BARRIERS TO EFFECTIVE SOLID WASTE MANAGEMENT IN PACIFIC ISLAND COUNTRIES

by

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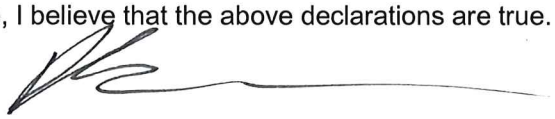
Signed: 

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Abstract

Solid waste management (SWM) in Pacific Island Countries (PICs) poses a challenge to communities, organisations and governments. Pacific islands are often small with limited land area, and have low population densities with the population spread widely across a large number of islands.

Increasing globalisation and consumerism within PICs is also leading to increased amounts of solid waste, in particular plastics and packaging that many countries are not equipped to appropriately deal with.

Data was collected from three PICs from the community, solid waste service providers and national governments in order to determine social, organisational and governmental barriers to effective solid waste management.

Analysis of the collected data demonstrated that:

- SWM a key issue across all countries surveyed, though to varying extents
- Awareness, access and affordability identified as primary barriers
- Community engagement is a crucial aspect of long term success of SWM schemes

Keywords: SWM, solid waste trends, community survey, SIDS (Small Island Developing States)

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Executive Summary

Background

Pacific Islands Countries (PICs) are a collection of a number of sovereign island states that lie in the western Pacific Ocean. The Pacific Islands are comprised of some 20,000 to 30,000 islands that are populated by approximately 4 million people. Some islands are relatively large in both size and population, such as Fiji, whilst others are split across multiple small islands, such as the Solomon Islands which is comprised of over 1,000 small islands and atolls. Islands comprising a single nation can be highly dispersed. Kiribati for example has 33 islands spread across a region of ocean larger than India (World Bank, 2014).

PICs have seen a relatively sharp rise in development in recent times, with a range of international donors, both governmental aid agencies and NGOs, investing in infrastructure, water, sanitation, health and education.

Increasing development and exposure to international goods and trade has resulted in PICs having to deal with increasing volumes of packaged waste (Mataki, 2011, p. 5). Infrastructure to recycle these wastes are often not available, with the result that they are either discarded directly to the environment, or sent to landfill, shortening the landfill's operational life (WHO, 1996, p. 2).

PICs face a complex future with regard to solid waste management as the amount of waste to manage increases, while space to implement management facilities reduces.

Project Aim and Objectives

The project aims to identify barriers to the effective management of solid waste within Pacific Island Countries. The project would seek to identify barriers in governmental, organisational and community spheres.

In addressing the project aim, the key objectives were to:

- Determine the current state and future trends of solid waste management in the Pacific
- Determine current community opinion on the state of solid waste management in their countries
- Determine community behaviour and expectations with regard to solid waste
- Determine if solid waste management organisations are appropriately placed to deliver services to the community.

Scope of Research

The primary focus was on residential solid waste, in large part as this was the subset of the community that was most contactable during the survey.

Some research was also conducted into other solid waste streams, such as medical, industrial and commercial, but it was not proposed to contact these groups specifically.

The countries investigated were all Pacific Island States. Only independent states were proposed to be part of the data collection, as islands that are the territory of another state (such as Australia or the UK) are likely to have access to funds and resources that are not available to island states. Furthermore, as the data is proposed to be collected via Australian Volunteers in the south Pacific, the scope was further restricted to those countries in which volunteers are currently operating.

Methodology

Three primary research methods were employed in undertaking the study, namely a literature review, distribution of electronic surveys and a detailed case study.

Literature Review

A literature review was undertaken to:

- Determine what information is available regarding solid waste management generally, and within the Pacific specifically;
- To gather an initial idea of what barriers are present to effect solid waste management in the Pacific, in order to tailor survey questions appropriately;
- To research what, if any, actions are being taken by other Small Island States with respect to SWM, and whether are applicable to islands in the Pacific;
- To determine what constitutes effective SWM; and,
- To determine the current state and expected future trends of solid waste in the Pacific.

