PACC TECHNICAL REPORT 15

MARCH 2015

PACC

Building Resilience to Climate Change in Pacific Communities

PACC Demonstration Guide: Improving rainwater harvesting infrastructure in Tokelau

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ACKNOWLEDGEMENTS

This report is an output of the Tokelau PACC Project. It was written by Louis Bouchet, and reviewed by Jewel Toloa-Tuitama (PACC+ Project Coordinator in Tokelau), Peni Leavai (SPREP), Netatua Pelesikoti (SPREP), Azarel Mariner (SPREP), Damien Sweeney (Pacific Research and Evaluation Associates) and Martin Pritchard (Pacific Research and Evaluation Associates).

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EXECUTIVE SUMMARY

In Tokelau, the PACC+ project is building resilience to drought by improving the territory's water resources management. As Tokelau is a territory of New Zealand, it was not able to benefit from the Global Environment Facility-funded Pacific Adaptation to Climate Change (PACC) programme. However, the country did benefit from additional funding to the PACC programme made available from the Australian Government in 2011, called PACC+. This guide, developed as part of the PACC+ demonstration project, details the process undertaken to design and implement various measures to enhance household and communal rainwater harvesting infrastructures in Tokelau.

Tokelau's water resources are scarce and the country relies solely on rainwater harvesting for all its freshwater needs. Prior to the PACC+ project, rainwater harvesting systems were not optimised to capture and store sufficient water to provide for the country during drought periods.

The PACC+ project engaged an external team of water and sanitation experts to scope out possible options for the project. Following this technical assessment, a baseline survey, review of existing literature, consultations in each village, and consultations with the Government of Tokelau, rainwater harvesting system upgrades were selected for all three villages.

In order to avoid duplication of effort, the project focused on implementing adaptation measures identified in the Integrated Waste Management, Water and Sanitation Review and Action Plan, the guiding document for the water sector. Project implementation started in 2012. Activities included installing new guttering and connections, carrying out repairs to existing water tanks, installation of first flush diverters, and a programme to raise awareness on water conservation and also rainwater harvesting equipment and its care and maintenance.

The project experienced some delays in its implementation, essentially due to coordination issues. With the main governing body (and the PACC+ coordinator) operating from Samoa, and the isolation of the islands from each other, this poses a challenge. A lesson learned from the project is that strong coordination mechanisms are needed to implement such projects in Tokelau.

ABBREVIATIONS

EDNRE	Economic Development, Natural Resources and Environment Department
EEZ	Exclusive economic zone
ENSO	El Niño Southern Oscillation
FFD	First flush diverter
GEF	Global Environment Facility
GoT	Government of Tokelau
ICZM	Integrated coastal zone management
IWRM	Integrated Water Resources Management [project]
NGO	Non-governmental organisation
PACC	Pacific Adaptation to Climate Change [project/programme]
PACCSAP	Pacific–Australian Climate Change Science Adaptation Planning [program]
PCCSP	Pacific Climate Change Science Program
RO	Reverse osmosis
SLM	Sustainable Land Management (project)
SOPAC	Applied Geoscience and Technology Division of SPC
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TALO	Tokelau Apia Liaison Office
ToT	Training of trainers
USP	University of the South Pacific
WHO	World Health Organization

1. INTRODUCTION

The Pacific Adaptation to Climate Change (PACC) programme is the largest climate change adaptation initiative in the Pacific region, with projects in 14 countries and territories. PACC has three main areas of activity: practical demonstrations of adaptation measures; driving the mainstreaming of climate risks into national development planning and activities; and sharing knowledge in order to build adaptive capacity. The goal of the programme is to reduce vulnerability and to increase adaptive capacity to the adverse effects of climate change in three key climate-sensitive development sectors: coastal zone management, food security, and water resources management. The programme began in 2009 and ended in December 2014 (with some ongoing activities to March 2015).

As a territory of New Zealand, Tokelau does not benefit from Global Environment Facility (GEF)-funded regional aid programmes such as the Integrated Water Resources Management (IWRM) project, the Sustainable Land Management (SLM) project or PACC. Although Tokelau was not included in the PACC project, the country was able to benefit from additional funding to the PACC project made available by the Australian Government in 2011, called PACC+. PACC+ aims at replicating or upscaling successful demonstration projects implemented by the initial PACC project. However, because Tokelau did not have any previous PACC project structure in place for PACC+ to build on, the PACC+ in Tokelau was established with the same structure, goal and objectives as the original PACC project.

PACC+ Tokelau also differs slightly from other PACC projects because its scheduled start coincided with a declaration of drought for the territory in October 2011. As a result, the focus of the PACC+ project, which was originally to incorporate both coastal management and water resources management, was changed to solely address water management issues.

Moreover, the available funding was essentially diverted to the demonstration project (Outcome 2), in order to provide a quick and efficient response. Communication and awareness activities (Outcome 3) were incorporated later on, after the urgent drought-response activities were completed.

Recognising the high risk that drought events pose to the country, the PACC+ project is working to enhance household and communal rainwater harvesting infrastructures to better capture and conserve the limited water available and develop resilience to drought at both the household and community level.

This report has been developed as a key output of the Tokelau PACC+ demonstration project. The report details the process undertaken by the project team to design and implement various measures to enhance household and communal rainwater harvesting infrastructures in Tokelau. The report is mainly directed at government agencies, local non-governmental organisations (NGOs), regional organisations and donor agencies interested in pursuing efforts to maintain and develop rainwater harvesting infrastructures in Tokelau. This document may also be valuable to climate change practitioners across the Pacific islands region involved in the development of similar water management projects.

In detailing the steps to design and implement the demonstration project, this document aims to provide the reader with the following information:

- An understanding of the challenges during drought events in Tokelau, and the added stress due to climate change;
- The current management of water resources in Tokelau;
- The water supply infrastructure prior to the PACC+ project;
- The design and implementation of measures to enhance household and communal rainwater harvesting infrastructures;
- Recommendations and lessons learned by the Tokelau PACC+ team that might help the design and implementation of similar projects.

1.1. PACC+ project objective and expected results

The goal for the PACC+ project in Tokelau is 'to contribute to reduced vulnerability and increased adaptive capacity to adverse effects of climate change in Tokelau'.

In accordance with the usual PACC project structure, three outcomes were developed to reach the PACC+ Tokelau overall goal:

- Outcome 1: Policy changes to deliver immediate vulnerability-reduction benefits in the context of emerging climate risks;
- Outcome 2: Demonstration measures to reduce vulnerability in water resources management;
- Outcome 3: Increased understanding of climate change impacts and awareness of how to adapt and build resilience (at community level).

However, as discussed in the previous section, the PACC+ project has focused on the demonstration project (Outcome 2) and the communication and awareness activities (Outcome 3).

1.2. Policy and strategic frameworks

The guiding document for Tokelau is the National Strategic Plan 2010–2015. The document defines medium-term goals for national development for the financial period 2010/11 to 2014/15.

For the climate change sector, the Climate Change Strategy has been endorsed by the General *Fono* (national assembly) in 2012. The document vision is to 'provide Tokelauans with climate change intelligence for safety, resilience, sustainability, well-being and prosperity'.

There is currently no water and sanitation policy for Tokelau, however it is intended to develop one from the village water and sanitation plans. The guiding document for the water sector is currently the Integrated Waste Management, Water and Sanitation Review and Action Plan, and associated Water Management Strategy. This document provides a review of issues and recommended actions for the water sector.

The PACC+ demonstration project is in line with these three strategic documents (Table 1).

Table 1. PACC+ links to national and sectoral policies.

Key policy or strategy	Sector	PACC project is contributing to:
National Strategic Plan	All	Goal 2: Improved standard of living through reliable, adequate and efficient infrastructure. • Section 4: Water and sanitation Key objective: To improve infrastructure design and increase storage capacity for water
Climate Change Strategy	Climate change	Outcome 3: Adaptation: climate-related risk reduction prioritisation and implementation • Water and sanitation Implementation of water resource management recommendations in the *Integrated Waste Management, Water and Sanitation Review and Action Plan*
Integrated Waste Management, Water and Sanitation Review and Action Plan	Waste, water and sanitation	Outcome 2: Physical: installation of 'leaf catches' and 'first flush diverters' for existing rainwater harvesting systems throughout each atoll of Tokelau

2. BACKGROUND AND CONTEXT

2.1. Geography and demographic background

Tokelau is a non-self-governing territory of New Zealand located in the South Pacific Ocean, about 500 km north of Samoa. The territory has three low-lying coral atolls, Atafu, Nukunonu and Fakaofo, with a total landmass of 10.8 km^2. Tokelau's exclusive economic zone (EEZ) covers about 300,000 km^2 (Figure 1).

The total population is 1,411 (2011), with a similar distribution on each island. The population of Tokelau is young with most people aged less than 30 years old (59%) (SNZ, 2012).

