POLICY BRIEF

Addressing climate-resilient WASH in urban informal settlements in Vanuatu, through planning processes

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International WaterCentre
Griffith UNIVERSITY Queensland, Australia
USP THE UNIVERSITY OF THE SOUTH PACIFIC
UACS urban analytics & complex systems
Water For Women
Australian Aid

Research to strengthen planning systems and tools for urban WASH, with a focus on climate-resilient WASH in urban informal settlements

This two-year research program sought to contribute to solutions to address the critical problem of inadequate Water, Sanitation and Hygiene (WASH) in urban informal settlements, in Fiji, Vanuatu and Papua New Guinea. Irrespective of the status of land tenure of urban residents, everyone has the right to access adequate and inclusive WASH services, and to be confident these services are sustainable and resilient to disasters, climate change and other shocks.

This is critical for the people living in informal settlements, but it also important more broadly for these urban societies, in which the residents of urban informal settlements contribute to the local workforce, food security, and vibrancy of the city. 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 services[i].

The specific aim of the research was to identify ways 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.

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*?".

Research Partnership & Approach

This research was undertaken by a multidisciplinary team of local and international researchers and analysts, 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**, and involved frequent engagement with government, utility, CSOs, FBOs and actors.

The mixed methods research included:

- on-site surveys
- key informant interviews
- participatory GIS
- spatially explicit hazard assessments including water quality monitoring
- participatory planning activities
- public media reviews.

These methods were designed to understand existing WASH services and preferences, urban planning approaches and the existing political economy of the provision of urban WASH

The **climate-driven hazards** that pose the greatest risks to safe and inclusive WASH services for urban informal settlements vary by location. In Port Vila, Vanuatu, Fiji, the primary climate-driven hazards identified in this study include flooding, landslides, cyclones, storms, and coastal inundation caused by rising sea levels.

The **Research Synthesis** brief outlines the methods and key findings in more detail. Here we focus on findings and key messages relevant to policymakers in government and utilities.

Access all research reports and outputs here:

watercentre.org/projects/PacificUrbanWASHPlanning/

Water for Women Fund

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. It 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.

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.

www.waterforwomenfund.org

Water For Women

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KEY MESSAGES FOR POLICYMAKERS

1. PEOPLE LIVING IN URBAN INFORMAL SETTLEMENTS ARE HEAVILY IMPACTED BY INADEQUATE WATER AND SANITATION SERVICES THAT HAVE HIGHER VULNERABILITIES TO CLIMATE HAZARDS

The current water and sanitation service options for urban informal settlements are, for many residents, not meeting their WASH needs and are causing negative impacts to their lives every day. This is partly because the options they have are not always resilient to climate and other hazards.

One notable challenge is the lack of data describing existing water and sanitation access in urban informal settlements. Available datasets, such as the JMP Global WASH monitoring dataset, which is based on **national surveys, do not disaggregate populations living in formal and informal settlements in urban areas – the access rates reported for urban populations masks the situation in informal urban settlements**. Our research and data collection activities allowed us to describe, in greater detail, the existing situation for residents across four settlements in Suva. These settlements were intentionally selected to be representative of a diversity of geographic and topographic conditions.

WATER SERVICES

- **Most households in Port Vila settlements, access water originating from the water utility UNELCO**. In many settlements, all surveyed households access a water utility connection; in some settlements the access rates are lower (e.g. 73% of surveyed households in Blacksans), although it is still the most common source of water.
- **More than half (67%) of all households surveyed rely on more than one water source** to meet their needs; additional sources include **bottled water**, **on-site sources** including rainwater, shallow wells, bores, and in a small number of households in some settlements, surface waters, which are rarely safe for consumption. The preferred arrangement for water supplies to meet all domestic needs was a combination of a utility connection with a rainwater tank, with 90% of households across settlements report this preference. However, in some settlements, such as Blacksans, there was also a preference by 19% of surveyed households for utility water with surface water.
- In all but one settlement surveyed, **sharing utility connections is commonplace**, with more than half of households sharing a connection with other family and non-family households; those sharing households typically contribute to bill-paying.
- Across all surveyed settlements, **only 5% of households access their main water source from a tap inside their house**; 78% access their main source outside their house in their yard, while 17% travel outside their yard to access and collect their main water supplies. When **water is not available inside the house, it is more difficult to maintain good personal and household hygiene** because it is more difficult to collect sufficient water for these purposes, **outdoor household connections are associated with lower health and wellbeing benefits**[ii]. It is also more **difficult to maintain the safety** of drinking water when it accessed from outside the house, because there is more handling and storage of water[ii].
- Even though piped utility water was generally available, it was **often unreliable and difficult to access**. 'Service disruptions' were common – periods of time when the household isn't accessing their usual water service, caused by very low water pressure or no flow to the tap.