Electronic Surveys

Two distinct surveys would be prepared; a survey for residents, to collect qualitative data on their experience and preferences with regard to SWM and, a survey for service providers, to collect more quantitative data on the services they provide.

In both instances, existing professional and personal networks would be leveraged to distribute the surveys. Connections are available through:

- Work networks (overseas offices and clients)
- Volunteer networks (who may be able to pass the surveys onto colleagues or friends)
- Personal networks (people known personally who have connections to PICs)

Two case studies were undertaken for this project. The first was the creation of a plastics recycling and organic composting scheme on the Fijian island of Taveuni. The community was highly involved throughout the both the design, implementation and ongoing operation and management of the scheme.

The second was a discussion with a volunteer working in the Tongan Waste Management Authority. The discussion examined the current services on offer, the challenges faced, and upcoming plans and schemes.

Results

A total of 43 surveys were returned from three countries – Vanuatu, Samoa and Tonga. The greatest number of responses where from Vanuatu, with smaller, similar sized responses from Samoa and Tonga.

The overall results demonstrate that the majority of respondents (77%) felt that solid waste management was an issue in both their local community, and their country overall. A reasonable number (19% of respondents) felt that solid waste was a concern in their country, but not in their community.

Examining the data based on country showed that there was some significant variability across the three countries. While overall, 77% of respondents said solid waste was a concern in both their community and country, the country breakdown shows that this opinion was held by 90% of Tongan respondents (13% higher than the overall average), and only 69% of Samoan respondents (8% lower than the overall average).

Samoa also had a significantly higher proportion of respondent's state that solid waste management was only an issue for their country, not their community, with 31% of respondents expressing that view, compared to 15% and 10% from Vanuatu and Tonga respectively.

Overall, plastics and packaging, closely followed by food waste and paper, where the most listed waste types, with very similar proportions. Garden wastes and electronic wastes were reported as being generated at about half the rate of packaging, food and paper waste.

Fully 50% of the waste disposed of was noted as being by rubbish collection or composting / animal food, with the primary disposal method being a rubbish collection service. Similar rates of disposal, 12%, were reported for burning of paper, burning of plastic and dumping in landfill. Recycling and dumping of vacant land were reported to make up 5% each of respondents' disposal practises.

An additional disposal method was noted by some respondents; disposal at a central, communal bin which is emptied and managed by the local authority or waste service.

Overall, most respondents felt that their solid waste services were lacking, with 55% giving a poor or very poor rating. Only 12% felt that their services were good, and 33% thought they were satisfactory, but with room for improvement.

The combined results show that, overall, respondents are willing to pay more for better solid waste management services, with 48% willing to pay a little more, and 25% willing to pay a lot

more. Approximately one quarter of respondents did not want to pay more, but were satisfied with the current cost. No respondents reported paying too much.

Samoan responders were much more likely to be satisfied with current fees, with 54% saying they are happy with the current system, and 23% and 15% willing to pay a little, or a lot more, respectively.

Conversely, of respondents from Vanuatu, only 5% were happy with the current system, and 50% and 30% of respondents were willing to pay a little, or a lot more, respectively.

The final section of the survey gave respondents the opportunity to provide additional information or comment on solid waste management.

The responses demonstrate a number of common themes, with respondents from every country noting that:

- Education and awareness are critical if behavioural change is to be made. One respondent suggested a school program to target children with these messages.
- Littering and burning off are very common, partly as a result of historical practise, partly as a result of lack of other, affordable options.
- There is a desire for recycling, but the means of doing so are not available.

