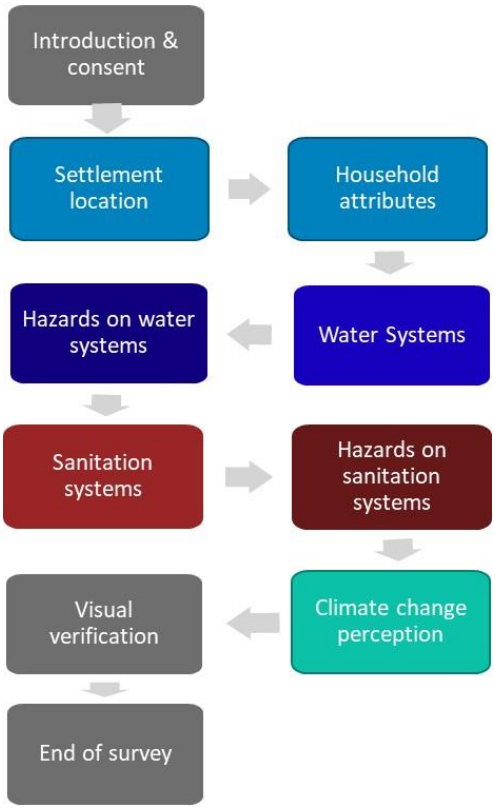


FIGURE 4: SCHEMA OF THE HOUSEHOLD SURVEY

The survey was administered via SurveyCTO® utilising tablets connected to the internet. Prior consent for participation was obtained, with surveys conducted on the participants premises (Figure 5).

FIGURE 5: LOCAL RESEARCHERS IN FIJI AND VANUATU CONDUCTING THE HOUSEHOLD SURVEY (PHOTOS: BENNY ZUSE RUSSO, IWC)

In September and October 2024, researchers from USP and IWC conducted 18 interviews in Port Vila settlements and 15 in Suva settlements with residents to collect qualitative data on their water, sanitation and hygiene (WASH) situation, in particular how those conditions affect the daily lives of those residents. A series of six overarching questions were planned, including *current situation, adequacy, impacts, importance, desired improvements* and *challenges to improvements*, and interviewers used prompting to ensure interviewees understanding of the questions and fulsomeness of their responses. Interviews were primarily conducted in Bislama (Vanuatu) and iTaukei (Fiji). All interviews were recorded and later transcribed for analysis. Participants were selected opportunistically based on who was available and willing to participate. Interviews were conducted within public places such as meeting halls.

Of the total 33 interviews, 18 were women and 15 men (no self-reports of other genders), and interviews were conducted across all 9 settlements included in the household survey.

Water services accessed by residents in urban informal settlements

The data collected from survey and interview participants in Suva and Port Vila reveal a diverse array of water service delivery models (Figure 6). These include both utility-provided services and onsite self-supply options managed at the household level. Notably, the findings indicate that, in Port Vila, approximately 20% of households utilize multiple water sources in their daily routines, selecting different sources based on specific uses.

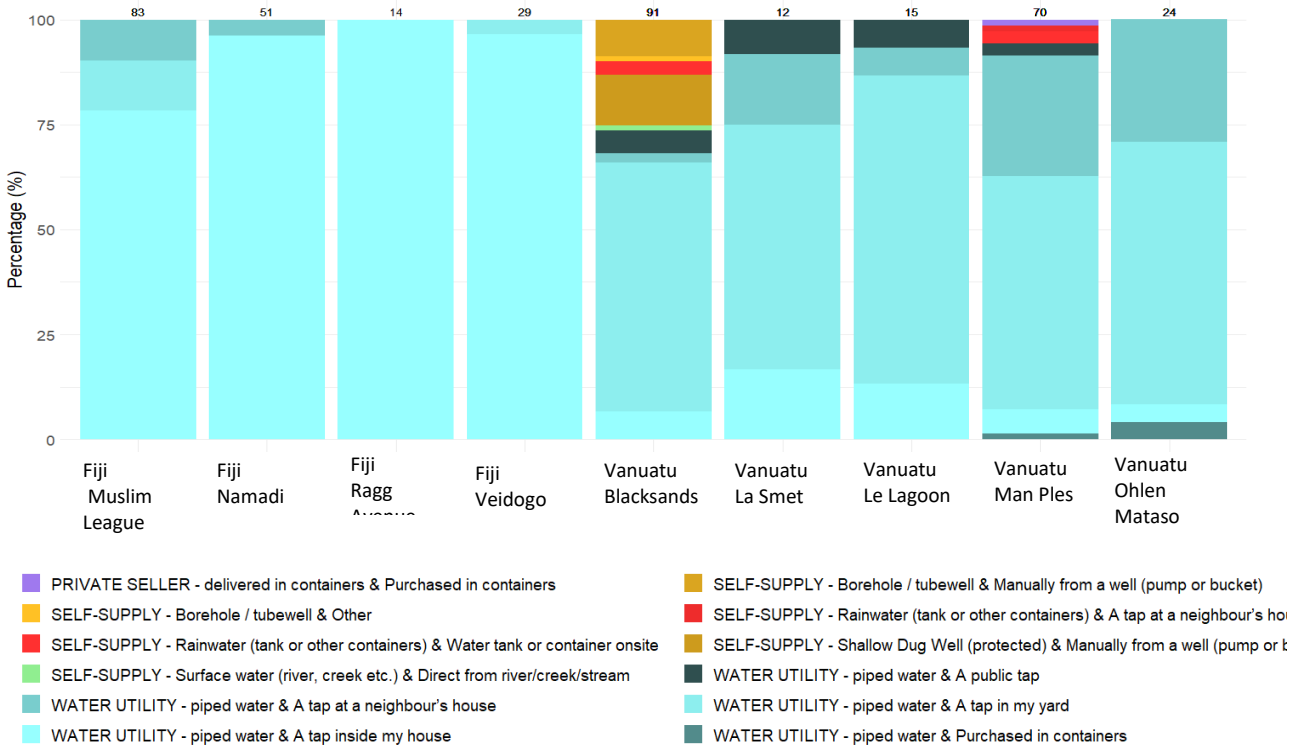


FIGURE 6: WATER SERVICE DELIVERY MODELS REPORTED DURING SURVEYS IN SETTLEMENTS IN SUVA AND PORT VILA

SUVA, FIJI

Most surveyed households in Suva accessed water through pipes connected to the Water Authority of Fiji (WAF) service. However, not everyone had water piped directly into their home. As shown in the graph, many people shared water meters and taps, and those taps were located outside their house, often not immediately outside their house, but closer to the connection-owner's house.

> *"Our water meter connects to the taps in our house, and we also provide water to five other households." (Female, Fiji)*

Even though piped water was generally available, it was often unreliable and difficult to access. This leads to 'service interruptions' – periods of time when the household isn't accessing their usual water service. When meters were further away from the access taps or shared, pipes are more likely to get damaged, leading to extra repair costs for residents. There was also higher uncertainty regarding the exact location of pipes, likely linked with the observation that about 10% of people surveyed were unsure what type of water system they used.

In Fiji, many families used bottled water for drinking because of these issues with piped water. This shows a clear need for better and more reliable household water connections.

The unreliability of the piped water access led the research team to conduct hazard assessments along the full length of pipe a sample of household water connections, from the meter, to the access taps.

PORT VILA, VANUATU

In Port Vila, most households rely on piped water, but access is often unreliable, making the system vulnerable to interruptions. Many residents supplement piped water with rainwater tanks, especially in urban and peri-urban areas

like Blacksands, where water sources are more diverse. This diversity highlights the importance of regular quality monitoring, particularly for self-supply sources, to ensure safety.

Rainwater tanks and wells show similar levels of faecal contamination. However, during long dry spells, rainwater tanks can experience sudden spikes in contamination due to accumulated dirt and bird droppings on roofs being washed into tanks during the first rains. River water is the least safe option due to its exposure to animal waste, trash, and runoff, making it a risky choice for drinking.

Even though tap water is generally the safest, it is not always perfect. During the wet season, heavy rains can cause contamination through cracks and leaks in pipes, allowing dirty water to mix into the system. Seasonal trends play a significant role in water quality, with rainwater tanks becoming particularly vulnerable after dry spells and tap water quality declining during the wet season.

One resident explained:

> *"There is not enough water for use to sustain our family. When we see that there is not enough water to use for cooking and drinking then we use the sea to swim [bathe]. We sometimes go and fetch water at the Teachers college to fill water in containers and bring home to use" (female, Vanuatu)*

Water quality testing revealed that surface waters (river) exhibited the highest level of total faecal coliforms (a marker of faecal contamination, compared to rainwater tanks, groundwater, and utility sources. Rainwater and groundwater exhibited similar levels.

Preferences for water services

Piped water was the preferred water source across all locations in both Fiji and Vanuatu. Among the 396 respondents surveyed—179 in Fiji and 216 in Vanuatu—93.5% indicated a preference for piped water, either as their sole source or in combination with other systems.

In Fiji, bottled water was the most commonly preferred complementary source to piped water, with preferences varying from 14% to 31% of respondents, depending on the location. In contrast, in Vanuatu, rainwater was the preferred complementary choice, with 40% to 88% of respondents across different settlements opting for it. Notably, 90% of cases favoured rainwater as an additional source to piped water.