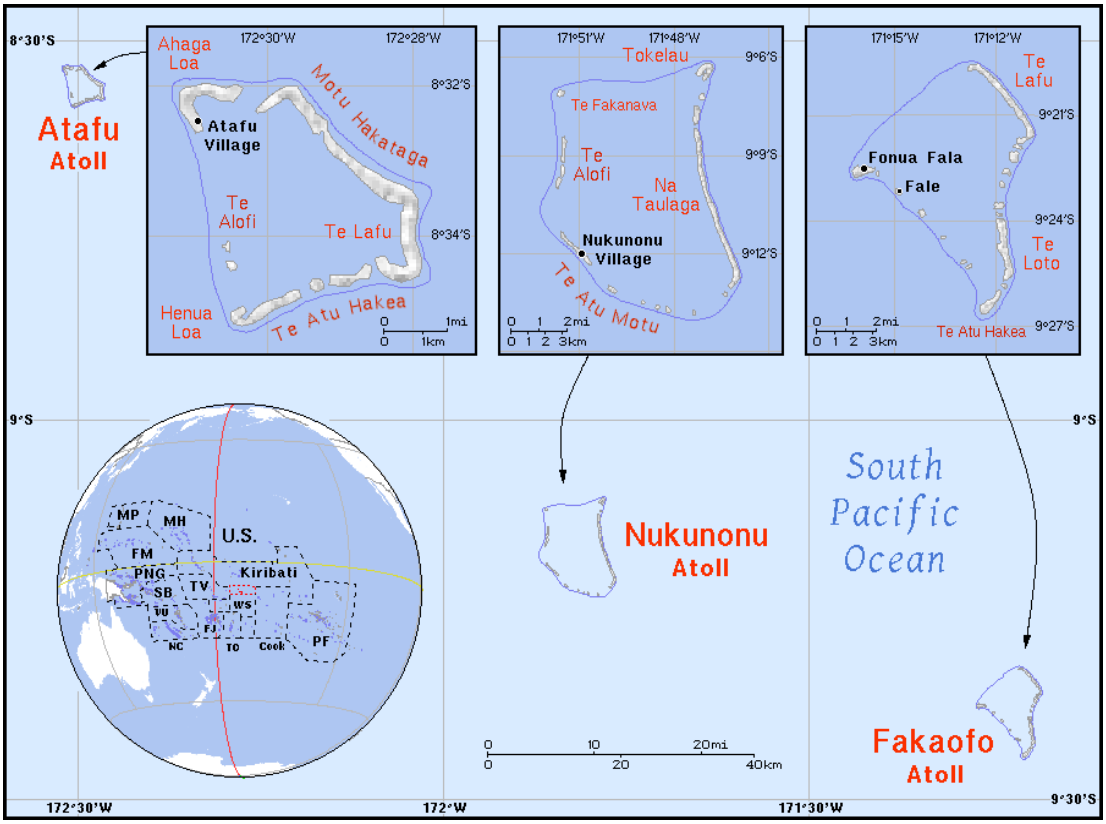

Figure 1. Map of Tokelau. (Source: Ian Macky: http://ian.macky.net/pat/map/tk/tk_blu.gif)

2.2. Economic and socio-cultural background

Historically, the three islands (which share the same language and social customs) have worked mainly independently from one another, each under the governance of a local chief. Since 1926, Tokelau has been under New Zealand administration. However, New Zealand has never had an administration base in Tokelau, which has limited its influence on the local governance (GoT, 2013).

The soil is relatively poor and only a few crops can be supported, such as coconut, breadfruit, pandanus, giant swamp taro, *taamu*, and banana.

The territory's economy is virtually restricted to fishing licence fees, and the Government of Tokelau receives budgetary support from New Zealand. Tokelau also has strong ties with its neighbour country, Samoa. Shipping varies from a weekly to a fortnightly basis from Samoa based on the need. There is no airport in Tokelau. The Tokelau national public service (also called Tokelau Apia Liaison Office or TALO) is based in Apia, Samoa (GoT, 2010; SNZ, 2012).

The TALO supports the Council for the Ongoing Government and the General *Fono* (national assembly), which provide policy direction at the national level. The *Ulu-o-Tokelau* (Head of Government) rotates every year from one atoll to another. Since 2003, Tokelau has been administering its own budget and each atoll is in charge of its own public administration. On each island, local government consists of the *Taupulega* (Council of Elders) led by an elected mayor (*Pulenuku*) and chief head of council (*Faipule*) (GoT, 2010).

Each *Faipule* has a ministerial portfolio. The Council for the Ongoing Government (which is composed of the three *Faipule* and the three *Pulenuku*) has ministerial responsibility over justice, public services and foreign relations (Figure 2).

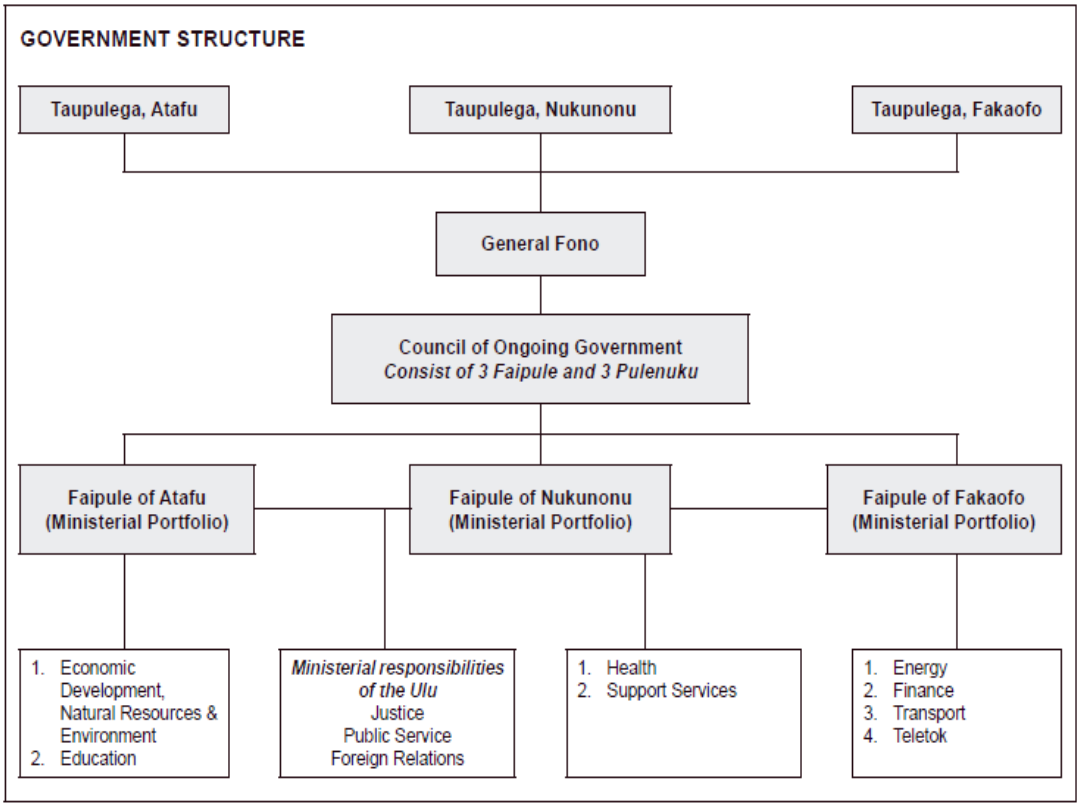

Figure 2. Tokelau government structure. (Source: GoT, 2010.)

Two important community-based groups in Tokelau are the *Aumaga* and *Fatupaepae*. The *Aumaga* represents the men in the community, and plays an important role in providing manpower and labour for community projects. The role of the *Fafine* group in the community is to lead in coordinating social activities such as awareness and outreach for public health and environmental safety (GoT, 2010).

2.3. Climate

2.3.1. Observed variability and trends

Tokelau's tropical climate is hot and humid throughout the year, with mean average temperature of 28°C. A wet season extends from November to April, when heavy rainfall usually occurs.

There have been no meteorological stations in Tokelau for the past 20 years and no accurate rainfall data are available for the period 1994–2013 (GoT, 2010; Australian BoM, 2014). According to Australian BoM (2014), the average annual rainfall for the period 1946–1986 at Nukunonu was 2,763 mm per year.

Three rainfall gauges were recently installed (September 2013) with the assistance of the Applied Geoscience and Technology Division of SPC (SOPAC) (SOPAC, 2014).

Similar to other Pacific island countries, the El Niño Southern Oscillation (ENSO) phenomenon influences Tokelau climate variability (Australian BoM and CSIRO, 2011). In Tokelau, a La Niña event brings drier conditions while during an El Niño event more than average rainfall is likely to occur. The last La Niña event in the region (2011) strongly affected Tokelau with a national emergency declared over the drought.

Tokelau is located in the Pacific tropical cyclone belt. According to GoT (2011), tropical cyclones have become more frequent in recent years, with the territory affected by cyclones in 1987, 1990, 1991 and 2005. ENSO events can also influence the likelihood and intensity of cyclones. During El Niño events, cyclones tend to occur more regularly in the western Pacific region (Australian BoM and CSIRO, 2011). In the case of a strong El Niño event, devastating cyclones have been observed (e.g. Cyclone Percy in 2005).