Shallow well, Urban informal settlement, Port Vila, Vanuatu (R. Sanderson, IWC)

- **33% of surveyed households in Vanuatu experienced water shortages in the month prior** to the research survey. 47% of surveyed households experienced water **interruptions due to accidental damage** to their supply pipe, and 20% experienced **contamination of the water supply**. Additionally, 37% of surveyed households say they the **cost of water led to interruptions of their service**.
- In many cases, these interruptions were specific to a water connection, rather than widespread across the settlement or utility, and were **related to problems with the pipes supplying water from the meter at the water mains which is on the boundary of the settlement, to the tap.** Connection owners have responsibility for pipes from meters to taps; in many cases those **pipes are only buried in shallow ground, and some are above ground, and traverse long distances.**
- Pipes that are not buried, and that travel overland longer distances **increase the risks to safe and reliable water supply**. It also makes it very difficult for connection owners to properly inspect and maintain their pipes.

Water supply pipes laid in a drainage channel in an Urban informal settlement, Port Vila, Vanuatu. (R. Sanderson, IWC)

- This means that the **type of water services being offered are typically more vulnerable to both climate hazards and local hazards**, than the services other urban populations can access. They also require additional 'work' by connection owners top manage on-site water supply pipes in difficult settings.
- Water quality is an issue for most residents. 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.

SANITATION

- 76% of households surveyed have a toilet in their house, though this access level varies between settlements, with some, such as Le Lagoon with 47% access, have lower levels.
- Most toilets were water-based, with 54% of surveyed households reported having a water-to-septic toilet system and 15% reported a water-based pit latrine.
- However dry-based sanitation was also commonplace, with 30% of all surveyed households having a form of dry pit latrine; very few were VIPs, with most being basic pit latrines with or without a slab (distributed equally between these two).
- Around 10% of surveyed participants reported they usually defecate in a toilet in someone else's house, and around 7% usually use a public or community (e.g. church) toilet.
- **Up to half of households surveyed in each settlements share a household toilet**, mostly with family members, although up to 40% of these sharing households in some settlements shared with non-family households. In some cases, one toilet was shared with up to 20 people; high rates of toilet sharing do meet minimum standards, and make it difficult to ensure maintenance, cleanliness and privacy.
- Around **47% of surveyed households did not meet standards for basic sanitation** according to UNICEF and WHO definition; this is mostly due to toilets shared among households, and poor infrastructure (e.g. broken/missing slabs).
- Most of the dry pit latrines were reported to have reached capacity at some time in the past, with the most common practice (71.9%) being sealing the full containment unit and constructing a new one.
- Most households (40-70% depending on settlement) with septic tanks reported engaging a private contract to empty the sludge, with a small number being emptied by a household member (up to 18% in Man Ples).
- However, 9-46% (depending on settlement) reported not ever emptying the septic tank, which is surprising given the median time of living in the settlements is 23 years and cases of the same containment unit being used for 60 years without

the need of emptying. This indicates improper operations and maintenance of the septic tank, with a high likelihood of local contamination.

- In cases where a resident emptied the containment unit (septic, water-based latrines, or dry latrines), the sludge was either disposed in a nearby pit, water stream, unused area, or a second containment unit used in alternation.
- Household roles including toilet maintenance, cleaning, managing hygiene materials, water for flushing, were reportedly shared approximately equally by men and women (93% of households reported sharing responsibilities of toilet operations and maintenance).
- In settlements that were on lower land, such as Blacksans, many households reported their sanitation system was affected by climate hazards, in particular flooding (17%) and heavy rain (14%). Most settlements report damage to their sanitation systems by cyclones, up to 50% in some settlements (e.g. La Smet).