Sanitation accessed by residents in urban informal settlements

SUVA, FIJI

Most residents surveyed in Suva reported a toilet in their own house, and in times of failure, most nominated using another toilet in their household or yard (or nearby). Most households used water-based pit latrines, followed by septic tanks, with some sewer connections available in certain areas (Figure 7). However, sanitation services are often not good enough, especially in informal settlements. Many households share toilets with others, which increases health and safety risks. One resident explained,

"I have put the toilet in the house because I have daughters, and it's for their security not to have the toilet outside the house. Also, it will be easy for everyone." (Male, Fiji)

Additionally, many toilet systems have been used for decades without being emptied. When these systems fill up, people often seal them off and build new ones. This lack of proper waste disposal services, combined with shared toilets, creates significant challenges. In informal settlements, access to basic sanitation is much worse than national estimates suggest.

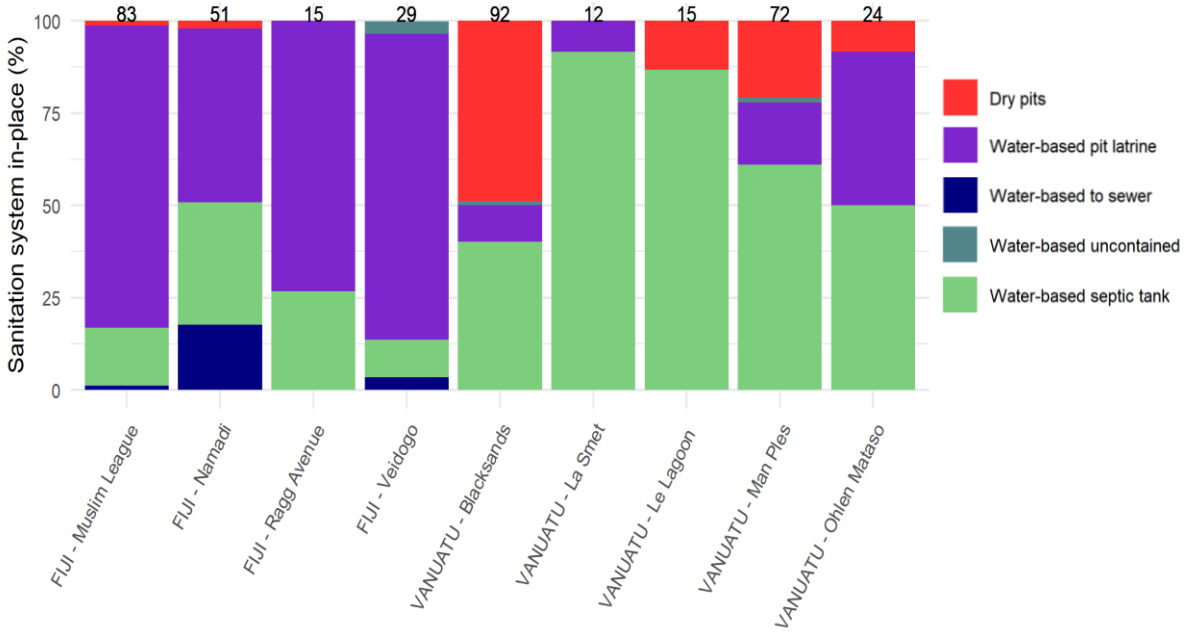


FIGURE 7: SANITATION SERVICE DELIVERY MODELS REPORTED DURING SURVEYS IN SETTLEMENTS IN SUVA AND PORT VILA

PORT VILA, VANUATU

In Port Vila, household ownership of toilets varied widely across settlements, with some at almost 96% of residents surveyed down to 47% in one settlement. There was also a higher proportion of use of public and neighbours toilets in times of disruption to services. Sanitation services in Port Vila primarily rely on septic tanks, though dry pit latrines are common in settlements like Blacksans (Figure 7). Around 50% of households in Blacksands use dry pits, many of which lack adequate slabs, increasing health risks. Overall, about 64% of households share toilets, which raises safety and hygiene concerns, particularly in densely populated areas.

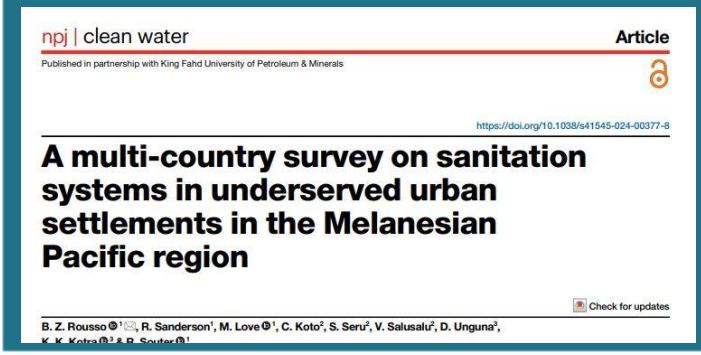
Septic tanks are usually emptied by private contractors, with most waste being taken to the Bouffa treatment plant. In contrast, dry pits are often sealed off once full and replaced with new ones. This lack of proper waste disposal services creates significant challenges, particularly in informal settlements, where access to basic sanitation is far worse than official estimates suggest. National reports indicate that only 6% of urban households lack basic sanitation, but in reality, nearly half of households in Port Vila's settlements face these issues.

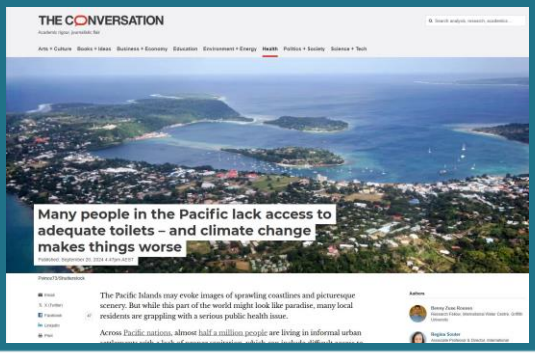
One resident shared:

"Regarding the toilet, [we are] building a toilet system but it's not yet complete. We are using the other toilet still; if my younger daughter wants to use the toilet, I have to go with her because the toilet is not clean." (male, Vanuatu)

Research Outreach

Communication and dissemination of the findings of this research to a diverse audience was a key objective. Academia and those who access peer-reviewed literature have an important role to play in influencing evidence-based policy and practice, and as such, emergent findings with respect to sanitation access in informal settlements in Suva and Fiji was published in Nature Clean Water in 2024. Concurrently, we wanted the important messages of the research to reach a wider audience, particularly that climate change is causing real and present impacts to sanitation in these contexts.





Faecal sludge management

In Suva's informal settlements, the majority of residents reported no need to empty their containment units, with some systems having been in use for over 55 years. A common practice was to seal full units and construct new ones rather than emptying existing systems. In contrast, in Port Vila, septic tanks were primarily emptied by private contractors, with 54% of households utilizing these services and disposing of waste at the Bouffa Landfill septage facility. However, dry pit latrines were often sealed and replaced once they reached capacity, consistent with practices recounted in Fiji (Figure 9).

Despite these containment practices, both Suva and Port Vila informal settlements faced significant challenges related to inadequate sludge disposal and widespread toilet sharing, leading to a high reliance on unimproved sanitation systems. Nearly half of households in Port Vila and 11% in Suva lacked basic sanitation services, which stood in stark contrast to the official Joint Monitoring Program (JMP) estimates, suggesting that only 6% of urban residents in Vanuatu and 0% in Fiji lacked access to basic sanitation. These findings highlighted critical gaps in sanitation service provision in informal urban areas.

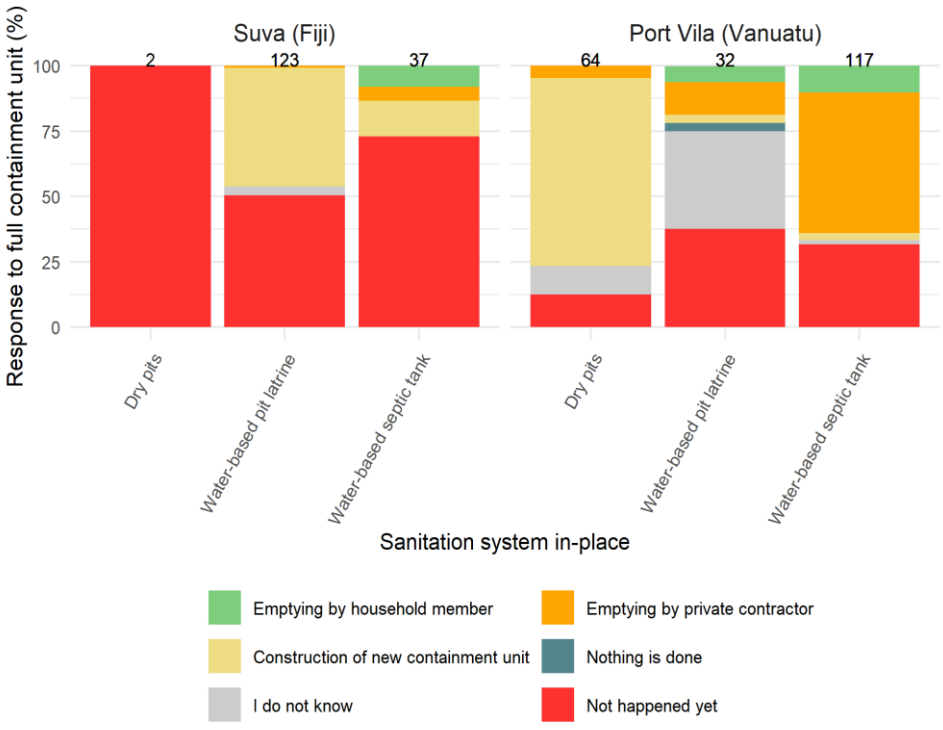


FIGURE 8: EMPTYING PRACTICES AMONGST RESIDENTS IN SUVA AND PORT VILA

Preferences for sanitation services

In settlements in Suva, sewer systems are preferred by more than half of residents surveyed, despite limited access to the necessary infrastructure to support them. The remainder elected preferences for water-based pit and septic systems. sanitation option among residents (Figure 9). In contrast, the majority of respondents in Vanuatu indicated a preference for septic tanks as their primary sanitation solution. Notably, in the community of Blacksands, nearly one-third of respondents expressed a preference for improved dry pit systems, such as ventilated improved pit (VIP) or composting toilets, reflecting a distinct local preference. No respondents in Vanuatu selected sewer systems, likely due to the lack of existing infrastructure or lived experience to make this option feasible.