Discussion & Conclusions

The investigations undertaken have demonstrated that a number of barriers prevent communities in Pacific Islands participating in effective solid waste management schemes:

- **Geographical factors**: An overarching factor, the geographic nature of the Pacific Islands makes effective and efficient solid waste for all communities a complex task. Limited land areas, disperse populations, and the requirement for ocean travel between islands makes designing and implementing solid waste schemes difficult.
- **Access**: Communities within the Pacific struggle with access to existing services, as well as to those that are desired but not implemented. As noted above, the geography is a key driver of access restrictions to existing services, with schemes being implemented on the larger islands only. For those on the major islands, access can still be difficult for remote communities due to transport and time concerns, which limits their ability to partake in the currently operating schemes. There was also a high demand for recycling initiatives noted in the surveys, but communities are prevented from accessing these services as they are not being implemented by government or private operations.
- **Affordability**: While affordability did not arise as a serious concern amongst the survey respondents, the case study demonstrated that poorer families are struggling

or unable to pay the costs leveed against them for solid waste management. Based on the likely bias of the survey responses towards urban dwellers, it is likely that this issue will increase with increasing distance from established urban centres.

- **Awareness**: The raising of awareness was noted in both case studies, as well as in some responses to the survey, particularly with regard to burning off waste. It was recognised as an area for investment by both Tongan and Fijian service providers, in order to ensure both uptake and the continued success of solid waste schemes. As demonstrated by the Tongan case study, previous recycling schemes have collapsed as a result of a lack of awareness.

Despite the above issues however, a number of opportunities were identified to further develop the solid waste schemes that are currently in place:

- **Awareness Raising**: Both the Tongan and Fijian case studies demonstrated that while there are some good regions of awareness (likely centred on major centres based on the survey results) there is still some misconceptions and lack of the importance of good solid waste management in rural areas. Such areas still practise a lot of burning off of wastes, including plastics and electronics that are hazardous when burnt. Capitalising on the current level of awareness to increase both the level and extent of understanding would assist in delivering better solid waste programs to these rural areas, by generating demand and increasing the likelihood of uptake.
- **Composting**: The case study from Taveuni, Fiji, suggests a good model for implementing composting schemes at village and community scale. Many villages, particularly those most in rural areas, still rely on locally grown crops for sustenance, as well as income. Encouraging these communities will assist in reduce the solid waste they have to manage, while also delivering health and economic benefits. These benefits were realised in Taveuni through better crop yields, and a reduction in reliance on fertilisers and pesticides. The advantage of such schemes is that they are particularly suited to rural villages who grow their own food, and it is these villages that are most likely to be unable to access larger island wide or national schemes.
- **Recycling**: There was a significant demand for recycling services from respondents from all countries. This is a significant opportunity as it indicates that both the awareness of this issues, and the desire to address it are already present in these communities. These are two substantial hurdles that many solid waste projects face, and allows the option to move straight into discussions with these communities about what structure of recycling scheme would be suit them, without first having to generate interest. Unfortunately, unlike composting above, such a scheme would require the support of government of private industry to make work due to the required

transport and processing costs, but a recycling scheme could be targeted on major centres first, and expand to more remote areas once established.

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Abbreviations

NGO	Non-Government Organisation
PICs	Pacific Island Counties
SIDS	Small Island Developing States
SPREP	Secretariat of the Pacific Regional Environmental Programme
SWM	Solid Waste Management
TPA	Tongan Ports Authority
UN	United Nations
UNEP	United Nations Environment Programme
WEDC	Water, Engineering & Development Centre
WHO	World Health Organisation
WSP	Water & Sanitation Programme (World Bank)

1 Introduction

1.1 Background

Pacific Islands Countries (PICs) are a collection of a number of sovereign island states that lie in the western Pacific Ocean. The Pacific Islands are comprised of some 20,000 to 30,000 islands that are populated by approximately 4 million people. Some islands are relatively large in both size and population, such as Fiji, whilst others are split across multiple small islands, such as the Solomon Islands which is comprised of over 1,000 small islands and atolls. Islands comprising a single nation can be highly dispersed. Kiribati for example has 33 islands spread across a region of ocean larger than India (World Bank, 2014).