Water-based toilet (L) and dry pit latrine (R) in settlements in Port Vila, Vanuatu (Photo: USP)

- The type of sanitation system was linked to the level of **damage sustained by climate hazards, with dry pits being 80 to 90% more likely** (4:1 to 8:1 odds depending of the settlement) to sustain moderate or heavy damage compared to septic tanks, especially from cyclones.

IMPACTS OF EXISTING SERVICES ON RESIDENTS' LIVES

Interviews with residents living in informal settlements in Suva, Fiji and Port Vila, Vanuatu described many ways that inadequate access to water and sanitation affects their lives. **Having to spend extra time and resources on coping with inadequate WASH leaves residents with less capacity to cope and adapt to climate changes, disasters and other shocks.**

- A significant concern raised by residents was the effect of inadequate water and sanitation on **education**, with 42% of interviewees stating that **children missed school when they lacked water to bathe and prepare**.
- Health issues were also commonly reported, with 36% households experiencing conditions such as scabies and diarrhoea.
- Hygiene, social and personal impacts were varied but often discussed. 33% noted **challenges in maintaining cleanliness and hygiene due to inadequate water access**, and for some this led to shame about personal presentation at their place of employment or education.
- 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.
- **Financial strain** was another issue highlighted, with 21% struggling to pay their water bills.
- Respondents that experienced low water pressure explained this was **time-consuming to address**, as it required waiting much longer to collect water, or walking much further to collect water from elsewhere.

Conversely, feedback from participants who reported their water and sanitation access was adequate, explained that their WASH conditions enabled them to accomplish their desired tasks, underscoring the **value and impact of good WASH to people's lives**.

Governments **need to prioritise informal settlements in their planning and monitoring efforts**. Assessments of investments by Development Partners have indicated also that poorer populations have been given low priority in most urban sanitation projects globally[iii].

2. URBAN INFORMAL RESIDENTS REQUIRE DIFFERENT WATER AND SANITATION SERVICES AND ENGAGEMENT PROCESSES

Utility and government agencies can clearly articulate the WASH needs, services available, and engagement strategies for urban formal residents, and for rural populations. Some stakeholders clearly identified there being two types of customers: urban and rural, implying that residents of urban informal settlements are one of these types of customer and expected to make use of the services available to these populations.

However, residents of urban informal settlements **cannot have the same types of services as rural communities**, which are typically supported community-managed water supply systems. Urban informal settlements typically don't have access to on-site water resources that they can manage the catchment areas of to ensure safety and reliability. Additionally, the collective action required would be challenging in urban informal settlements that are larger and socially diverse.

Residents in urban informal settlements **also cannot access the same level of services as formal urban residents** due to their tenure situation, access to resources, perception of an unwillingness to pay for services, and the requirement for meters to be on the boundaries of settlements. The existing service option requires all residents, in formal or informal areas, to take responsibility for managing all water distribution pipes between the meter on the water mains, and the access taps belong to the connection owner. This is feasible for residents on formal urban properties, whose taps are typically short distances from the water meter, and are able to bury pipes to ensure they are protected from damage.

However, this is not feasible for many residents of urban informal settlements. Unless their house is close to the boundary of the settlement and to the location of cluster meters on the water mains, most households will have to manage water supply pipes traversing overland through local hazards such as waterways, drainage ditches, on-site sanitation, as well as under or over other houses limiting access for maintenance. **Thus, the service that these residents actually achieve, is of a considerably lower level than residents of formal urban areas.**

Most large water and sanitation 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 these populations, and that doing requires acknowledging them as a unique type of customer. Dedicated units are created that oversee communication and engagement with informal settlements. They can work to develop service options that are suited to the context of urban informal settlements, and deliver a level of service that can meet the needs of these customers.

Public media attitudes towards urban informal settlements

A media content analysis indicated in Vanuatu, a generally positive sentiment towards the WASH needs of residents of urban informal settlements (Refer Research Brief).