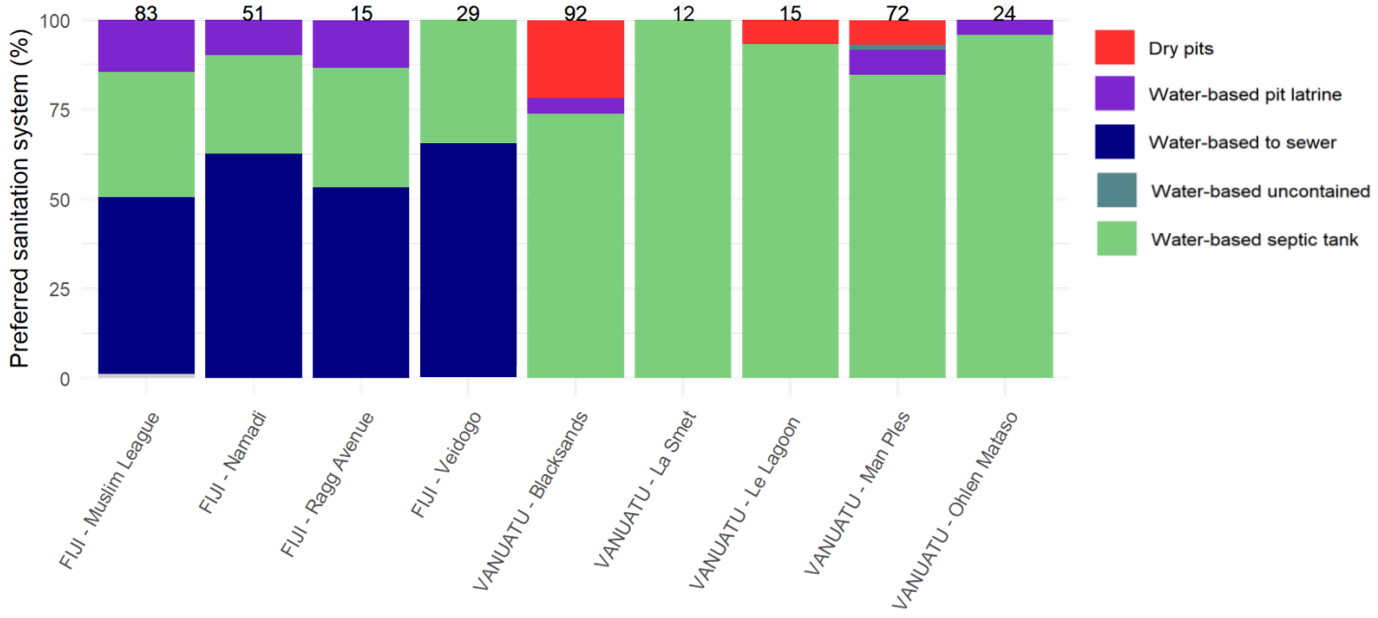


FIGURE 9: PREFERRED SANITATION SYSTEM FOR RESIDENTS IN SETTLEMENTS ACROSS SUVA AND PORT VILA

Impacts of existing WASH services on people

During impact interviews, residents reported several negative impacts of poor WASH conditions on their daily lives. A significant concern was its effect on education, with 42% (14 respondents) stating that children missed school when they lacked water to bathe and prepare. Health issues were also commonly reported, with 36% (12 respondents) experiencing conditions such as scabies and diarrhoea. Additionally, 33% (11 respondents) noted challenges in maintaining cleanliness and hygiene

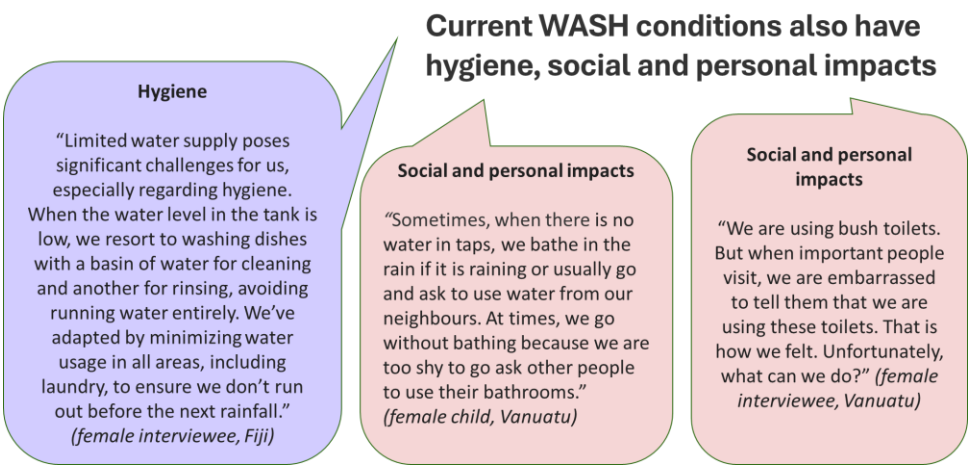
Current WASH conditions have significant impact on education, health and finances

Education / health
"Yes, sometimes we face issues with bus fare, sometimes kids get sick. So, when there is water the kids can be fast to get ready for school but when there is no water they don't go to school." *(female interviewee, Vanuatu)*

Education
"We store water at night to help meet our daily demands, but when our stored supply runs out, we often have to ask the neighbours if we can use their tap to refill our supply. The inconsistent water availability significantly impacts our family, particularly the children's education. There are days when they cannot go to school due to a lack of water in the morning, which also complicates meal preparation. Finding water is a constant struggle. *(female interviewee, Fiji)*

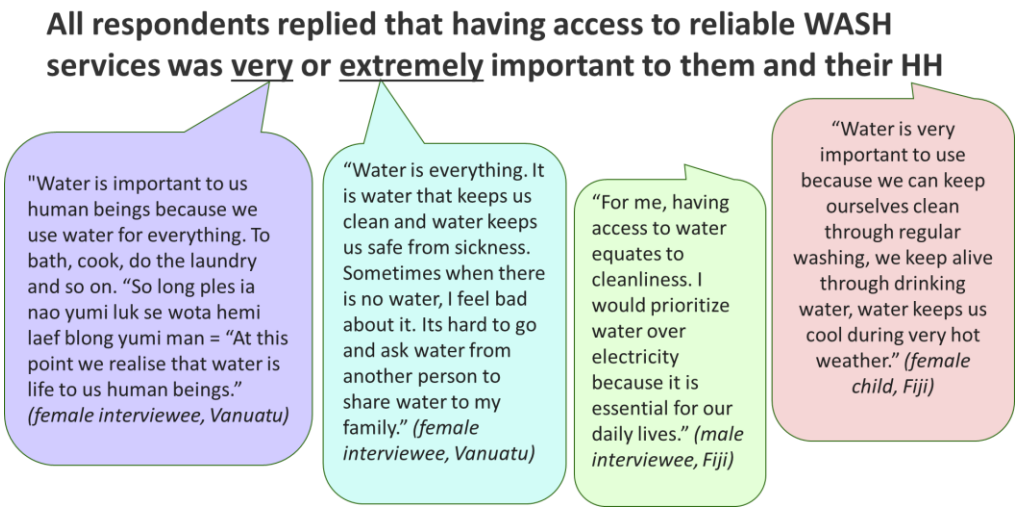
Finance
"Finance is one of the things we struggle with in order to meet other needs at home. However, the only things we tried is to make sure they are met are the electricity bills and water bills. We can pause on the school fees for a while just because we do not want our family to run out or not have water." *(male interviewee, Vanuatu)*

due to inadequate water access, and for some this led to shame about personal presentation at their place of employment or education. Hygiene, social and personal impacts were varied but often discussed.



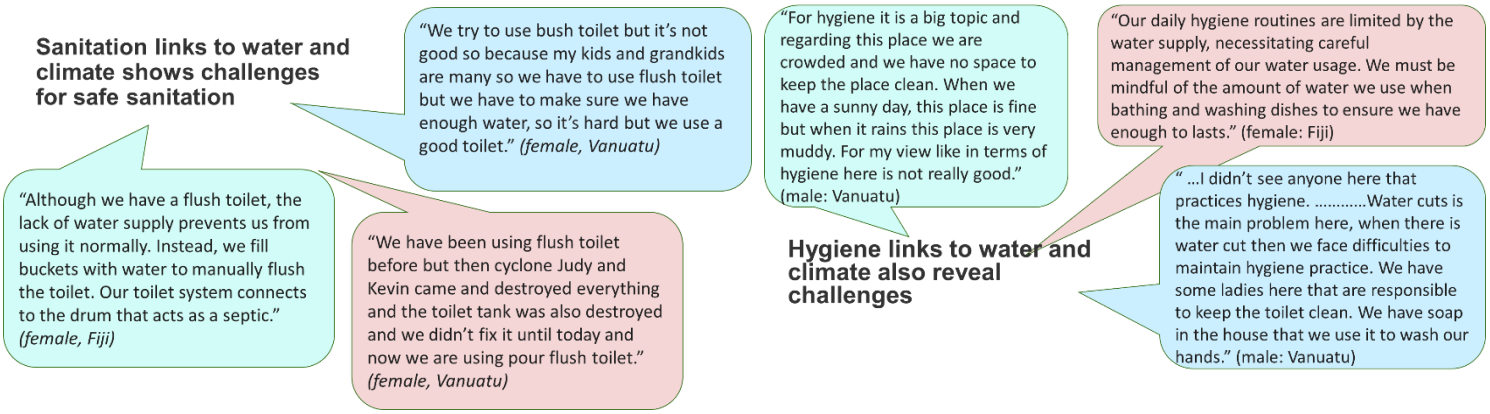
Financial strain was another issue highlighted, with 21% (7 respondents) struggling to pay their water bills. Some respondents (12% / 4) reported experiencing low water pressure, which was time-consuming to address. A few respondents (2 females) expressed feelings of embarrassment and inconvenience due to poor WASH conditions, and that achieving sanitation privacy and convenience was difficult.