PICs have seen a relatively sharp rise in development in recent times, with a range of international donors, both governmental aid agencies and NGOs, investing in infrastructure, water, sanitation, health and education. Much of the development that has occurred has been focused on capital cities and major regional centres due to the critical mass of population and resources in these locations (Connell & Lea, 2002).

Outlying islands have experienced relatively little change, however their exposure to, and access of, consumer goods and processed foods has increased with an improvement in shipping and transport between islands (Douglas, 2006).

Increasing development and exposure to international goods and trade has resulted in PICs having to deal with increasing volumes of packaged waste (Mataki, 2011, p. 5). Infrastructure to recycle these wastes are often not available, with the result that they are either discarded directly to the environment, or sent to landfill, which shortens the landfill operational life (WHO, 1996, p. 2).

Landfill has been the typical disposal method for PICs due to the relative ease of construction and maintenance. However, many PICs are coral atolls with restricted space (much of which is already utilised for agriculture or settlements), shallow water tables and a lack of the raw materials needed to construct a sanitary landfill. Some larger islands may have appropriate locations available, but smaller nations, or remote islands, satisfactory disposal sites may not always be available (WHO, 1996, p. 2).

Disposal options with smaller land requirements, such as incineration, are typically costlier and more technologically demanding that landfill, which restricts their use on remote Pacific Islands.

PICs face a complex future with regard to solid waste management as the amount of waste to manage increases, while space to implement management facilities reduces.

1.2 Project Aims & Objectives

The project aims and objectives, are set out in Table 1-1. The table also defines research questions for each objective, and the proposed collection methods for addressing these research questions.

Table 1-1 Project Aim and Objective Summary

Project Aim	To identify barriers to the effective management of solid waste within Pacific Island Countries within community, organisational and governmental spheres.

Objectives	Research Questions	Collection Methods
Determine the current state of solid waste management in the Pacific, and to identify future trends	▪ What are the current solid waste practises employed in the Pacific? ▪ How are waste streams changing as a result of development and globalisation? ▪ Are there future risks that may further restrict the ability of PICs to manage solid waste? ▪ How do the solid waste practises in the Pacific compare with other island states internationally?	Details on current practises and emerging trends in solid waste management across the Pacific were collected through the literature review. Some supporting information may be sourced through community surveys, but this information would be minor at best and would serve only to highlight particular issues or to provide general support of the conclusions drawn from the literature review. The literature review is presented in Chapter 2.
Determine community behaviour and expectations with regard to solid waste	▪ Does the community see the current SWM state as a problem? ▪ Are the community aware of the health issues surrounding poor SWM? ▪ How do the community manage their solid waste? ▪ What is the prevalence of illegal dumping or unsafe disposal practises?	Community sentiment, expectations and behaviours were assessed primarily through a community survey. A case study was also undertaken to explore in a more detailed and contextual manner the results collected from the survey. Further details on the methodology are provided in Chapter 3 and the results are presented in Chapter 4.

Determine if solid waste management has appropriate governmental support	▪ Is SWM governed by local, regional or national bodies? ▪ Are roles and responsibilities clearly defined? ▪ Are SWM requirements budgeted for by the responsible agency?	Governmental information was collected as part of the literature review from government websites and regional bodies (such as the Secretariat of the Pacific Regional Environmental Programme). The literature review is presented in Chapter 2.
Determine if solid waste management organisations are appropriately placed to deliver services to the community.	▪ Are services accessible to the community? ▪ Are costs aligned (where practical) with community expectations and ability to pay? ▪ Do organisations provide the services that the community wants? ▪ Are organisations sustainable? Or do they rely on government assistance?	Details on the services provided were sourced from organisational websites where possible, or via a survey emailed to the organisation. Further supporting information was sourced from the community survey (community wants and expectations) and government websites (funding). Further details on the methodology are provided in Chapter 3 and the results are presented in Chapter 4.

1.3 Scope of Research

The primary focus was on residential solid waste, in large part as this was the region of the community that was easily contactable during the survey (refer Section 3.2 for further details on the survey).