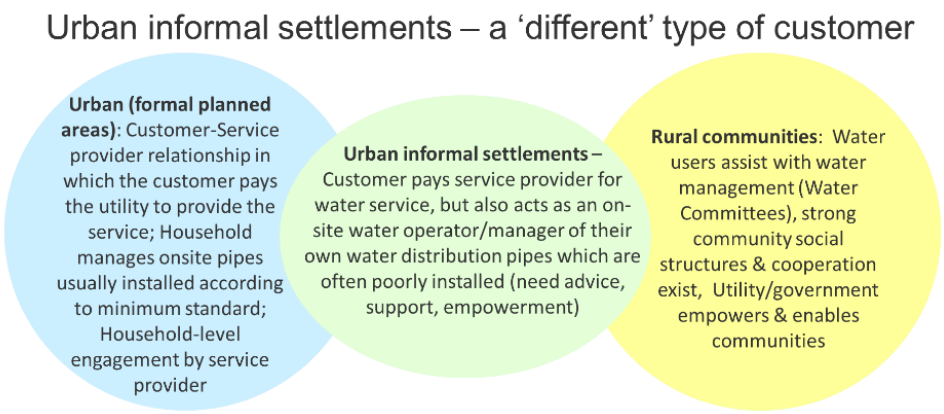
81% of articles published in the last 10 years in Vanuatu's Daily Post, that discuss WASH and informal settlements, **presented a positive sentiment** towards the need for informal settlement residents to have access to improved water and sanitation services.

Four key themes emerged from the analysis of public media content:

1. There exists a **public health crisis** due to poor WASH in urban informal settlements in Vanuatu
2. This **disproportionately impacts women and children** (more than adult males)
3. WASH for everyone is essential for socioeconomic development, with the lack of adequate WASH at the centre of extremely poor living conditions in urban informal settlements and presenting a key **barrier to Vanuatu's socioeconomic development**.
4. Informal settlements are often more exposed to climate hazards and so there is **greater urgency to address the climate-resilience of WASH in informal settlements**.

These themes, and positive sentiment indicate a level of societal support to improve WASH situations for residents of informal settlements

In the case of **water services for urban informal settlements in Vanuatu**, there would be significant benefit in a dedicated engagement team that is able to provide technically and socially-robust advice to residents on how pipes from meters to taps can be protected. The responsibility for pipe management and maintenance may remain with residents, however **there is a need for settlement-specific technical advice, suited to the specific local environment and hazards, as well as to the social dynamics of the settlement**. Such support could come from a **dedicated unit with the water utility or a government agency**, or this group could **partner with suitably skilled civil society organisations, universities, or private sector businesses to provide additional capacity**.



Addressing sanitation for urban informal settlements in Vanuatu requires expanding discussions beyond provision of on-site and off-site (sewered) technologies, to a broader view on how sanitation services, from toilets through to the safe disposal of treated waste, are working[iv]. Taking such a **service delivery approach to designing and assessing sanitation services** will enabling climate and other vulnerabilities to beyond the impacts to toilet facilities to be considered, ensuring that human waste can be safely contained, treated and disposed of in the face of increasing hazards.

Sanitation issues requiring attention include:

- **Improving the promotion and accessibility, including cost, of household sanitation infrastructure**, so that households can upgrade and maintain at least basic sanitation infrastructure meeting minimum standards. Given the heavy reliance on on-site sanitation rather than sewered sanitation, these low-cost sanitation facilities must include **waste containment systems that prevent contamination** of the local environment creating health risks - this is particularly **important given the prevalence of above ground water supply pipes**. Improving the accessibility of low-cost, durable, climate-resilient, toilet infrastructure may also assist in **reducing the need for sharing of toilets** between households.
- **Improving emptying services for non-sewered sanitation systems**, including emptying services that can access difficult-to-reach household toilets in urban informal settlements. This problem has been addressed in other cities of the world with innovative technologies and creative service delivery and business models, such as Loowatt's pay-per-service waterless container-based sanitation services in urban centres in South Africa and Madagascar or Sanergy's Fresh Life model that introduces sealable containers and transportation technologies enacted under a franchise business model.
- **Providing city-wide coverage of safe sanitation through a diversity of sanitation service offerings.** As described in Key message #3, different sanitation service delivery models have different vulnerabilities and therefore different resilience to different climate and local hazards. The service type that offers sufficient resilience to floods may not be the same as that which offers resilience to storms or landslips. This means a mix of sanitation service options are likely to be required across any one city, to ensure the availability of safe and resilience sanitation services to suit every type of local environment. This is explained further in Key message #4.