However, not all feedback was negative; 2 respondents (1 male, 1 female) reported positive impacts, stating that their WASH conditions enabled them to accomplish their desired tasks. Further, all respondents were clear about the importance of adequate WASH services in their lives and the lives of their households.



Linking WASH services with impacts from climate hazards

During interviews, residents also spoke about linkages between climate-driven hazards, local hazards and impacts on their water, sanitation and hygiene services. Residents had experienced cyclones, floods and heavy rainfall and the associated impacts, both on their lives and on their ability to access safe and sufficient WASH services, were clear.



SPATIAL DATA TO SUPPORT PLANNING

Geospatial data is a specialized form of information that incorporates a geographical or location-based component. This type of data is inherently tied to specific points, areas, or features on the Earth's surface, providing a contextual framework for analysis and understanding. At its core, geospatial data encompasses a diverse range of information, including spatial data that defines the shapes and locations of physical entities, such as points, lines, and polygons. These spatial components are complemented by attribute data, which furnishes descriptive details about features situated at distinct geographic coordinates. Beyond these technological dimensions, geospatial data encompasses cartographic information, crucial for the creation of maps. The analysis and visualization of geospatial data enable the extraction of valuable insights into spatial patterns, relationships, and trends, thereby facilitating informed decision-making across a spectrum of applications.

Geospatial datasets, processing and tools were used in this research to support decision-makers to make informed decisions. It also recognises that informal settlements are diverse in many ways both internally and across cities, and some of this diversity extends or is related to spatial and place-based characteristics. These characteristics, for example proximity to waterways, the slope of the landscape, the density of housing, access roads and more, have important implications for both WASH services and climate change risk. To develop climate-resilient service models, it is important to consider user preferences, site suitability, and long-term sustainability throughout the entire service chain, and again, these factors can vary significantly between and within communities. Spatial data can also help identify, describe and differentiate the different dimensions of climate risk to allow for better, place-based risk management and resilience options.

Mapping informal settlements

A critical challenge to all forms of planning (urban, WASH, climate change) with respect to urban informal settlements is the lack of spatial information and mapping to describe the location, extent and growth of informal settlement areas. While some settlements have remained static in area over time, constrained by physical or cultural boundaries, others, particularly in peri-urban areas, change and grow rapidly. Even those in national and subnational positions report difficulty in staying current with the location and extent of settlements within their jurisdiction.

As part of this research, we mapped informal settlements using two approaches – one that used available datasets including from literature to locate and name settlements, and then using open-source data including building footprints and roadways to delineate extent, size and building counts where possible. Building footprint datasets are readily available, mostly complete and regularly updated for Port Vila and Suva, however this was not available for Port Moresby.

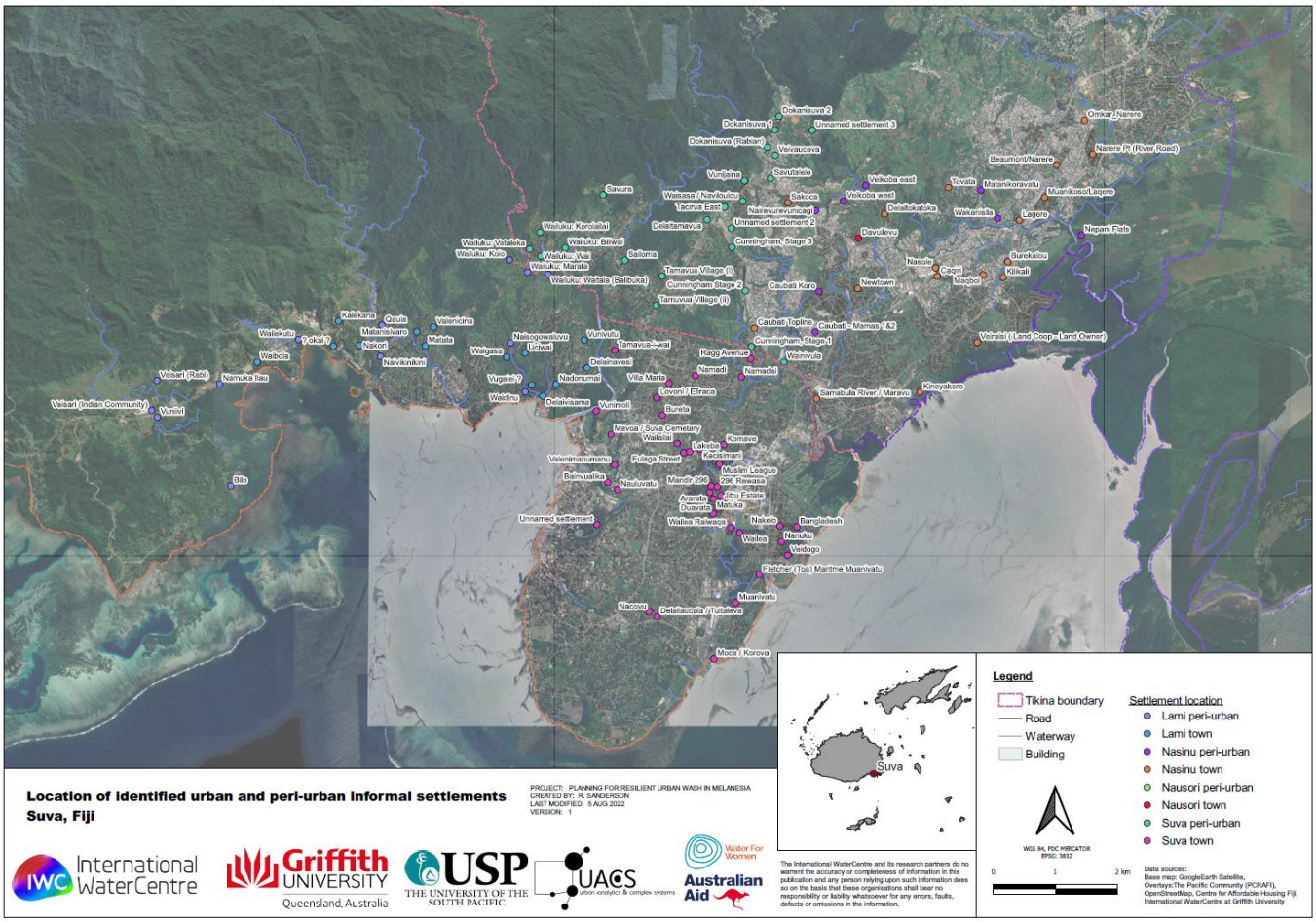


FIGURE 10: MAP CREATED DURING THE RESEARCH SHOWING THE LOCATION OF IDENTIFIED URBAN AND PERI-URBAN INFORMAL SETTLEMENTS IN SUVA

Our second approach was based on machine learning techniques applied to remote sensing to autonomously detect urban landscape features from multi-spectral satellite imagery, to locate and map settlements. This methodology is reported in Patorniti et al. (2022). During this phase of our research, we used the autonomous identification tool to support water utilities forward planning. Satellite imagery offers frequent and accessible spatial data, with revisit times from 1-16 days and resolutions between 5m and 300m, ideal for tracking urban population growth. Image classification automates the identification of features, distinguishing planned urban areas from informal settlements based on landscape differences. By combining satellite data with other essential information, such as existing or planned water and sewerage systems, disaster-prone zones, or geopolitical boundaries and zones, the tool equips water utilities to plan ahead with much greater accuracy and inclusiveness for marginalised communities.

For example, with Water PNG, settlements were detected across the Port Moresby region at three time intervals over the last 8 years (Figure 11). A timeline for the growth of settlements was created to compare it against the trunk water supply and sewerage network to provide insights about settlements not served by municipal infrastructure. Of most value to Water PNG was the ability of the tool to turn a persistent and complex challenge – the rapid and non-regulated growth of informal settlements—into something more manageable and allow for data-driven decision-making.