2.3.2. Projected trends

There is limited information available on Tokelau's future climate scenarios. As a territory of New Zealand, Tokelau was not included in the latest research on climate change in the region conducted by the Pacific Climate Change Science Program (PCCSP) and the Pacific–Australia Climate Change Science Adaptation Planning (PACCSAP) Program in 2011 and 2014. However, the regional trends from PCCSP and PACCSAP indicate that:

- Sea level is expected to continue to rise (very high confidence): from 1993 to 2009, sea level has been rising on average by 4 mm per year;
- Sea surface and air temperature will continue to rise (very high confidence): this includes an increase in frequency of extreme heat days;
- Ocean acidification will continue to increase (very high confidence);
- Annual and seasonal mean rainfall could increase (moderate confidence);
- Occurrence of tropical cyclone and drought events could decrease (moderate confidence) (Australian BoM and CSIRO, 2011).

3. THE TOKELAU WATER SECTOR

3.1. Overview

3.1.1. Water resources

The only source of freshwater in Tokelau is rainwater. Rainwater is used for all needs, including flushing toilets. Groundwater is mostly unused and is likely to be contaminated by sewage and other pollutants, as well as saltwater intrusion. Some wells have been used in the past but most have now been blocked by the villagers (some have been sealed and some are filled with rubbish) due to the health risks.

Although groundwater is not commonly used, it may be an important source of water during drought periods. For example, during the drought in 2011, groundwater was used in Atafu for building purposes. There is no information on the use of groundwater or seawater for flushing toilets and bathing during drought, but practices such as these are common in other atoll islands across the region and likely to also apply in Tokelau. Dedicated studies are needed to assess the opportunity of further using groundwater; SPC-SOPAC is scheduled to undertake these studies in 2015.

3.1.2. Water infrastructure prior to the PACC project

All of the households on Tokelau's atolls have either completed or partially completed rainwater-harvesting facilities. Concrete and polyethylene tanks are common storage. Under the Tokelau building code, new households are to be equipped with a concrete rainwater tank within the foundation of the house. Recent houses (>1990) generally have sufficient storage to meet the demand; however storage capacity of older houses is likely to be insufficient. Drought periods are a particular challenge to most of the households (GoT/SPREP, 2010).

Leaking tanks are an issue, commonly for older concrete tanks, but also in some cases for recent tanks that have not been built properly. This is being addressed by efforts to enforce the Tokelau national building code.

During the 2011 drought, each island was provided with a small desalination unit with a capacity of 15,000 L per day (OCHA, 2011). These have been maintained and are all currently functional at time of writing.

3.1.3. Sanitation

Sanitation facilities vary on each atoll. The main types are water-sealed toilets with septic tanks or cesspits and overwater latrines. Water-sealed toilets are a concern because precious freshwater is used for flushing. Also, most septic tanks are thought to have been poorly designed and are likely to discharge raw sewage into the groundwater. Cesspits are essentially holes in the ground allowing raw sewage to enter the shallow groundwater. Overwater latrines (on the lagoon side) are becoming less common but continue to pose a health risk for the community (GoT/SPREP, 2010).

3.2. Institutional and policy framework

Coordination of the water sector is shared by two main departments:

- The Economic Development, Natural Resources and Environment Department (EDNRE), which provides strategic and policy advice for water and sanitation management;
- The Department of Health, which is in charge of water safety.

The Council for the Ongoing Government is the overarching entity for the water sector. Legislation and policy development are processed through the General *Fono* for approval. Water and sanitation projects are being implemented on each atoll by the *Taupulega* under supervision from the Council for the Ongoing Government (Figure 3).

Tokelau has no overarching water and sanitation policy or plan. The main document for water management is the Integrated Waste Management, Water and Sanitation Review Action Plan. Each village has an endorsed Village Water and Sanitation Action Plan, and these will form the basis of the national policy and action plan.

Tokelau's current institutional and policy set-up for the water sector is positioned to provide support to water projects under various donors and partners. The EDNRE and the Department of Health are the main conduits whereby technical, human and funding support is channeled through to work on the ground.

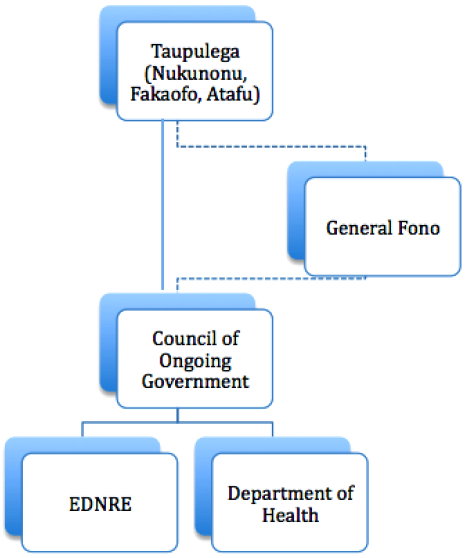

Figure 3. The water sector institutional framework in Tokelau.

3.3. Climate risks and vulnerabilities

The following are the major risks to the water sector due to climate variability and climate change.

- Drought: drought periods have always been a threat to Tokelau and will inevitably remain as one of the main risks to the water sector. The entire population is vulnerable because of the high reliance on rainwater and limited access to alternative sources of water.
- Cyclone: risks associated with cyclones include damage to infrastructure, livelihoods and biodiversity as well as coastal erosion and inundation. For the water sector, rainwater-harvesting facilities are at risk from damaging strong winds and pollution, and also saltwater intrusion (i.e. ground-level concrete tanks).
- Sea-level rise: the rise in sea level poses a serious threat to the country. With a very low elevation, the entire country is vulnerable and in the long term the territorial integrity of the islands could be threatened. Medium-term risks include the exacerbation of current threats such as coastal erosion, inundation, saltwater intrusion, storm surge and reducing freshwater resources that are already scarce (Australian BoM and CSIRO, 2011; GoT/SPREP, 2010; GoT, 2010).

3.4. Non-climate-related risks

- Pollution: contamination of groundwater with sewage effluent is a common problem in low-lying atoll islands. Although there is no regular monitoring of groundwater quality in Tokelau, it is acknowledged that in all three villages the groundwater is polluted, mainly from household sanitation systems. Even though groundwater is not widely used in Tokelau, this poses a risk, especially during drought when reliance on groundwater is likely to increase. Pollution also affects domestic rainwater harvesting facilities, with typical low maintenance increasing the risk of contaminants entering the system. There is currently no regular water quality monitoring for either communal or household water storage infrastructure.
- Infrastructure management: the rainwater harvesting infrastructure that Tokelau depends upon is ageing and in some cases, in poor condition. This increases the risk of pollutants entering the system. Additionally, not all buildings are properly connected to water storages, and guttering is not always designed to capture all of the roof runoff. There are also concerns over design standards for concrete water tanks as some recently built tanks appear to be already leaking.
- Population fluctuations, for example, during holiday periods when people return to the atolls. This temporarily increases the demand on water resources. This is however considered in the Village Water and Sanitation Action Plans, and additional water is brought in if needed.

4. THE DEMONSTRATION PROJECT

4.1. Preparatory phase

4.1.1. Planning

The inception report for PACC+ Tokelau was completed in July 2011.

At the inception meeting, it was proposed that PACC+ Tokelau focus on two priorities:

- Integrated coastal zone management (ICZM) – prevent the further loss of land from the effects of climate change for current and future generations; and
- Water resource management – ensure safe and sufficient water for all Tokelauans in response to the risks and impacts of climate change.

It was proposed to focus on water management for Fakaofo and Atafu and ICZM for Nukunonu. For each island, a set of options was proposed.

A multi-year workplan and a logical framework (logframe) were also drafted for the project. The report recommendations were to follow a 3-month inception phase to allow key stakeholders for the project on each island to agree on the project focus and set up a project management unit; use the existing project steering committee for infrastructure development as the steering committee for the PACC+ project, with some additional key stakeholders; and the Tokelau Liaison Office in Apia to act as the government and country contact for the implementing agency, SPREP.

However, by the end of the 3-month inception period, Tokelau was under severe drought conditions and a state of emergency was declared. As a result, it was agreed for PACC+ to focus on water resource management for the three islands, and to solely focus on the demonstration project (Outcome 2), as a drought relief activity.

An overview of the project process is given in Figure 4.