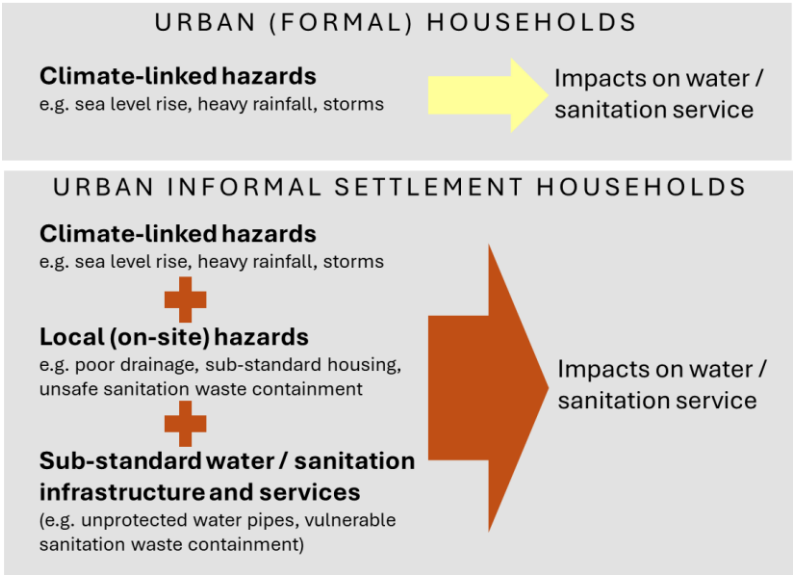
City-wide Inclusive Sanitation

CWIS is a concept developed to address the serious lack of progress in achieving universal urban sanitation in many countries.

It is described as follows[v]:

*Everyone benefits from adequate sanitation service delivery outcomes; human waste is safely managed along the **whole sanitation service chain**; effective resource recovery and re-use are considered; **a diversity of technical solutions is embraced** for adaptive, mixed and incremental approaches; and onsite and sewerage solutions are combined, in either centralised or decentralised systems, to better respond to the realities found in developing country cities.*

3. Climate impacts are exacerbated in urban informal settlements by local (on-site) hazards and sub-standard water/sanitation infrastructure



Different types of water and sanitation services have different vulnerabilities and resilience to climate hazards (refer Technical Brief *Localising vulnerability and resilience considerations for water and sanitation service delivery models*). Considering the climate-resilience of different service options assists service providers to ensure services can be continued, or reinstated quickly, following climate and other disasters.

However, 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**.

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. Such hazards can be conceptualised as vulnerabilities that contribute to climate-related risks to WASH services, but they also contribute in their own right as hazards with respect to public health and wellbeing risks.

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.

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.