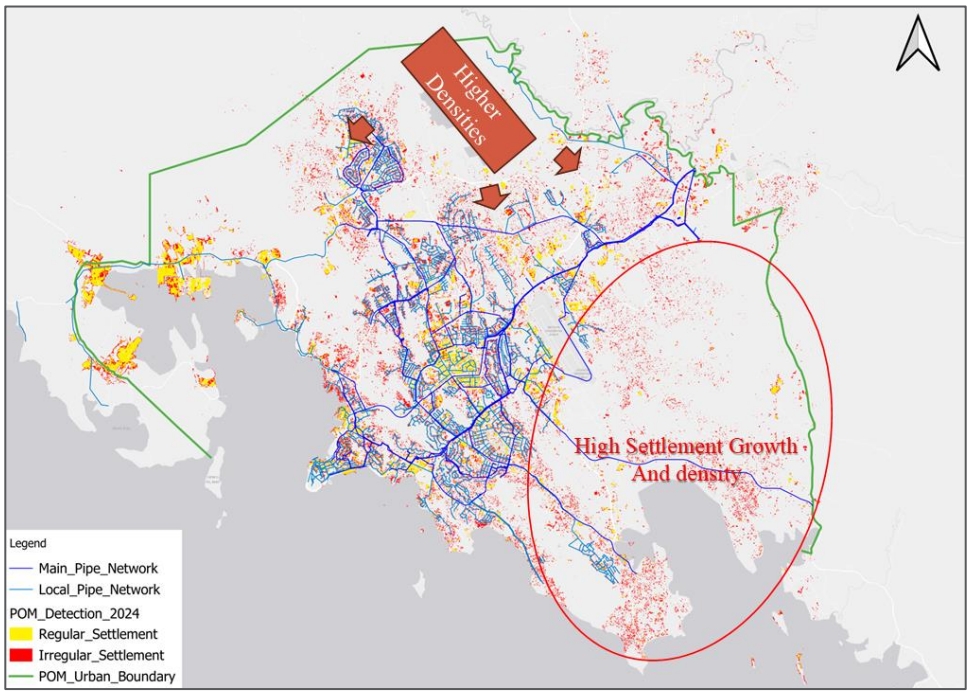


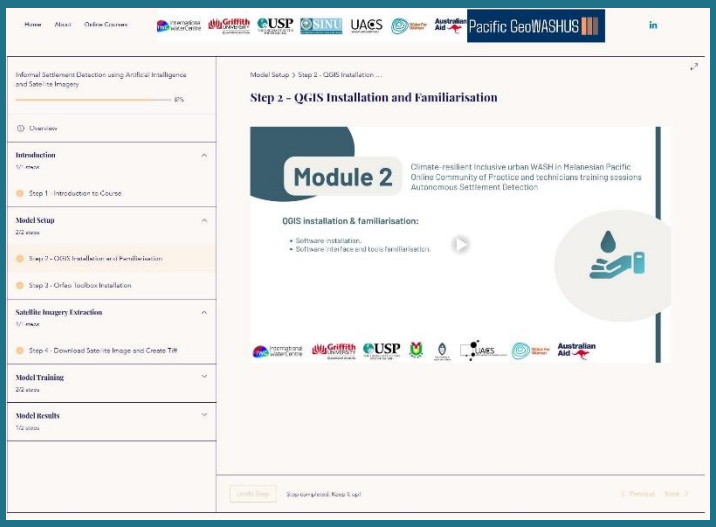
FIGURE 11: IDENTIFICATION OF HIGH DENSITY AND GROWTH AREAS OF SETTLEMENTS IN PORT MORESBY IN 2024, USING MACHINE LEARNING TECHNIQUES

Pacific GeoWASHUS

Prior to this research, there was no time-efficient means to identify the location – boundaries – of urban informal settlements. Without this capability, it is difficult for governments and utilities to detect new unplanned growth areas, essential for forward planning of service delivery.

Pacific GeoWASHUS is an online resource created during our research, for GIS technical users in the Pacific region. The site includes free access to an online self-paced training course where users can gain skills in autonomous detection of settlements using GIS.

https://www.pacificgeowashus.com/



Mapping climate hazards affecting water and sanitation services

Spatial data can help identify service gaps and provide a clearer understanding of local conditions. For example, maps can show settlement boundaries and areas affected by sea-level rise (Figure 12), as well as household water services and the impact of cyclones or heavy rainfall, highlighting areas where water access is vulnerable and may need improvements.

Various types of spatial data can contribute to these efforts. Basemaps and satellite imagery offer foundational information about the geography and layout of informal settlements. Topographic data, including contour maps and Digital Elevation Models, can be used to assess terrain suitability for new infrastructure and identify areas prone to flooding. Climate prediction data, such as projections of sea-level rise and storm impacts, can help design more resilient water and sanitation systems. Urban planning maps can also assist by showing settlement boundaries, population density, and existing infrastructure networks, making it easier to identify underserved areas and plan service expansions.

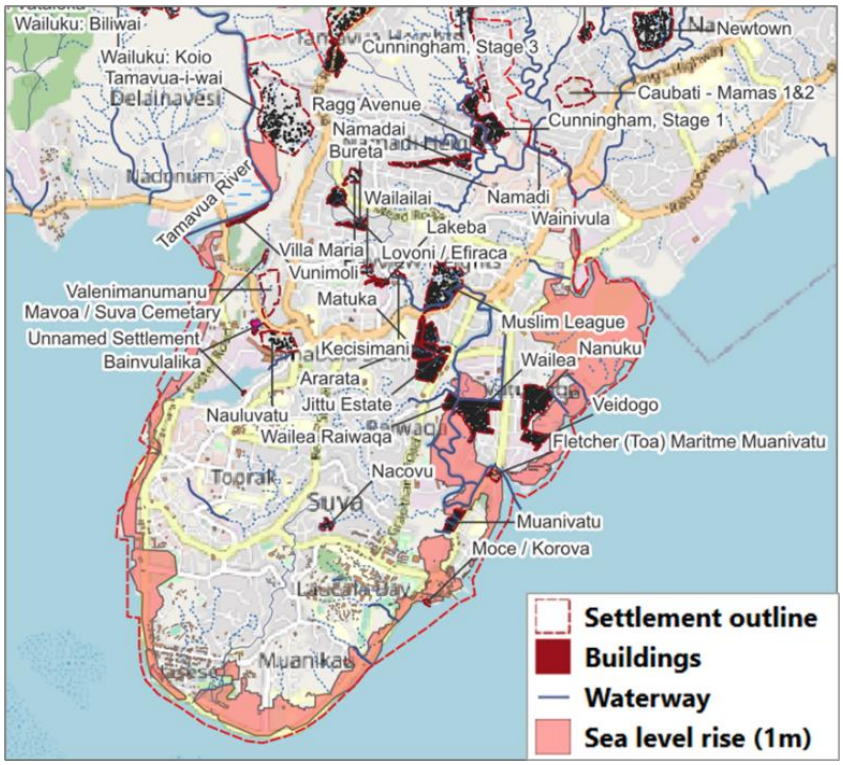


FIGURE 112: MAPPING OF PROJECTED SEA LEVEL RISE OF 1M AROUND THE COASTLINE OF SUVA, FIJI (COASTAL RISK SCREENING TOOL (HTTPS://COASTAL.CLIMATECENTRAL.ORG/))

Spatial data can be used to explore key issues like vulnerability to disasters, such as cyclones, heavy rain, or rising sea levels, which helps prioritize infrastructure upgrades. Mapping can also identify inequities in access, like shared water meters, distant taps, or inadequate sanitation facilities, and highlight areas where pipes and systems are at risk of damage. Additionally, data can inform future infrastructure needs based on population growth and land availability. On site data collection methods, including household surveys and participatory approaches like mapping, can complement global model data and identify areas prone to flooding, landslides, or intermittent water supply, as well as areas affected by sewage overflow that are not precisely located. These community-driven methods provide a more detailed understanding of local challenges, complementing traditional mapping techniques and guiding better planning and service delivery.

By using spatial data, decision-makers can develop city-wide inclusive water and sanitation solutions that address both current challenges and future risks. Combining these data-driven insights with cooperation across service providers, communities, and civil society can help achieve more resilient and equitable WASH outcomes.

The research was also able to spatially locate the results of our household survey data, which allowed for a deeper understanding of how different service delivery models and impacts from events interacted with geographical and topographical features (Figure 13).

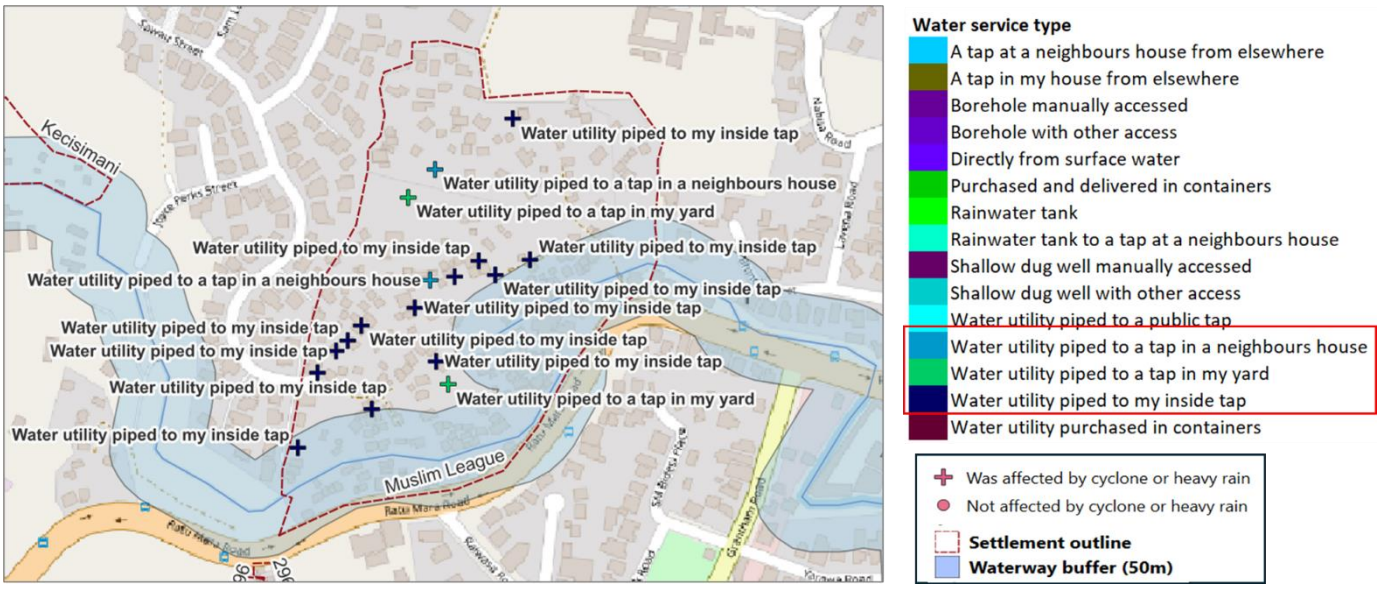


FIGURE 12: MAPPING OF HOUSEHOLD SURVEY RESULTS TO GAIN GREATER INSIGHT INTO THE DIVERSITY OF HOUSEHOLD EXPERIENCES ON A SPATIAL BASIS