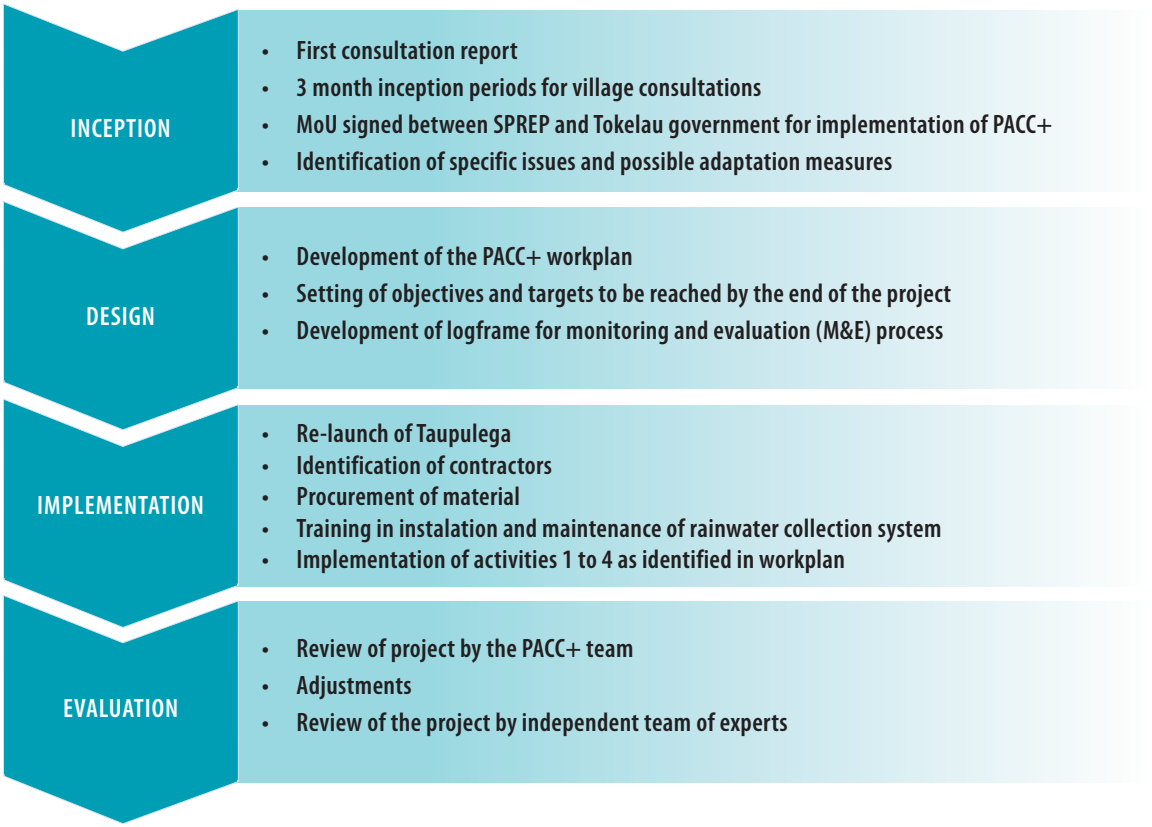

Figure 4. The project process.

4.1.2. Institutional framework for the PACC+ project

The PACC+ project is being hosted under the EDNRE with guidance from the Office of the Council for the Ongoing Government. A steering committee for the PACC+ comprises the General Managers (GMs) of the three villages (atolls), the Tokelau Apia Liaison Office (TALO) GM, the EDNRE Director and the PACC+ national project coordinator. At the village level, a focal point from each of the three villages facilitates activities on the ground, with support and oversight from the national project coordinator who is also the point of contact between the project and donors, partners and other national departments (Figure 5).

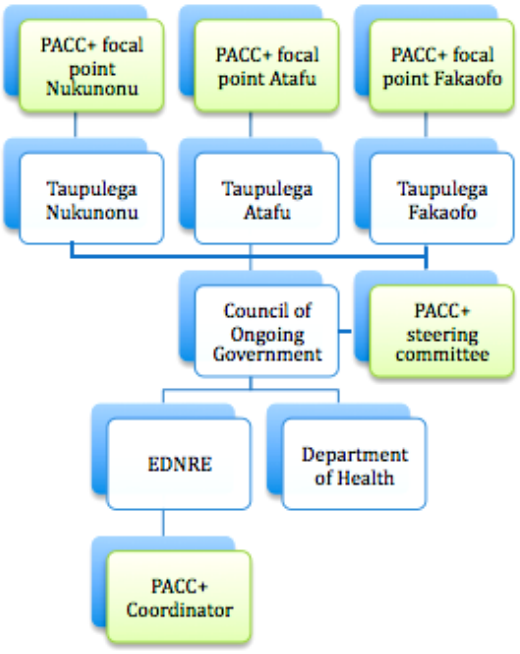

Figure 5. PACC+ institutional framework.

4.2. Situational and problem analysis

4.2.1. Assessment process

Because the territory was suffering a severe drought, project partners UNDP, SPREP and the Government of Tokelau agreed that it was necessary to act quickly. The PACC+ project in Tokelau therefore did not carry out any formal vulnerability and adaptation (V&A) assessment, cost–benefit analysis (CBA) or socioeconomic assessment (SEA). Instead, PACC+ engaged a team of experts, including a water and sanitation consultant, to develop a workplan for the project.

The team undertook a baseline review of existing literature, a technical assessment on each island, and community workshops in order to identify the main issues faced by each village regarding water management. This revealed that rainwater infrastructures were not optimised to capture and store sufficient rainwater for the community during drought periods.

The main issues identified by the village assessments are presented below.

4.2.2. Project sites and specific water management issues

FAKAOFO

Fakaofo Atoll has land area of about 3 km^2 with a central lagoon estimated at 45 km^2. The Atoll's population is split between two villages: Fale and Fenua Fala (Figure 6).

Specific water issues for Fakaofo are:

- The building code is not respected by households, nor enforced;
- There is limited community understanding of water and sanitation systems and issues; and
- Rainwater harvesting systems for some buildings (with great catchment capacity) are not being optimised or implemented.

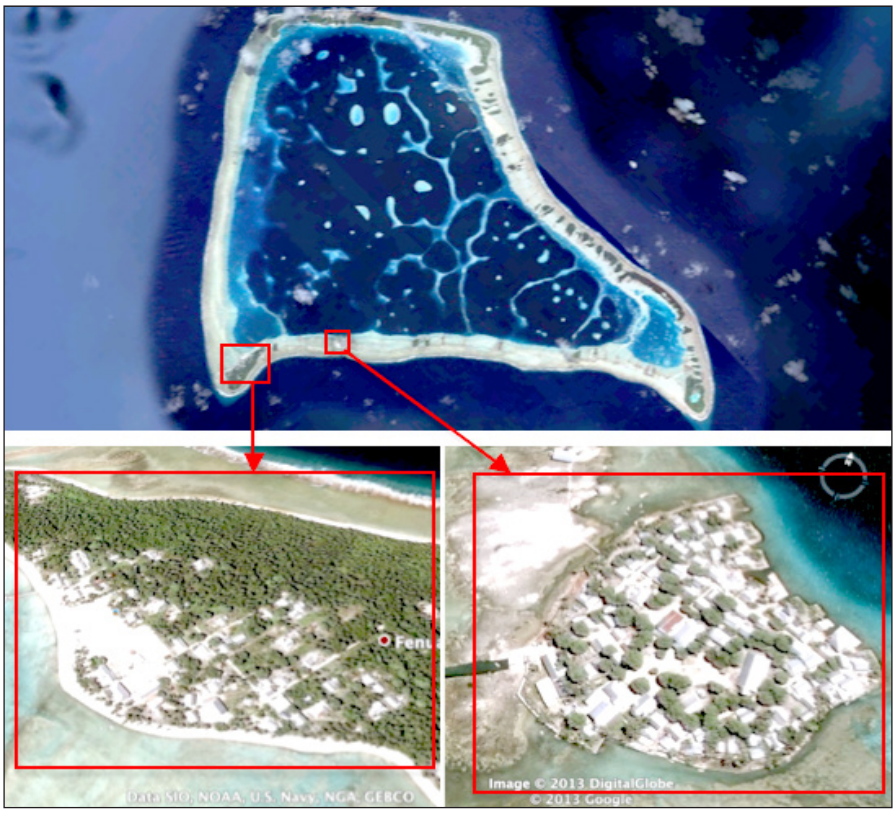

Figure 6. Fakaofo Atoll. Bottom left: Fenua Fala, right: Fale. (Source: Google Earth, 2014.)

Table 2. Summary of rapid assessment findings for Fakaofo Atoll.

Population	490	
Villages	Fale	Fenua Fala
Number of HHs	87	63
Public infrastructure	Local government	Hospital and School
Average number of people in HH	8	
Water demand	80 to 120 L/person/day	
Average HH storage capacity	34,000 L/35 days of storage[1]	
Sanitation type	Mostly cesspits	

HH = household.

[1] Assuming a full tank, average HH and highest demand figure (120 L/person/day).

NUKUNONU

Nukunonu Atoll has land area of about 5.5 km^2 with a central lagoon estimated at 90 km^2 (Figure 7). Specific water issues for Nukunonu are:

- Several public open toilets (direct discharge into the lagoon);
- Various community buildings have no water tank; and
- Lack of knowledge on installing and maintaining rainwater harvesting systems.