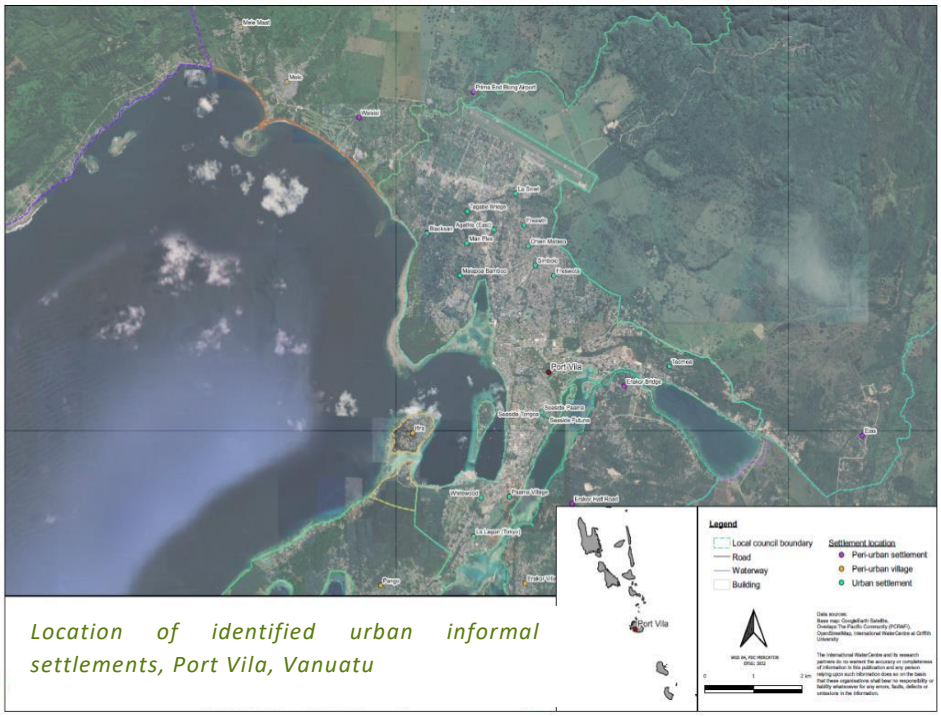
Assessments about the suitability of different water and sanitation service options need to be place-based, specific to the settlement (and areas within). This also allows for other locally specific information, such as resident preferences and other socio-economic factors to be considered (see Key Message #5).

4. Advance city-wide planning support systems with latest technologies, datasets and ability to integrate diverse information

Key messages 2 and 3 above indicate the importance of locally specific data and information about services and infrastructure, local hazards, and how climate hazards are manifest in the local environment. Local hazards interact with climate hazards as well as with specific construction and installation of water and sanitation infrastructure, which can also vary locally.

To support a **locally specific understanding of services, local and climate hazards, a diversity of types of data and information is needed**. The research project identified a range of data sources as useful in supporting assessment and planning of water sanitation services, in particular:

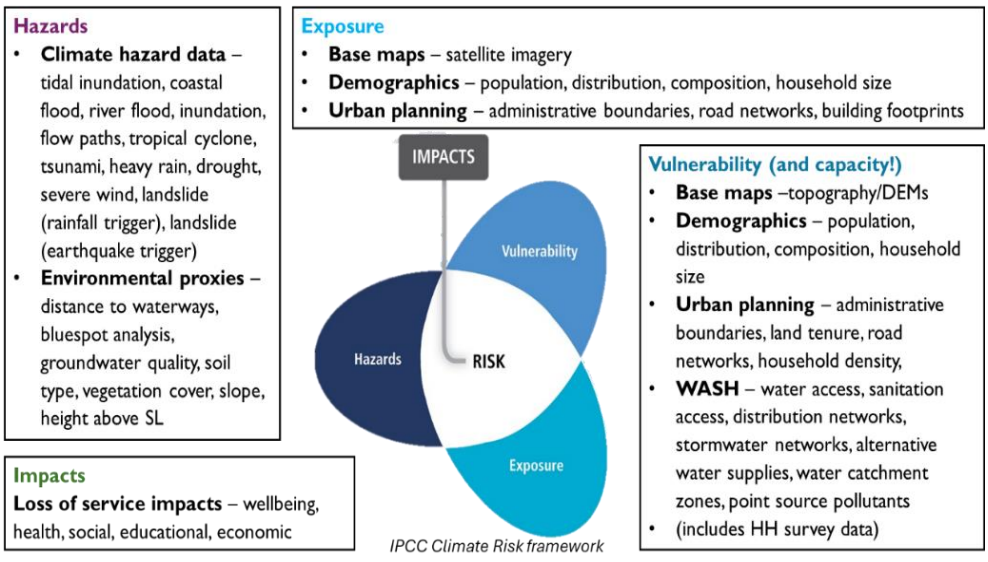
- Aerial images of dwellings, from which the boundaries of informal settlements can be identified e.g. Figure right (refer to Technical Brief, *Pilot study – autonomous identification of informal settlements in Pacific Islands using machine learning and satellite imagery*, 2022).
- Free / low-cost climate hazard mapping data (e.g. Figure below), or, environmental data that can be used as proxy when climate hazard data is insufficient.
- Complimentary, finer-scale spatial data of climate hazards acquired through participatory GIS (e.g. mapping local flood-prone areas based on residents' observations about past flood events).