PARTICIPATORY PLANNING – WORKING WITH RESIDENTS TO IMPROVE WATER AND SANITATION SERVICES

The research explored participatory planning methods to address WASH challenges in an informal settlement in Suva, Fiji. Through workshops held inside and outside the community, the study aimed to (1) identify participatory planning tools for WASH planning and (2) adapt and test these tools in the local context. Given the need to adjust theoretical planning to real-world conditions, the research was exploratory, asking: *Can participatory planning tools improve WASH in informal settlements? And which tools are most effective?* The activity highlighted the importance of coordinated household action in managing water and sanitation, reinforcing the value of participatory approaches in complex urban environments.

The workshops introduced planning approaches and tested them in practice. A community-based workshop featured transect walks led by residents, followed by a simplified problem tree analysis. This process allowed government stakeholders to directly observe challenges, such as the unplanned nature of water pipes, often makeshift and vulnerable to damage from flooding. The walks shifted the focus from external assumptions to community realities, as demonstrated when an engineer revised their understanding after joining a resident-led walk. We conducted a problem tree analysis in mixed groups of locals and experts, which encouraged rapid transition from problem identification to action planning.

The solutions identified focused largely on infrastructure, particularly improving the placement and protection of water meters and pipes. A notable non-infrastructure proposal was forming a "Direct-Action Committee" (DAC). In discussions on water metering, participants realized existing informal zoning could guide meter placement. Using maps, they identified alternative locations to better align with zones, creating a structured approach that benefited

both residents and the water agency. This example illustrated how participatory planning bridges technical expertise with local knowledge, revealing solutions that external agencies might otherwise overlook.

The activity provided key learnings about participatory planning in WASH. When employed appropriately, it has the ability to engage community leadership, helping balance power dynamics with government and utilities, particularly in informal settlements with limited governance representation. The workshops fostered understanding, allowing stakeholders to grasp issues they might not have otherwise recognised. They also demonstrated community empowerment, shifting perspectives from solely demanding government action to exploring collective solutions. The process inspired discussions on collection action, particularly working together to protect shared water infrastructure such as pipes, within zones (Figure 13). Ultimately, participatory planning strengthens collaboration between communities and service providers, facilitating locally driven WASH improvements.

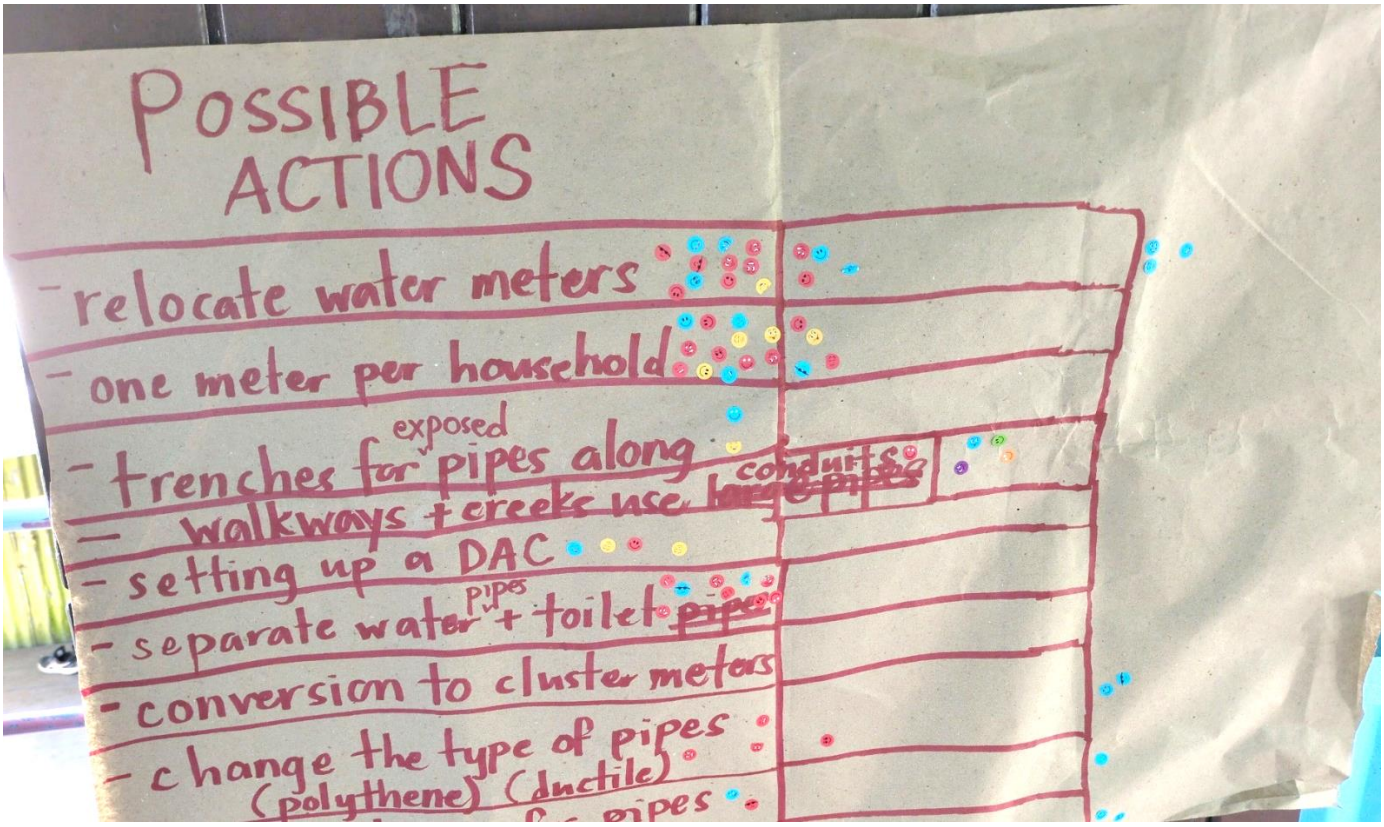


FIGURE 133: ACTION LIST DEVELOPED DURING OUR PARTICIPATORY PLANNING WORKSHOPS

POLITICAL ECONOMY – PUBLIC MEDIA REPRESENTATION OF WASH AND URBAN INFORMAL SETTLEMENTS

A media scan was conducted to assess public sentiment toward WASH services in urban informal settlements. Articles published over the past decade were analysed to understand how WASH issues are reported in Fiji, Vanuatu, and Papua New Guinea (PNG). The findings revealed distinct national differences in sentiment and focus areas.

Of the 122 articles reviewed, sentiment was generally positive in Fiji (59%) and Vanuatu (81%), while in PNG, more articles had a negative tone (42% positive). Water and sanitation were the dominant focus areas, with hygiene receiving considerably less attention. Nearly half of all articles described specific community development initiatives aimed at improving WASH conditions, such as the installation of water tanks, water supply projects, and hygiene and sanitation workshops.

Government perspectives dominated media coverage, appearing three times more frequently than those of informal settlement residents, other urban residents, NGOs, or journalists. WASH was most commonly linked to health and social impacts, though economic, environmental, and climate resilience aspects were also frequently mentioned. Four key themes emerged, as discussed below.

Key theme: WASH as essential for socioeconomic development

All five newspapers present an alarming and confronting humanitarian crisis in informal settlements, identifying a lack of WASH at the centre of extremely poor living conditions, and as a key barrier to socioeconomic development. Informal settlements were often depicted as facing a humanitarian crisis, where poor water and sanitation infrastructure limited economic and social progress. Lack of access to clean water and sanitation was frequently cited as a barrier to employment, education, and public safety (e.g. Figure 14).


PAPUA NEW GUINEA Post-Courier
The heartbeat of PNG

Indo-Pacific in focus: PM apologises for delay in proposed bilateral security treaty with Aust - P8

NOHO Ranu and her daughter Angeline Raga standing in front of the community well.

Surviving from this well

Families carry 20 litres of water everyday for 10 years

BY THEOPHILES SINGH

WATER is the very essence of life. Without water, the quality of life diminishes and eventually life ebbs away.

In Papua New Guinea's capital city Port Moresby, water is becoming a rare commodity for many who live in the city's crowded squatter settlements. Such is the case that carting water over long distances in small containers has become a way of life for many women and children even as Papua New Guinea prepares to celebrate its 50th year as an independent nation.

- CONTINUE ON PAGE 4

Marape invites Korean president to visit PNG

BY GORETHY KENNETH

PRIME Minister James Marape has invited the president of the Republic of Korea, Yoon Suk Yeol to visit Papua New Guinea.