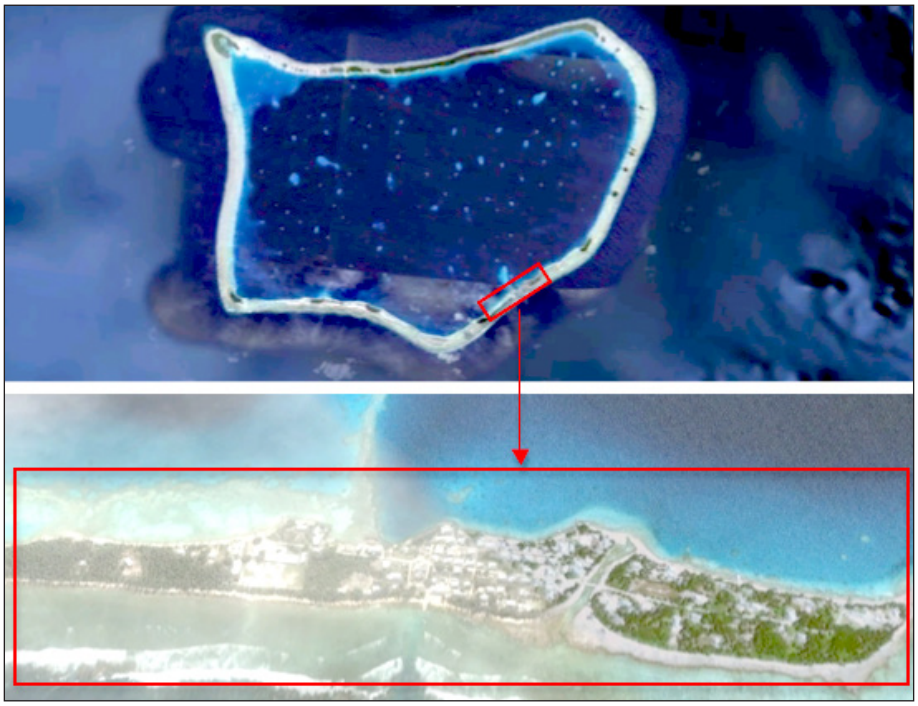

Figure 7. Nukunonu Atoll. (Source: Google Earth, 2014.)

Table 3. Summary of rapid assessment findings for Nukunonu Atoll.

Population	397 (222 males, 175 females)
Number of HHs	95 (not all inhabited)
Water storage type	Most HHs have concrete water storage within the foundation
Average number of people in HH	7
Estimated water demand	120 L/person/day
Average HH storage capacity	49,000 L/58 days of storage[1]
Sanitation type	Mostly dual chamber septic tank/Poor design and likelihood of groundwater pollution

[1] Assuming a full tank, average HH and highest demand figure (120 L/person/day).

ATAFU

Atafu Atoll land area is about 2.5 km^2 with a central lagoon estimated at 15 km^2 (Figure 8).

Specific water issues for Atafu are:

- Gutters and downpipes in a state of disrepair;
- Many large catchment roofs are not used to collect water/the previous communal water system has been abandoned; and
- Low community awareness of water quality related health risks.

Figure 8. Atafu Atoll. (Source: Google Earth, 2014.)

Table 4. Summary of rapid assessment findings for Atafu Atoll.

Population	482
Number of HHs	128 (not all inhabited)
Water storage type	Most HH have concrete water storage within the foundation
Average number of people in HH	8
Estimated water demand	120 L/person/day
Average HH storage capacity	38,000 L/40 days of storage[1]
Sanitation type	Mostly dual chamber septic tank/Poor design and likelihood of groundwater pollution

[1] Assuming a full tank, average HH and highest demand figure (120 L/person/day).

4.2.3. Summary of key issues identified for Tokelau

The main issues in regard to water management (prior to the PACC project) that were identified as critical and which may be exacerbated under future climate patterns are given for the entire territory in Table 5.

Table 5. Main issues for the water sector in Tokelau (prior to the PACC project).

- The building code for Tokelau is not appropriate to the local context and is not enforced.
- Although rainwater systems are in relatively good condition, some houses do not have an optimal system in place.
- Large catchments from community/public buildings are not well equipped (or not equipped at all) to collect rainwater.
- Some household concrete tanks are in very poor condition.
- There are no guidelines to build concrete tanks, resulting in poor design and leaking tanks.
- Many leakages in household water systems.
- Water in tanks may be polluted from salt-spray and bird excreta.
- A lack of awareness on water conservation.
- Institutional capacity for water governance on each island is low.
- There is currently no rainfall monitoring in Tokelau.

4.3. Solution analysis

4.3.1. Expert review and focus area

The need to upgrade the rainwater harvesting systems in each village was the first priority for both the community and the Government. The PACC+ expert team recognised that focusing on rainwater harvesting infrastructure would fit within the PACC+ objectives and budget. The demonstration project thus decided to focus on rainwater harvesting infrastructure for all three atolls of Tokelau. The expert team also gave great consideration to previous and ongoing work of Tokelau's government in association with regional NGOs and agencies such as SPREP and SPC. In order to avoid duplication of effort and to best coordinate aid initiatives for the sector, it was decided that the PACC+ workplan would also serve as the implementation plan for the Water Management Strategy (developed in 2010 as part of the Waste Management, Water and Sanitation Action Plan). Thus, some of the adaptation measures below were previously identified under the Water Management Strategy.

4.3.2. Selection of adaptation measures

The project proposed simple technical solutions to improve current rainwater harvesting facilities:

- Installation of new plastic tanks. New plastic tanks can be shipped from Samoa and fitted quickly to houses.
- Repair of concrete tanks. Existing tanks with minor leakages can be fixed with bituminous paint and sealant products, which is an affordable way to extend the lifespan of the tanks.
- Install first flush diverters (FFDs) and other technical improvements to collection systems. FFDs are an efficient and affordable way to reduce contamination of water.

In addition, the PACC+ project also proposed to develop a water awareness programme because, according to the PACC+ technical assessment, the level of awareness and knowledge on water conservation measures was very low.

4.4. Project design

The project design phase for PACC+ Tokelau included:

- Setting of objectives and targets for the project;
- Developing a workplan, including a detailed budget for implementation;
- Developing specific technical designs for each adaptation measure; and
- Developing a logframe to track project progress (see Section 4.5.2).

4.4.1. Objectives and targets

The main objective of the demonstration project was to have, by the end of the project, sufficient quality and quantity of water available to the three villages of Tokelau (Nukunonu, Atafu and Fakaofo) during dry spells.

A series of targets was developed to monitor progress and efficiency of the project, towards achieving the objective (Table 6). The targets are used within the logical framework (logframe) (see Section 4.5.2).

Table 6. PACC+ demonstration project targets.

- 100% of households have access to enough clean drinking water.
- 100% of people from both the community and government level benefit from the project.
- By the end of the project 100% of households have flush diverters installed.
- By the end of project, 100% of households have their water tanks and guttering repaired or replaced.
- 100% of households are aware of the need for water management and conservation.

4.4.2. Workplan

As part of the project design, additional data were collected in each village regarding the status of household rainwater infrastructures and water tank connections. Consultations were held with all three villages and with the TALO, UNDP and SPREP in order to agree on the workplan and budget.

The PACC+ workplan is also the implementation of Tokelau Water Management Strategy. The workplan includes a detailed table of activities including budget and timeframe for completion (Table 7).

Priorities 1 to 5 detailed in the workplan were given priority and it was agreed that the implementation phase would commence immediately.

Table 7. Tokelau PACC+ project workplan.

Priority	Task	Timeframe for completion	Who	Cost (NZ $)
1	Purchase scaffolding to complete installation of spouting and downpipes which have been supplied by New Zealand Defence Forces	1–2 months	Installation by local labour	$12,000 (ex NZ)
2	Rainwater connections	1–2 months	Installation by local labour after training	$76,934
3	Household tank water proofing	1–2 months	Installation by local labour after training	$145,875
4	Install 756 FFDs and rain heads	3–4 months	Installation by local labour after training	$330,939
5	Tank bladder trial, one on each atoll	4–6 months	Installation by local labour after training	$7,923
6	Tank liner trial in the rectangular tank near church in Fakaofo	4–6 months	Installation by supplier with specialised equipment	$26,188
7	Additional storage tanks	4–6 months	Installed by local labour, or constructed by skilled workers	$159,300
8	Plumbing systems	4–6 months	Installation by trained plumbers	N/A
9	Modifications to Tokelau Building Code	6–8 months	Standard design by qualified professionals	N/A
10	Governance	6–8 months	As agreed by General *Fono*	N/A

4.4.3. Technical design for selected adaptation measures

NEW PLASTIC TANKS AND FITTINGS

The new tanks were 10,000 L tanks produced by Samoa Superior Poly Products and shipped from Apia. Fittings were supplied with the tanks.

Concrete bases for the tanks to stand on were constructed by the communities.

CONCRETE TANK REPAIRS

The concrete tank repairs used bituminous paint and sealant products available on the market. The method consisted of sealing the concrete surface with epoxy sealer and filling cracks with fibreglass strips and bitumen. The generic method is detailed in Appendix 1.

INSTALLATION OF FIRST FLUSH DIVERTERS

The first few litres of water collected from a roof (first flush run-off) can carry contaminants. FFDs enable the diversion of these first few litres of water away from the water tank (Figure 9). FFDs need to be properly installed to ensure their efficiency and sustainability. Under the PACC+ project, the contracted plumbing company (Rainline Water Solutions) carried out a training programme and prepared an installation tutorial sheet (Appendix 2).