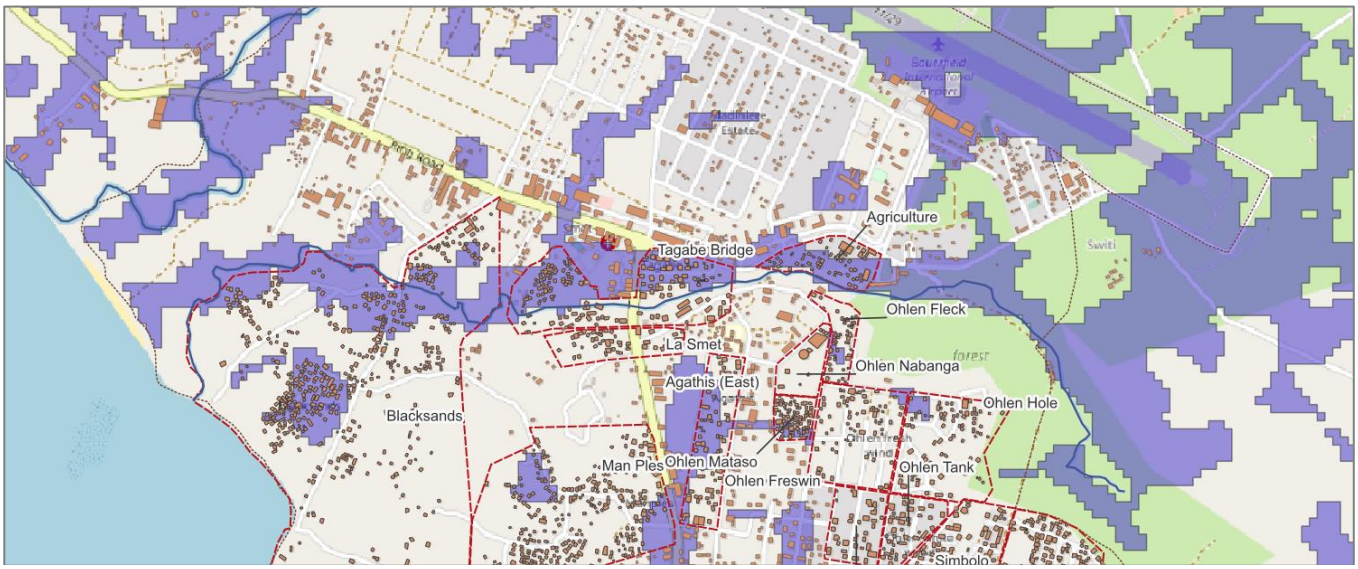
Location of identified urban informal settlements, Port Vila, Vanuatu

- Household level data, collected through surveys, describing: Specific water and sanitation needs; Impacts of different water / sanitation services; user perspectives on resilience of different water/sanitation services; Exposure histories to climate hazards at a local scale; nature of local hazards; coping strategies when water / sanitation services fail.

The research identified types of spatial data useful in assessing and planning, across a city, water and sanitation services (figure below). These datasets represent different components of the IPCC's Climate Risk framework, and so are helpful in identifying **water and sanitation services that decrease the vulnerability** of residents of urban informal settlements to the effects of climate change.



Spatial datasets helpful to understand climate risks associated with water and sanitation services, in local areas



Example of the use of GIS to integrate climate hazard spatial data – in this case, predicted flood areas, with mapping of urban informal settlements, Port Vila, Vanuatu

The practical application of diverse and locally specific data is made easier with the use of Geographical Information Systems (GIS). Such systems allow for city-wide analysis, that recognises local variability. In particular GIS will support city-wide planning of service options, ensuring that all parts of the city have access to safe and resilient service options.