Mr Marape and President Yoon met during the Korea-Pacific Island Summit this week in Seoul, to further embrace both countries' enhanced relationship.

The PNG delegation was made up of Minister for International Trade and Investment Richard Maru, Vice Minister for Finance and Implementation John Boito and Vice Minister for Treasury Solen Loifa.

At the meeting, Mr Marape announced to President Yoon that PNG will sign a visa waiver arrangement for diplomats and officials with the Republic of Korea's Minister for Foreign Affairs Park Jin. Mr Marape also made a commitment for PNG to look into visa on arrival arrangements as well for both countries.

-CONTINUE ON PAGE 3

Get your STATE OF ORIGIN GAME 1 lift-out INSIDE

PAGES 23-46

FIGURE 144: ARTICLE IN PNG'S POST-COURIER FROM MAY 2023

Several articles framed WASH as a universal right, arguing that informal settlements should have access to essential services, including clean water, proper sanitation, and waste management. Others highlighted the role of community development projects in improving conditions. In Fiji and Vanuatu, coverage was largely optimistic, with reports of projects aiming to enhance living standards. However, some articles in PNG, mostly featuring government perspectives, questioned whether informal settlements should receive state-funded services, given their legal status. Some reports also implied that settlement residents bore responsibility for their own poor conditions.

Key theme: public health crisis due to poor WASH

A significant number of articles described WASH-related public health challenges, portraying a worsening crisis in informal settlements. Insufficient access to clean water and sanitation was linked to higher rates of preventable diseases in these communities compared to the broader population. Waterborne diseases, including cholera, typhoid, and hepatitis, were frequently mentioned as consequences of poor sanitation and contaminated water. The COVID-19 pandemic further exposed vulnerabilities, with media reports highlighting the difficulty of following hygiene protocols in settlements lacking water infrastructure. Hygiene issues were also linked to food safety and general cleanliness, particularly affecting women's responsibilities within households.

Key theme: the disproportionate impact on women and children

Women and children were consistently identified as the most affected by inadequate WASH services. Many articles described the daily burden of water collection, which often required long and dangerous journeys, limiting women's ability to work and forcing children to miss school. Some articles also highlighted efforts to increase women's involvement in WASH-related decision-making.

Access to water was directly linked to education, as some schools struggled to operate due to unreliable water supply. Reports from Fiji and Vanuatu detailed cases where teachers ended classes early or students missed school entirely because of water shortages.

Key theme: WASH and climate change

In Fiji and Vanuatu, inadequate WASH services were strongly linked to climate vulnerability. Informal settlements, often located in flood-prone or cyclone-exposed areas, were portrayed as highly susceptible to environmental hazards (e.g. Figure 15). Media reports emphasized the urgency of improving WASH infrastructure to mitigate disaster risks.


The Fiji Times

HOME NEWS SPORT LIFESTYLE KAILA PEOPLE NA ILALAKAI DINING & ENTERTAINMENT

Settlements vulnerable to storms

Local News, News | Published: December 6, 2023 | Last Updated: March 8, 2024 | By Wata Shaw

Listen to this article:

FIGURE 155: ARTICLE FROM FIJI'S THE FIJI TIMES FROM MARCH 2024

Some articles suggested that strengthening WASH services could enhance community resilience to climate change. Government and expert sources argued that investing in water and sanitation infrastructure was essential for long-term adaptation, particularly in settlements where living conditions are already precarious.

While media narratives varied across the three countries, they collectively underscored the critical role of WASH in public health, social and economic development, and climate resilience. Coverage reflected both the challenges and progress in addressing WASH issues, with differing national perspectives on government responsibility and community agency.

Research insights

WATER AND SANITATION SERVICE DELIVERY MODELS IN URBAN INFORMAL SETTLEMENTS

In Port Vila and Suva's informal settlements, water service delivery is more externalized than sanitation, which remains largely a household responsibility. Water service delivery models (SDMs) identified included utility or self-supply (e.g., rainwater) and sanitation SDMs categorized as water-based or waterless, with few piped systems and reliance on road-transported waste removal. Backup water sources were common for managing disruptions. While some households reported engaging a private contractor to empty pits and tanks when they were full, a greater proportion did not empty or simply closed off full pits to start again, even in dense urban contexts. Conversely, for water services, it was far more common for households to pay for utility water than access self-supply options such as groundwater or rainwater. Note, not all service delivery options identified should be considered adequate, safe or appropriate.

Examples of water service delivery models included:

- Utility water with utility distribution infrastructure, individual household meters or shared meters, with a tap inside the house and water piped out of the house.
- Utility water with utility distribution to group meters at the edge of a settlement, with settlement internal distribution pipe networks to taps inside houses or taps in yards.
- Utility piped water purchased in containers from neighbours or others, and transported and stored in containers (buckets, bottles, makeshift tanks) (Figure 16).
- Rainwater, directly captured at households and stored in rainwater tanks or containers (buckets, bottles, makeshift tanks.
- Rainwater captured at a community building (e.g. a church, hall, meeting house) and stored in a rainwater tank. Residents fill containers to transport and store water.
- Groundwater accessed manually from an unprotected or protected spring or shallow well, transported and stored in containers (buckets, bottles, makeshift tanks) (Figure 16).
- Groundwater accessed from a constructed borehole and retrieved with a pump, transported and stored in containers (buckets, bottles, makeshift tanks).
- Bottled drinking water purchased from stores and manually transported, stored in bottles.
- Water collected from streams or rivers and transported and stored in containers (buckets and bottles).

FIGURE 166: EXAMPLES OF WATER ACCESS AND

Sanitation service delivery models reported included:

- Waterless (pedestal or squat toilets), directly collected in a pit that is containment only, likely some infiltration. The user interface might be unimproved or improved (slab, ventilation, superstructure), and some pit owners reported emptying by private contractors in septage trucks. In Suva these trucks empty at the Kinoya WWTP while in Port Vila they empty at the Bouffa Landfill STP. Some pit owners reported emptying to another pit or nearby environment, and some did not report emptying at all.
- Only one household reporting using composting, waterless toilets but they provided no information on how or if the compost was used in any way.
- Water-based (pedestal, pour flush OR utility flush) piped to pits or septic tanks (or approximations of such - Figure 17), with the same range of emptying conditions as reported for waterless pit toilets.
- Water-based utility flush to centralised sewer was reported by a small number of households only in Suva, which would be transported to the Kinoya WWTP.
- Hanging toilets and open defecation were indicated as backup options for several residents.

FIGURE 177: A CONSTRUCTED SANITATION CONTAINMENT UNIT COMPRISING A PLASTIC BARREL AND PIPING. THIS SYSTEM IS UNLIKELY TO MEET RELEVANT STANDARDS OR BE EFFECTIVE AS SAFE SANITATION OR CONTAINMENT

These outcomes are explored further in our technical brief *Localising vulnerability and resilience considerations for water and sanitation service delivery models in urban informal settlements, 2025.*

RESILIENCE OF WATER AND SANITATION SERVICES TO CLIMATE HAZARDS

The study used targeted surveys across 395 households to identify households affected by climate-related hazards, assessing the extent of damage, service interruptions, breakdowns, leaks, and overflows. The goal was to evaluate the resilience of various WASH service delivery models in these settlements.

WASH resilience to climate change, defined as the ability to adapt and sustain services under climate challenges, was a key focus. Findings revealed that many residents lacked adequate WASH access, and even those with services faced frequent disruptions. These ranged from routine infrastructure damage to severe impacts from floods and cyclones.

The data highlighted natural hazards as a persistent challenge. In Suva, the most common threats to water systems were storms, heavy rains, floods, and cyclones, while in Port Vila, cyclones were the primary concern. In most cases, residents depended on external assistance to restore services after disruptions. Sanitation systems were less frequently disrupted in Suva, although 25% of residents in one settlement reported minor damage from floods, heavy rain and cyclones. In Port Vila, residents in all five settlements reported major or moderate damage to sanitation. However, it is likely that when a resident was reporting damage to sanitation, their perspective was limited to the user interface (toilet and superstructure), with less focus on sub-surface infrastructure or elements further down the sanitation chain.

The most likely sanitation facility to retain moderate or major damage following an extreme weather event amongst settlement residents surveyed were pit toilets – particularly waterless or dry pit toilets. The most likely water sources impacted were boreholes, shallow dug wells and surface water sources, although damage of different magnitudes was reported across all water sources. Notably, households accessing water inside their home were less likely to report damage than those that accessed outside their home.

While it is recognised that numerous factors across a wide spectrum can affect explicit and implicit resilience of residents in informal settlements, in our analysis of research data we identified 10 factors that affected either the vulnerability or exposure of the water and sanitation systems of residents to climate-based hazards.