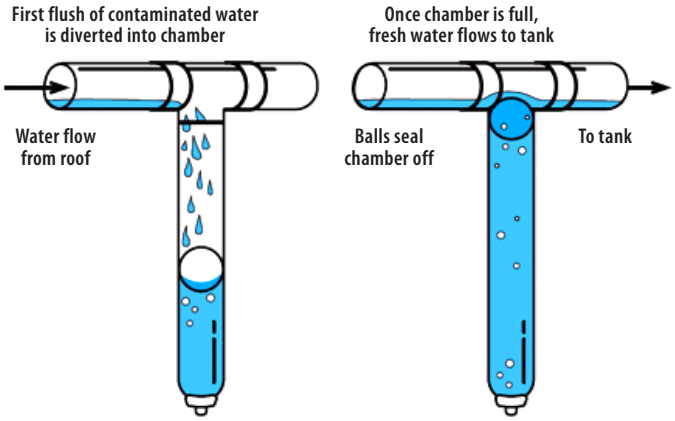

Figure 9. FFD operation diagram.
(Source: Sinvac Plastics, http://www.sinvacplastics.co.za/38firstFlushDirector.html)

4.5. Implementation, monitoring and evaluation

4.5.1. Implementation

The project implementation started in early 2012, with consultations on all three atolls to relaunch the *Taupulega* (Council of Elders) and reaffirm the villages' commitment to the project.

The *Taupulega* for all three villages took ownership and contributed greatly to the progress of the project. Despite commitments of village labour and capacity to other development projects, they addressed the water issue as a priority. They allocated working groups to ensure that progress was made and every effort put into the project activities.

Scaffolding was purchased and delivered to all three villages by mid-2012. The remaining activities were prioritised according to the availability of workers and contractors in each village, as well as availability of materials which depended on shipping schedules and operations. Each village thus progressed at different speeds for each activity.

GUTTERING AND CONNECTIONS

In Nukunonu, the guttering and rainwater tank connections were carried out by the Samoan company, Kiara Enterprise, along with local plumbers. Kiara Enterprise also carried out training with local plumbers. The activity was completed by July 2014.

Fakaofo and Atafu allocated their own local labour force to work on their harvesting systems and had nearly completed this activity at the time of writing (January 2015).

TANK REPAIR

The concrete tank repair activities (Figure 10) took more time than anticipated due to the process involved and the drying time required. Following the methodology provided by the supplier (see Section 4.4 and Appendix 1), the project found that it takes approximately two months from start to finish:

1. Empty water out of tank – 1 day;
2. Wash and flush all rubbish from tank – 2 days;
3. First coat application and drying – 2 weeks;
4. Second coat application and drying – 2 weeks;
5. Test and inspect to see if okay, otherwise another coat may be needed.

As of January 2015, the tank repair phase was completed on Nukunonu, and still in progress on Atafu.

In Fakaofo, the working group decided that the tank repair process was too lengthy and might not be effective if rushed. They decided to stop this activity and use the remaining funds to purchase new plastic tanks instead.

Figure 10. Kiara plumbers with the Nukunonu PACC+ focal point Mr Mikaele Maiava supervising the tank repair activity. (Photo: PACC+ project.)

INSTALLATION OF FIRST FLUSH DIVERTERS

After training was carried out by Kiara Enterprise, local plumbers were able to install the FFDs and also share their knowledge and training with interested householders. This process has been lengthy, essentially due to the training process involved and the need for the experts to travel to each village, and also the availability of local plumbers. As of January 2015, on Fakaofo 82.5% of this phase is completed; on Nukunonu 65.5% is completed; and on Atafu the figure is 30% (Figure 11).

Figure 11. House with new guttering and two FFDs connected to under-house concrete tank. (Photo: PACC+ project.)

INSTALLATION OF ADDITIONAL TANKS

The procurement of the 60 tanks (20 per village) started at the end of 2013. By January 2015, all new tanks had been installed for all three atolls.

4.5.2. Monitoring and evaluation

The PACC+ project uses a logical framework (logframe) to monitor progress against the project outcomes. For each outcome, a series of targets has been identified that should be achieved in order to reach the project outcomes. Each target is associated with an indicator that is measured and compared against the baseline value (i.e. value at the start of the project) to evaluate progress. As much as possible, quantitative indicators are used to monitor progress (Table 8).

Table 8. Simplified logframe for the Tokelau PACC+ project.

Outcome 2: Sufficient quality and quantity of water available to the three villages of Tokelau (Nukunonu, Atafu and Fakaofo) during dry spells and seasons			
Indicator	**Source/data collection method**	**Baseline**	**Target**
% of households with acceptable water quality	Monitoring and evaluation of results Data of households and communal buildings in the Tokelau PACC+ Implementation plan Water committee report Water testing reports from Health Dept Progress reports	Only 25% of the water sampled is within WHO potable water guidelines	100% of households access clean drinking water
Total number of people and communities benefiting from the project (gender disaggregated)	Post-project survey		100% of people from both community and government level benefit from project
% of homes with FFDs installed	Progress reports, project records	No household tanks with flush diverter No water is tested	By end of the project 100% of households have water testing and FFDs installed
% of household with water tanks and guttering repaired and installed		95% of households have damaged/ leaking water tanks and dysfunctional guttering	By the end of project, 100% of households have their water tanks and guttering repaired or replaced
Number of workshops Total number of people attending workshops on water awareness	Awareness programme reports	20% of households aware of need for water management	100% of households aware of need for water management

4.6. Adaptive management

A series of issues affected the progress of the implementation phase. The main issues faced by the project in all three villages were delays with shipping and a lack of available workers (due to them being already committed to other projects).

In Atafu, some of the challenges encountered by the team on the ground included a mistake in one order from the NZ-based company delivering the FFDs and connection components: the tees and elbows arrived in two pallets with different sizes, with some too big and not able to fit into the downpipes. Considering that the time between ordering and delivery can take up to two months, this affected the progress of the project. Similarly, the products needed to do the tank repairs were not supplied in sufficient quantity in the first shipment, so a second delivery was needed.

In Fakaofo, most of the delays were attributed to competing village priorities and lack of available labour. Also, a shortfall in connection material for the tanks (elbows and tees) created delay in the installation of the FFDs. After completing about a third of the planned tank repairs, the village *Taupulega* decided to redirect remaining funds for this activity towards the procurement of new plastic tanks as it appeared that the harsh climate conditions did not allow optimum repairs.

During the period in which water tank repairs were carried out, a forecast of another drought was issued through Tokelau meteorological services. This advice prompted the *Taupulega* of Nukunonu to opt for a different method to fix their water tanks. This method consisted of injecting sealant into the cracked areas of the tanks. As soon as the sealant comes in contact with water, the foam blows out and expands, covering all the cracked areas of the tanks, and thus preventing water from leaking out. This method was quite effective at the time as it managed to save the water during heavy rainfall periods in the months of July–September 2012. However, it was discovered that the sealant was not able to withstand the pressure from full tanks. The *Taupulega* of Nukunonu is now requesting through the PACC+ project for the adoption of the coating methodology used by Fakaofo and Atafu.

As part of the monitoring process, the PACC+ team recorded the main issues faced during the implementation phase and the adjustments made to address these issues (Table 9).

Table 9. Implementation issues and responses.

Issue	PACC team response
Procurement highly reliant on shipping schedules and changes to it	Materials predicted and orders placed in plenty of time to allow for delivery
Insufficient local labour to carry out work due to other village commitments	Hired plumbers from Samoa to assist the local labour force
Lack of understanding of FFD installation and maintenance	Providing local plumbers and community with ongoing awareness and training for FFD installation and maintenance
No clear maintenance and cleaning plan/responsible personnel	Establishing village water and sanitation working groups to provide clear guidance for families to take ownership and become responsible for maintaining water harvesting infrastructure

4.7. Training, knowledge sharing and awareness

Community engagement and training has been an ongoing activity for the PACC+ project in each village. Widespread consultation has taken place at village and government level to increase ownership of the project and increase community awareness on better management of water in each village.

A series of workshops was held to train public health officials and students of the University of the South Pacific (USP) in drinking water risk assessment and sanitation surveys. Public health staff and USP students have then been delivering workshops and training activities to the community.

Poster competitions were organised to raise school students' awareness about water issues. They have proven to be very effective in engaging the entire community (Figure 12).

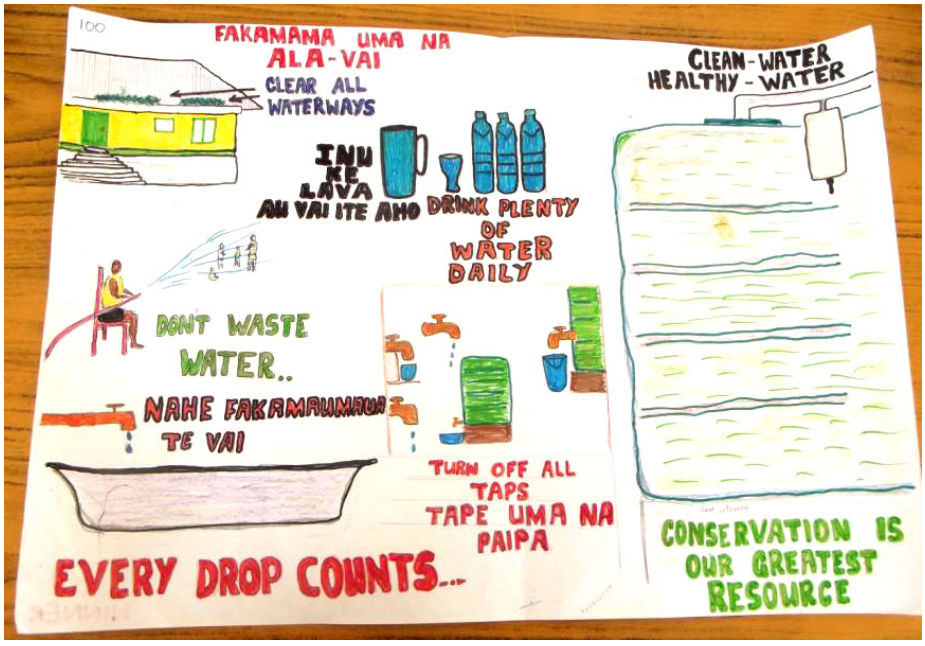

Figure 12. Winning poster from the 2013 poster competition. (Photo: PACC+ project.)