Some research was conducted into other solid waste streams, such as medical, industrial and commercial, but it was not proposed to contact these groups specifically.

The countries investigated were all be Pacific Island States. Only independent states were proposed to be part of the data collection, as islands that are the territory of another state (such as Australia or the UK) are likely to have access to funds and resources that are not available to island states. As a result, the following Pacific Islands were not considered:

- American Samoa, Guam and the Northern Mariana Islands (US)
- Niue (NZ)
- Pitcairn (UK)
- New Caledonia and Wallis & Futuna (France)

Furthermore, as the data was proposed to be collected via Australian Volunteers in the south Pacific, the scope was further restricted to those countries in which volunteers are currently operating.

Other islands states outside of the Pacific were investigated as part of the literature review, but did not form part of the data collection or analysis.

1.4 Country Information

Pacific Islands refer to those independent states that lie within the south-western region of the Pacific Ocean. Within this region there are 15 states. These are shown in Figure 1-1, and some background information on each is provided in Table 1-2.

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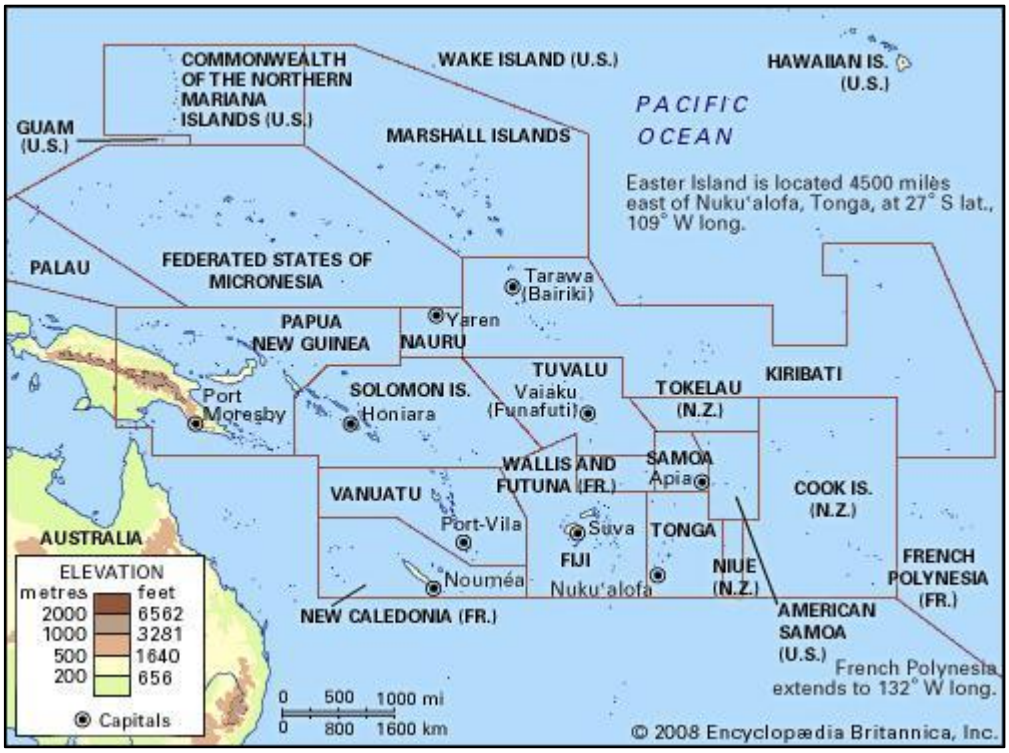

Figure 1-1 Island States within the South Pacific Region (West, 2016)

Table 1-2 Summary of Characteristics of Pacific Island States (CIA, 2016)