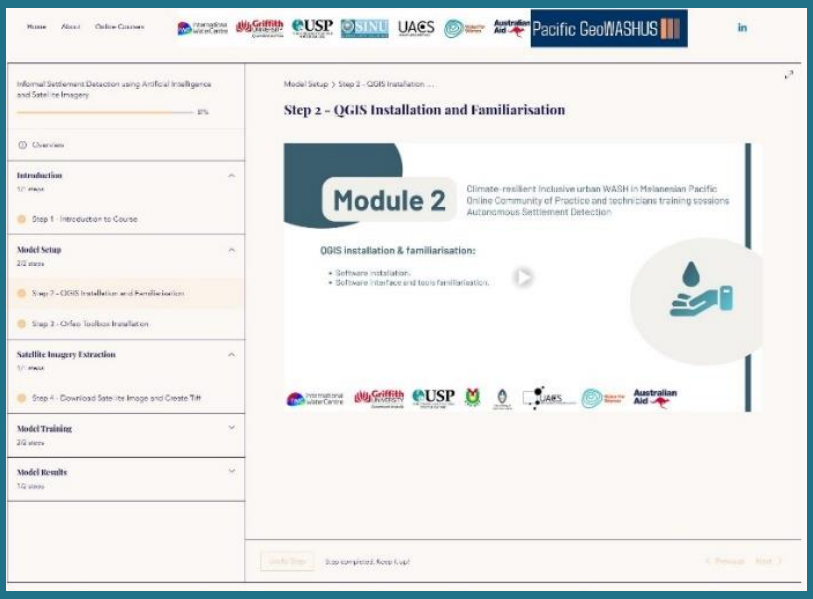
GIS has the capability to integrate spatial data describing physical and environmental features, such as those identified in the figure above for climate hazards, and exposure. This research demonstrated the benefits of integrating household survey qualitative data, such as exposure to local and climate hazards, and the level of damage to water and sanitation infrastructure. This provided a more accurate and locally-specific understanding of the functionality, and resilience of water and sanitation systems to local and climate hazards.

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/



5. PARTICIPATORY PLANNING PROCESSES ARE BENEFICIAL FOR IMPROVING WATER AND SANITATION IN URBAN INFORMAL SETTLEMENTS

The **need for coordinated action amongst individual households** for the protection of water pipes and management of on-site sanitation facilities and waste, together with the **environmental and social complexity** of urban informal settlements, means that participatory planning approaches are beneficial.

In **Fiji**, a **Participatory Planning approaches** were piloted to assess their potential to benefit planning to **improve water services in an urban informal settlement in Suva**. Although a different governance, social and environmental setting, the learnings are likely to be relevant to Vanuatu's context. The key learnings included, Participatory Planning:

- can provide a way for service providers and government to engage with residents, to clarify service options and constraints collectively (which helps to ensure accurate information is known by all, those with and without water connections)
- can lead to unexpected and localised ideas to address problems; on-site discussion back-and-forth between service can give residents an opportunity to talk about the impacts that they felt, some of which are not well-appreciated or understood by external stakeholders; in particular, the site inspections led by groups of residents, enabled residents to take the lead in identifying and explaining local issues
- provides a way to even out, to some extent, the significant power imbalances that are common to utility provision. This is particularly important when dealing with informal communities or other highly vulnerable populations who have limited access to governance arrangements and to government more generally.
- providers and residents, assisted by independent facilitators (such as University or CSO personnel), can allow ideas to be raised, and further developed with collective input, and because of residents' inputs, are localised to the physical and social setting and more likely to be strengths-based
- can even inspire leadership from settlements, where leadership can be contested and complex. Natural leaders emerged in the process of discussing ideas and solutions, particularly those that built on existing strengths such as social structures within settlements (e.g. zones), and which involved collective action, such as working together, within zones, to protect each other's water pipes
- have the potential to encourage and empower residents to move away from focusing on the problem as one of government not providing them with direct access to water, more towards a view that they may be able to do some things themselves to improve the situation, alongside continued advocacy for their desired solution.

Participatory Planning activities in an informal settlement, Suva, Fiji, Community-led site inspection (L), and Problem tree: cause and solution discussions (R) (Photos: R. Souter, IWC)

Community meeting to discuss water survey results, Photo: B. Sousso, IWC

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ADDITIONAL RESOURCES

The project has produced other publicly available resources available at www.watercentre.org/projects/PacificUrbanWASHplanning

SUGGESTED CITATION

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