Training sessions were also delivered by three contractors (Kiara Enterprise, A–Z Plumbing and a private contractor) to local plumbers during the installation of FFDs. The training covered FFD installation, guttering and rainwater connections. Village workshops were held to raise awareness on maintenance of water catchment and associated infrastructure (guttering, FFDs and tanks).

A training of trainers (ToT) workshop was carried out in Apia, Samoa, focusing on training youths, health workers and environment officers to carry out programmes to build community awareness on water and sanitation. This workshop also allowed participants from various groups to develop their own village water and sanitation action plans, which was a highlight of the workshop. These plans are now endorsed in the villages.

Other regional target audiences were identified by the project, and communications products were developed and disseminated. Examples include news stories published on the PACC webpages (www.sprep.org/pacc) and further circulated in the online newsletter Climate Change Matters; a 'country brief' describing the project and targeting decision makers across the region; and the video Vital Health produced in 2014 and broadcast at national, regional and international events. Information was also drawn from the Tokelau PACC+ project in synthesis publications, in particular the PACC Experiences series (see for example PACC Experiences No. 4: Building resilient freshwater systems).

The PACC webpages (www.sprep.org/pacc), and in particular the Tokelau project webpage (http://www.sprep.org/pacc/tokelau), was the main dissemination tool used to share information and knowledge generated by the project with regional and international audiences. Outputs are also being shared through the Pacific Climate Change Portal, and other online information hubs, such as the Climate & Development Knowledge Network (CDKN), Eldis and ReliefWeb.

5. SUSTAINABILITY, RELEVANCE, EFFECTIVENESS AND EFFICIENCY

5.1. Sustainability

The Tokelau PACC+ project has taken a 'no regrets' approach, i.e. improvements made for the water sector are necessary and will benefit the community regardless of climate change scenarios. Enhancement of the rainwater infrastructure should deliver quick benefits for the entire Tokelau community while also improving overall resilience to drought events.

The project has improved rainwater harvesting and storage for the three communities of Tokelau. However, the sustainability of the project will depend on local skills, knowledge and capacity to maintain and repair the infrastructure.

Critical aspects to ensure project sustainability are:

- Ensuring appropriate training in rainwater harvesting equipment maintenance and tank repairs for key community members on all three islands – the project has carried out this training, as described in Section 4.7; and
- Developing awareness around rainwater infrastructure maintenance needs, water quality and water conservation – the project has begun an awareness programme, as described in Section 4.7.

Other factors affecting sustainability of the project are given in Table 10.

5.2. Relevance

The PACC+ project in Tokelau is relevant to and aligned with the territory's national policies and plans, as described in Section 1.1.2.

In Tokelau, rainwater is the main source of freshwater, which introduces risk, especially during drought periods. The project has focused on key needs identified by the communities and the Government which were not being addressed by other projects. At the start of the project, groundwater investigations were set to be undertaken by SPC-SOPAC in the coming years. New Zealand and Samoa were providing small reverse osmosis desalination units. It was thus relevant for PACC+ to address rainwater harvesting issues identified in the Integrated Waste Management, Water and Sanitation Review and Action Plan, in order to sustainably improve the water supply for all three islands.

Table 10. Factors affecting sustainability of project interventions.

Domain	Factor	Details
Socio-cultural	Water demand	Although there is no clear indication of population growth in Tokelau, water demand has increased with the introduction of sealed toilets and washing machines. The project is addressing this issue in improving rainwater catchments and storage efficiency
	Cultural compatibility	The proposed enhancement does not modify the status quo of rainwater harvesting techniques in Tokelau
Infrastructure	Life span	One aspect of the project was to increase lifespan of current storage tanks. However, these are only temporary fixes and cannot be seen as a permanent repair. Bituminous paint and water sealant in the Tokelau environment will have a lifespan of between 5 and 10 years (depending on the quality of the work). PVC guttering and downpipe lifespan depend on the material. The pipes installed with the PACC+ project have an estimated lifespan of 25+ years under Tokelau environmental conditions
	Maintenance	Required maintenance is relatively inexpensive, does not require particular skills but does need to be regular. Downpipes and gutters need regular cleaning and concrete water tanks might need to be repainted/sealed every 5–10 years
Political	Political support/ in line with public policy/political agenda	The project is in line with the three national strategic documents as detailed in Section 1.1.2
	Policy development	Promotion of policy that enforces building codes to ensure new tanks are longer lasting, new homes and infrastructure with cement water tank bases are built to standard and last
Economic	Energy consumption	No modification of status quo
	Net benefit/return on investment	This is a community project and no benefit or return on investment is expected. However, in extending the lifespan of current water infrastructure, the project reduces the need for the government and householders to purchase or build new storage tanks
Environmental	Freshwater resources	Negligible impact as groundwater use is very low in Tokelau
	Adverse effect on environment	None identified at this stage
	Climate resilience	The project is increasing resilience to drought events by optimising rainwater harvesting systems. Downpipes and gutters are vulnerable to cyclones, but concrete rainwater tanks can endure cyclone winds. Underground concrete cisterns are at risk of pollution from extreme rainfall events (flooding)

5.3. Effectiveness

The work undertaken to improve domestic and communal rainwater harvesting has been effective, with successful repair of 137 concrete tanks, maximisation of rainwater harvesting with guttering covering 100% of roofs and FFDs installed to increase water quality.

Assessing full project effectiveness would be possible only after completion of the project. The current plan is for assessment to be carried out by the PACC+ team through a community perception survey. An independent review of the overall project will also take place at the end of the project, providing more insight on the project effectiveness.

A brief community perception survey was conducted in mid-2013 by the PACC+ team. The main results of the survey were:

- Fakaofo: Nearly half of the tanks had been repaired and were not leaking anymore. The community would like to use the PACC+ project opportunity to further develop the skills of their local plumber in order to best maintain the current infrastructure.
- Nukunonu: Most of the tanks had been fixed and were not leaking anymore. However many families in the village were yet to have their own water tank.
- Atafu: The community was reported to be satisfied with the project. The community was waiting for all FFDs to be installed before the water quality testing could be done.

Although not possible at this stage, assessing the long-term effectiveness of concrete tank repair under Tokelau environmental conditions will provide valuable insight for other Pacific island countries with old concrete tanks.

5.4. Efficiency

The efficiency of the PACC+ project was maximised by 'in-kind' provision of most of the labour from the villagers in all three villages. Each village was in charge of its own budget to implement activities discussed and agreed under the PACC+ workplan. However, alterations were made to the workplan in some cases in order to ensure that allocated resources were best used. An example is on Fakaofo, where the working group identified that procuring new plastic tanks would provide a more durable alternative to tank repair, even though fewer households would benefit from the project.

6. LESSONS LEARNED

6.1. Overall

In the particular context of Tokelau, with three isolated atoll islands and the project coordinator based in Samoa, effective communication and coordination is vital. One of the main lessons learned from the project is that definition of roles and responsibilities at national and village level needs to be very explicit from the start of the project. With projects running on three islands and only one ship every fortnight to provide necessary supplies, coordination mechanisms also need to be explicit and well understood by all project stakeholders.

For example, various materials needed to be shipped to the islands, and most of the project delays were due to delays in delivery of the materials. Better coordination between villages and national agencies such as the Office of the Council for Ongoing Government and departments of Transport and Health would have improved the likelihood of the correct material arriving in the right amount and on time.

Another area that may have benefited from better coordination is the management of labour at the village level. Most of the villagers volunteering to implement the PACC+ project were also involved with other projects. This would ideally have been taken into account during project planning in order to integrate the PACC+ project within the village priorities. However, the urgency of the PACC+ project may have precluded this.

The context of severe drought that coincided with the inception of the PACC+ Tokelau encouraged the project team to act quickly and speed up consultations in the villages. A more comprehensive inception phase with more time allocated to consultations would have likely helped to better understand the context and local challenges in implementing the project.

6.2. Step by step

As part of the M&E process, the project team made quarterly reports on progress, issues faced and lessons learned in dealing with these issues. Table 11 summarises the main lessons learned by the PACC team in this way.

Table 11. Lessons learned by the project team during the course of the project.