State	Land Area (km^2)	Population Density (ppl / km^2)	Population Growth (2015)	No. Inhabited Islands	GDP (Millions of $US in 2015)	Rate of GDP Growth (2015)
Palau	465	39	0.8%	10	272	9.4%
Federated States of Micronesia	702	158	0.2%	65	306	-0.2%
Nauru	21	480	0.2%	1	150	8%
Marshall Islands	181	293	0.2%	29	175	1.6%
Solomon Islands	28,400	18.1	2.1%	> 300	1,146	3.3%
Vanuatu	12,189	20	2.2%	65	685	-0.8%
Samoa	2,842	63	0.8%	9	1,000	1.7%
Fiji	18,274	46	0.7%	106	8,048	4.3%
Tonga	748	139	0.4%	36	414	2.6%
Cook Islands	240	42	0.5%	15	244	0.1%
Kiribati	811	135	1.5%	33	203	4.2%

The table highlights a number of issues that create a challenging environment for Pacific Island Countries.

The first of these is the dispersed nature of the population. With the exception of Nauru, all countries have populations living on a number of separate islands. The most extreme case of the Solomon Islands has people living on over 300 separate islands. This creates a significant barrier to effective solid waste management. It requires either that each island manage its own solid waste or that waste is transported from individual islands to a central disposal site.

Requiring each island to manage its own solid waste is a proposal that becomes increasingly untenable as the consumption of plastics, glass and metals rise. There is insufficient space on many of the small islands to construct safe disposal sites for these materials.

Transporting waste also has large challenges. It would require a large number of transport vessels and result in high transport costs. The distances in some instances are also significant; the 33 islands of Kiribati for example cover a sea area equivalent in size to the continental United States

The second issue highlighted by the table is the limited resources available to these countries. While some of the large countries Fiji, the Solomon Islands and Samoa have a reasonable GDP, the majority of nations have a small GDP, which limits their ability to invest in solid waste management projects.

Finally, the table also shows that GDP is increasing faster than population growth. In the absence of more detailed information, GDP may be used as a proxy for the generation of solid waste (Metz, Davidson, Bosch, Dave, & Meyer, 2007, p. 591). This means that the solid waste volume being generated per person is increasing for the majority of nations in the Pacific. As such, the longer that poor solid waste management practises are used, the harder they will be to change, due to the increased waste volume to deal with. This highlights that the sooner barriers are addressed, and improved solid waste procedures are implemented, the easier it will be to make these changes.

1.5 Dissertation Overview

The initial chapter of the thesis provides background information on the issues of solid waste as they relate to Pacific Island Countries, as well as some general information on the countries reviewed in this this thesis. Chapter 2 provides a literature review, focusing on solid waste management challenges and opportunities in the Pacific, as well as wider points of waste management for other island countries, and a review of what constitutes best practise waste management. Chapter 3 of the thesis details the methodology used to undertake the study, as well as discussion around managing bias and ethical issues with relation to the data collection. The data and data analysis are presented in Chapter 4, with a discussion of the results undertaken in Chapter 5. The conclusions of the study, and recommendations for further research are made in Chapter 6.

2 Literature Review

2.1 Introduction

A literature review was undertaken in order to locate the current study within the existing research an information available, and also to collection information to inform the development of the study methodology.

The review began broadly, looking at solid waste management generally, in order to define what solid waste management is, what it aims to provide, and what factors can be used to gauge whether a scheme is successful or not. The research was then narrowed to Pacific Island States, to examine what specific barriers exist to effective solid waste management given islands unique geographic and demographic conditions. The review also sought to determine what information was available, what data gaps currently exist. This review allowed for the current study to be placed within the existing body of research.

A review of Islands States more generally was also undertaken, to examine if other island nations face similar issues, what issues may be unique to the Pacific, and if there are any lessons learned from other regions that may be applicable in the Pacific.

The methodology for undertaking the literature review is set out in Section 2.2, with the findings from the literature presented in the following Sections of the Chapter.

A review of the literature that examines how to design and implement effective surveys and case studies was also undertaken to inform the development of the project methodology. The results of this review are presented in Chapter 3.