These factors, and their implications, are summarised in brief *Localising vulnerability and resilience considerations for water and sanitation service delivery models in urban informal settlements, 2025.* Table 1 and discussed further in our technical brief *Localising vulnerability and resilience considerations for water and sanitation service delivery models in urban informal settlements, 2025.*

Table 1: Review of factors affecting resilience of water and sanitation services in Port Vila and Suva

Factor	Vulnerability	Exposure
Facility type	Inadequate or flimsy infrastructure increased chance of damage during events. Pit toilets, groundwater, surface water sources most likely to be damaged	
Shared facilities	Sharing of both water and sanitaiton facilities decreased the prevleance of minor damage in favour of those facilities sustaining moderate or major damange.	
Superstructure condition	Inadequate or flimsy infrastructure increased chance of damage during events	
Land tenure	Decreased coping ability as less access to decision-makers (e.g. landlords, renters protections) when land tenure is insecure.	Increased exposure as a greater number of residents may be less likely to invest in secure and resilient WASH.
Distance from water meter		Increased expsoure of infrastructre (particularly pipe distribution network) to damage, leakage and contamination.
Backup water sources	If backup water sources are unsafe, vulnerability is increased during interruptions of primary services. If backup sources are safe, can increase resilience during shocks and events.	A greater number of sources used can increase the exposure of those sources to a variety of hazards.
Distance from nearest road	May reduce likelihood of emptying sanitation containment, increasing vulnerability to pits and tanks overflowing during events.	
Distance to coastline		Increased exposure to tidal surge, sea level rise, and effects of cyclones
Proximity to waterways		Increased exposure to flooding
Steep topography		Increased exposure to landslips and impacts from heavy rain and cyclones

In urban informal settlements, the **effects of climate-linked hazards are exacerbated** by the presence of additional **local hazards**, and the reliance on **sub-standard water / sanitation infrastructure** (Figure 18).

Local hazards include contamination of grounds with faecal leakage from inadequate sanitation, inadequate draining causing pooling of unhygienic water and localised flooding, sub-standard housing that comes lose during storms with the potential to cause further damage to water and sanitation facilities.

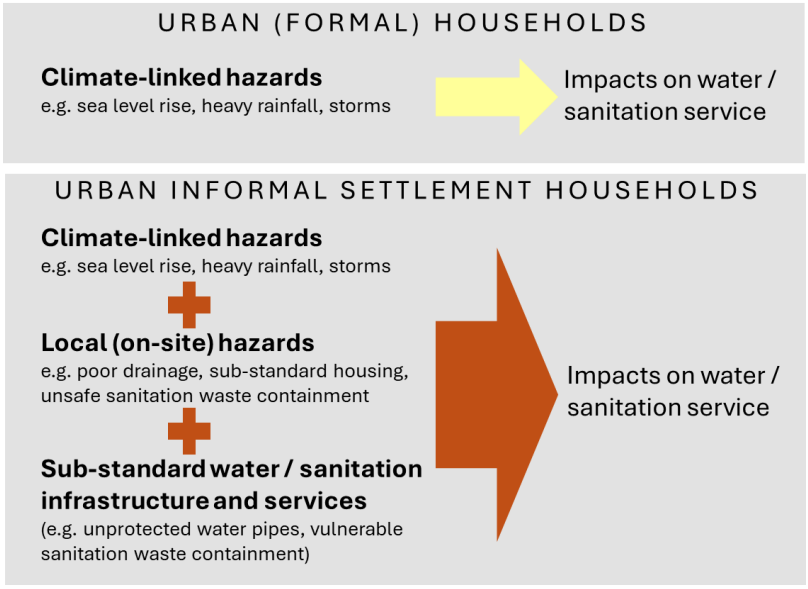


FIGURE 18: CONCEPTUALISATION OF HAZARDS AND IMPACTS ON WASH IN UIS

Water or sanitation infrastructure that is not designed, installed or maintained to meet minimum standards may not withstand exposure to local or climate hazards. For example, PVC water pipes laid above ground and unprotected are vulnerable to breakage. Pit latrines and septic tanks may not be constructed to ensure waste remains safely contained during heavy rain or storms.

For example (Figure 19), poorly maintained water connections and unprotected and inaccessible pipe installations, that run through poorly drained areas and under buildings, create local hazards that affect water safety and availability, and increase the vulnerability of residents to climate hazards, such as flooding which would have greater impacts (damage) to water services given these local hazards.

FIGURE 19: CLUSTER WATER METERS AND WATER PIPES INSTALLED NEAR THE BOUNDARY OF AN URBAN INFORMAL SETTLEMENT, SUVA, FIJI. PHOTO: B. ROUSSO, IWC

Improve WASH data collection and monitoring for UIS communities.

Disaggregating UIS data from broader urban statistics will provide a clearer picture of service gaps, enabling better planning and investment decisions. Governments and international organisations need to prioritise informal settlements in their planning and monitoring efforts. These areas have been ignored for too long, and without proper data, it's hard to grasp the full extent of the problem. As populations in these settlements grow, they should be prioritised in urban planning to support progress toward Sustainable Development Goal 6, which aims to ensure clean water and sanitation for all.

Develop climate-resilient water and sanitation services tailored to UIS realities.

To address these problems, we must invest in water and sanitation systems that can withstand extreme weather and ensure they are supported by comprehensive services. This includes designing toilets that won't be damaged by floods, creating waste management systems that prevent contamination and policy adjustments to protect water supply infrastructure, particularly household connections from meters to taps. But also, and even more importantly, this requires building a local, skilled workforce to capable operate and maintain these systems. It's crucial to work with communities to develop culturally appropriate and enduring solutions. Local hazards need to be managed

However, in urban informal settlements, the effects of climate-linked hazards are exacerbated because of the presence of additional local hazards, and the reliance on sub-standard water / sanitation infrastructure. Improving the safety and reliability of water service will require not only improvements to on-site water infrastructure, but also specific attention to reducing local hazards, in particular inadequate waste containment of sanitation facilities, and to mitigating the impacts of climate-related hazards, in particular flooding, which are exacerbating the effects of local hazards and inadequate water infrastructure.

Similarly, improving the safety and reliability of sanitation services requires not only improvements to on-site sanitation infrastructure, but also consideration of how local hazards, including the loss/reduction of household water supplies due to on-site or climate-related events, affect the resilience of sanitation.

Advance planning support systems that take advantage of latest technologies, datasets and ability to integrate diverse information are required for climate resilient water and sanitation.

GIS mapping, climate hazard assessments, and resident input should inform adaptive WASH strategies that respond to both environmental risks and social dynamics in UIS settlements.

Recognize UIS residents as a distinct customer group in utility service models.

UIS cannot have the same type of services as formal urban residents – due to their tenure situation, and the requirement for meters to be on the boundaries of settlements. Additionally, they cannot have the same types of services as rural communities: supported community-managed water supply systems – they don't have access to water resources to enable this, and the collective action required would be challenging in UISs that are larger and socially diverse. A distinct customer service typology is required (Figure 20).

Governments and utilities should explicitly define UIS service strategies, creating tailored policies, engagement processes, and infrastructure solutions that acknowledge their unique constraints and needs.

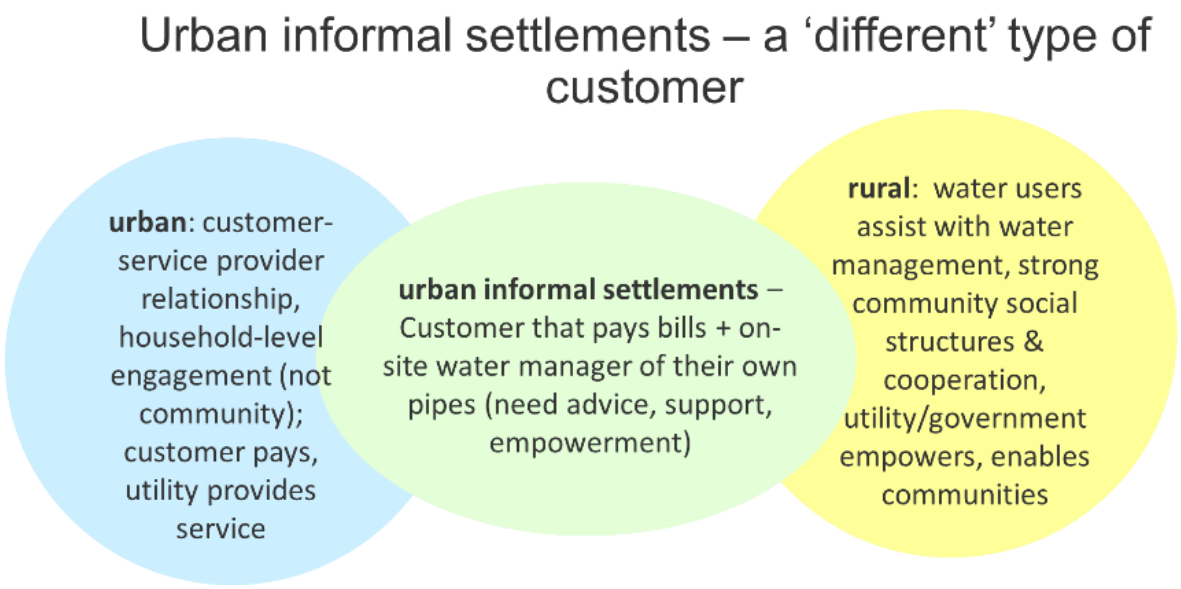


FIGURE 18: CONCEPTUALISATION OF WATER AND SANITATION CUSTOMERS IN URBAN SETTINGS

Strengthen engagement between utilities, UIS communities, and support organizations.

Dedicated utility teams, in partnership with NGOs and academic institutions, can provide technical and social expertise to design and implement UIS-appropriate WASH solutions. Most large utilities across the globe that have informal settlements and poor communities in their service area, adopt an organisational structure that recognises the importance of providing services to suit this unique type of customer – they create dedicated units that not only oversee communication and engagement, but develop service options to meet the needs of these customers. Utilities should consider an engagement team that is able to provide technically and socially robust advice on how pipes from meters to taps can be protected, given the unique and local contexts in UIS.

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COVER IMAGE Household toilet and water supply pipes in a settlement in Suva, Fiji (Regina Souter, IWC, 2024)

ADDITIONAL RESOURCES are available at www.watercentre.org/projects/PacificUrbanWASHplanning

RESEARCH PARTNERS

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