Process	Lessons learned
Coordination	• Better communication channels between project/national/village • Clear attribution of roles and responsibilities for all stakeholders
Community engagement, awareness and training	• It is important to acknowledge that cultural sensitivities exist and find the best way to address issues with community groups (e.g. social activities, consultations, awareness activities requiring maximum participation) • People are aware of changes in environment and climate through their own experiences, so it is important to capture personal accounts during consultations • Poster competitions and posting on billboard are very effective ways to engage all age groups
Implementation	• Demonstration work (installation of tanks etc.) needs to be planned to take into account national and village activities for a smoother and more speedy implementation

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APPENDIX 1. CONCRETE TANK REPAIR FACTSHEET

Sealing cracked and eroded concrete water troughs and Reservoir Water tanks using Duromastic Bitumen

It is essential to empty, clean and dry the interior of the tank/ trough to assess the best method of repair. Regis Industrial Ltd staff will be glad to advise on the best repair method, but generally the following procedure will be recommended.

1. Remove any loose aggregate in the area to be coated using a brush, vacuum or Waterblaster. Area must be structurally sound and free of contamination .
2. Ensure area is no more than slightly damp. Prime area with one heavy coat of Duromastic EP Hibuild @ 5m²/ litre. Duromastic EP Hibuild is a non-solvent, two pack epoxy sealer. Allow to dry.
3. Stir Duromastic BE-3 thoroughly. DO NOT THIN BITUMEN.
4. Bandage all significant cracks and base/ wall junction using chopped strand fibreglass cloth cut into strips 100-200mm wide as follows: Coat the area over cracks with a heavy coat of Duromastic BE-3 bitumen using a soft brush/ broom then immediately lay C.S matting onto the wet bitumen, then apply bitumen over and work in well with brush.
   Continue to apply bitumen to ensure no pin holes in cloth. Apply one heavy coat to entire wall and floor. Allow to dry.
5. Over coat complete area with one or two more coats of Duromastic BE-3.
   Apply each coat at right angles to previous to ensure a thick even build.
   Final coverage should be 1-1.5 litres/ m².
6. **IMPORTANT**: Ensure bitumen is thoroughly dry and cured before filling tank with water. A simple test to check if cured is to use a clean **damp** cloth, lightly rub over dry coating. No staining should be evident on cloth.

   Refer to specific current product data sheets before use.

   Date: 11-3-2010

Statements made are based on experience and tests believed to be reliable and should be taken as a general guide only. The users must satisfy themselves as to the suitability for a particular application. Since the use of this product is beyond the control of the manufacturer no warranty is expressed or implied.

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APPENDIX 2. FIRST FLUSH DIVERTER INSTALLATION CHECK LIST FOR PACC+ PROJECT

First Flush Diverter Installation Check List for PACC+ Project

1• Inspect gutters and spouting and remove any debri and leaves. Repair any damaged guttering and seal holes

2• Determine how many FFDs to install based on number of catchment areas/downpipes and rainwater tanks

3• Measure catchment area of roof to determine FFD chamber size. Check FFD specification sheet how much water to divert and length of chamber to achieve this. Take into account roof pollution from birds, trees and dust.

4• Install rain heads on fascia board below spouting dropper

5• Position FFD on wall allowing enough fall from bottom of the rain head to top of FFD with some fall in the pipes. Keep in mind access to the control valve & filters at the base of the FFD.

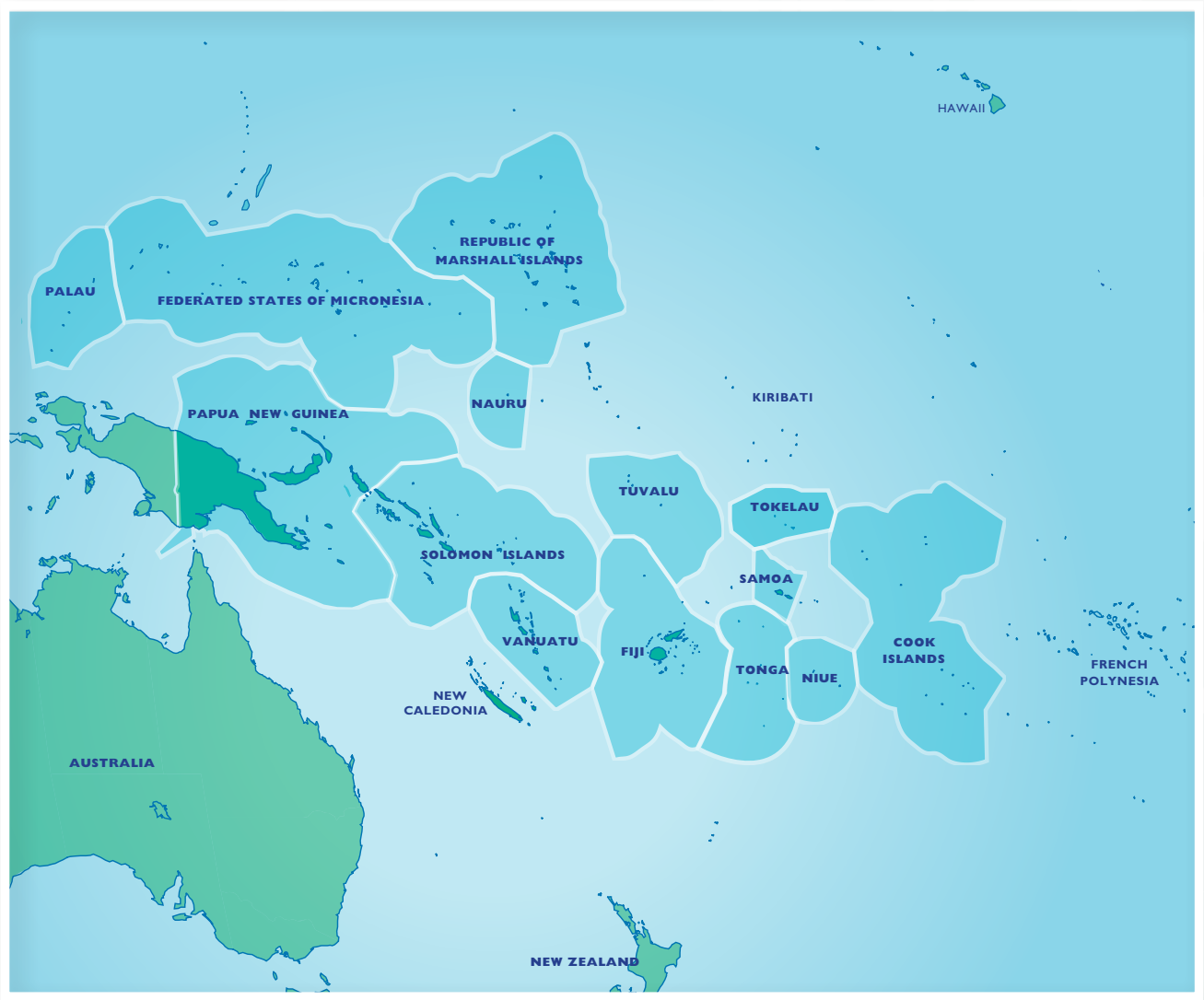
6• Insert ball seat in the top of the FFD, this is critical to ensure ball cannot escape FFD housing. Glue 80/90mm adaptor into the top. Insert a T Junction on top of the 80/90 mm adaptor.

7• Connect pipe work from bottom of rain head to top of FFD. Pipe configuration will differ depending on number of downpipes and position of FFD.

8• Connect pipe work from T junction into rainwater tank.

NOTE: Always ensure your pipework is configured in a way that rainwater will fall first into the FFD and not directly into the rainwater tank.

9• Select a control valve size and install black ball, filters and crew cap.



PACC – building adaptation capacity in 14 Pacific island countries and territories

PACIFIC ADAPTATION TO CLIMATE CHANGE (PACC) PROGRAMME

The PACC programme is the largest climate change adaptation initiative in the Pacific region, with activities in 14 countries and territories. PACC is building a coordinated and integrated approach to the climate change challenge through three main areas of activity: practical demonstrations of adaptation measures, driving the mainstreaming of climate risks into national development planning and activities, and sharing knowledge in order to build adaptive capacity. The goal of the programme is to reduce vulnerability and to increase adaptive capacity to the adverse effects of climate change in three key climate-sensitive development sectors: coastal zone management, food security and food production, and water resources management. PACC began in 2009 and is scheduled to end in December 2014.

The PACC programme is funded by the Global Environment Facility (GEF)'s Special Climate Change Fund (SCCF) and the Australian Government with support from the United Nations Institute for Training and Research (UNITAR) Climate Change Capacity Development (C3D+). The Secretariat of the Pacific Regional Environment Programme (SPREP) is the implementing agency, with technical and implementing support from the United Nations Development Programme (UNDP).

www.sprep.org/pacc

PACC TECHNICAL REPORTS

The PACC Technical Report series is a collection of the technical knowledge generated by the various PACC activities at both national and regional level. The reports are aimed at climate change adaptation practitioners in the Pacific region and beyond, with the intention of sharing experiences and lessons learned from the diverse components of the PACC programme. The technical knowledge is also feeding into and informing policy processes within the region.

The Reports are available electronically at the PACC website: www.sprep.org/pacc, and hard copies can be requested from SPREP.

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