2.2 Methodology

The search strategy adopted to investigate the topic is summarised below in Table 2-1. Summarised in the table are the information sources investigated, and what in particular was being looked for in each information source, as well as key search terms were appropriate.

It was found during the search process that short, general search terms proved more effective at returning reasonable numbers of sources (for instance “solid waste pacific” rather than “solid waste management pacific islands”). The exception to this was if a very particular piece of information was sought, in which case a more detailed search string was more suitable, such as the search to see if GDP was a reasonable proxy for the volume of solid waste generated by a country.

Overall, the quality of the sources collected was good, with reasonable numbers of formal and reviewed sources such as journal articles and books found. It was noted that many of the sources used are not overly recent, with most of the sources used dating from over 5 years ago, and many from 10 years or more. One issue found in the research and mentioned in the sources used is the lack of detailed research in this area, which may be a contributing reason to the lack of recent material.

Table 2-1 Literature Search Strategy

Source	**WEDC Resource Centre and Knowledge Base**
Purpose / Aim	To gather initial resources to develop an overview of the topic.
Search Terms & Methods	Solid waste (management) pacific (islands); SWM pacific islands; solid waste disposal pacific (islands)
Quality & Quantity of Returns	Returns relating to solid waste in the Pacific were limited, typically older references, and largely books. There were a number of returns from the searches focused on water resources and groundwater issues. A number of publications were by the UN and the WHO, suggesting a search of these websites may provide further information.
Source	**Google Scholar**
Purpose / Aim	Similar to the above, the primary aim was to collect background information on the topics, and to assess the scope of resources available. Google scholar provided a straightforward way of searching across a range of sources.
Search Terms & Methods	Solid waste (management) pacific (islands); waste disposal pacific (islands); solid waste types / characteristics / components / generation pacific (islands); case study development / methodology / set up; survey design / pilot; preparing / undertaking / developing surveys
Quality & Quantity of Returns	The searches largely resulted in a range of articles discussing the impacts of poor waste management in Pacific Islands (such as plastic pollution on beaches and in surrounding waters, and contamination of ground water). There were few articles that dealt with the actual disposal of solid waste for Pacific Islands, or the sources of solid waste in the Pacific. While this was important to know, it the returns did not discuss the actual solid waste management practises. Google scholar also shows where articles have been cited. This feature enabled a search of newer information sources that cited older, but still relevant sources. The results were not always appropriate (impacts of solid waste on tourism for example) but the process did yield some useful sources. Results from searches relating to case study methodologies and developing appropriate and effective surveys were more successful, yielding a range of papers and books across both topics.

Source	**Library Catalogue**
Purpose / Aim	To collect journal and periodical papers on the topic, with the expectation being that these sources would be more scientifically rigorous compared to other sources.
Search Terms & Methods	Solid waste (management) pacific (islands); waste disposal pacific (islands); solid waste types / characteristics / components / generation pacific (islands)
Quality & Quantity of Returns	Papers were found that discussed the unique issues faced by island states in terms of waste management. Only a few of these papers related directly to the Pacific. Other papers looked at islands in the Caribbean, south-east Asia and Africa. These papers still provided a general insight into waste management issues for island states, and also provided a similar but different example against which the practises adopted in the Pacific can be compared. The papers may also highlight lessons learned elsewhere that may be applicable to the Pacific. The reference list of those papers dealing with the Pacific were used to generate further sources, and a citation search was undertaken to find more recent papers that referenced the older papers initially found in the search.
Source	**UN, WHO, WSP**
Purpose / Aim	These agencies release discussion and technical papers on a range of issues for various geographic regions. Their publication databases were searched to see if any documents had been prepared discussing solid waste management in the Pacific.
Search Terms & Methods	Solid waste pacific (islands); waste management pacific; waste generation pacific (islands)
Quality & Quantity of Returns	A number of reports were found discussing solid waste management for Pacific islands, however many were dated. A number of reports included estimates of waste volumes, however the source of these numbers was unclear, so it could not be determined if they were arrived at by analysis in various countries, or were based on generic formulas or anecdotal evidence.

Source	**Government Aid Agencies**
Purpose / Aim	A number of Pacific states are highly dependent on aid for development and infrastructure assistance.
Search Terms & Methods	Searches were undertaken using Google and the *site:* control that limits search returns to those from a particular site. The country aid agencies searched were Australia, New Zealand, Japan, China and America.
Quality & Quantity of Returns	A number of fact sheets were found that detailed ongoing and completed projects relating to waste management and disposal for Pacific islands. Whilst detailed information was generally lacking, the sources found did provide an indication of what aid agencies considered suitable for funding in relation to solid waste in the Pacific.
Source	**Internet (General)**
Purpose / Aim	Wide ranging, general search. The search was expected to return information from NGOs, development agencies, private firms, news articles and blog posts, in order to gather a wide range of material for review.
Search Terms & Methods	Solid waste (management) pacific (islands); SWM pacific islands; solid waste disposal pacific (islands)
Quality & Quantity of Returns	In addition to reports from the UN and WHO that had been found on the organisational sites, the general internet search also found a range of other material, that while not scientifically robust, did serve to provide further background information on the issue, and how it is perceived and managed in various island locations. Sources found included presentations made to conferences, news articles on the impact of new SWM schemes, programme updates and reports from NGOs and Governments working in the space and fact sheets from agencies on SWM works.

2.3 Solid Waste Management

2.3.1 What is Solid Waste?

The management and control of solid waste within the community is an important issue for governments. Management requires the input from a range of fields and disciplines including engineering, environmental, legislative and cultural components (Chang, Pires, & Martinho, 2011).

Waste is a broad term that defines any discarded material for which there is no value attached to it by the person disposing of it (Sasikumar & Gopikrishna, 2009). While this material is termed waste and has no value to those discarding it, it may still have a value to others, such as plastics and metals in a recycling chain.

Waste is a very broad term, and solid waste only slightly less so. Wastes generated by communities are highly variable, with the mixtures and make-up dependent on the communities' level of technology and consumption. Waste is typically broken down into various categories to aid in planning and control. These categories are dependent on the waste streams that various municipalities are managing. The New South Wales Environmental Protection Agency in Australia, lists 17 categories of waste for which they provide controls (NSW EPA, 2015):

- Hazardous and liquid;
- Asbestos;
- Biosolids;
- Clinical waste;
- Construction and demolition;
- Dry-cleaning;
- E-waste;
- Expanded polystyrene;
- Glass;
- Lead acid batteries;
- Mineral oil;
- Organic;
- Quarantine;
- Radioactive;
- Timber;
- Tyres; and,
- Virgin excavated natural material.

This list demonstrates the wide range of waste streams generated by communities. The list also demonstrates that as communities expand and develop, their consumption, and consequently their waste streams change and evolve.

2.3.2 What is Solid Waste Management?

For the purposes of this project, the waste considered was restricted to solid wastes, generated from residential sources. As indicated above, solid wastes are also generated by commercial, industrial and medical processes, however these streams were not considered in this project.

Solid waste management as defined in this project, may be considered therefore, as methods and actions taken to safely, effectively and securely manage the collection and transport of solid waste from generators to a place of safe disposal and /or storage.

2.3.3 Benefits of an Effective Solid Waste Management Scheme

An appropriate and properly managed solid waste scheme delivers communities a range of benefits. These include (UNEP, 2005, p. 2):

- **Health**: Those who come into frequent contact with solid waste, such as workers who handle refuse, and individuals that leave near or on disposal sites, are more prone to infection by worms and parasites. Living with and treating these diseases comes with a cost to both the individual and the community. A safe solid waste management scheme reduces the incidence of these infections and results in improved health conditions for both workers and the surrounding community. It has been shown that for many communities, the benefits realised in health savings as a result of better control of solid waste, outweigh the costs involved with implementing an effective solids waste management scheme (UNEP, 2005, p. 5).
- **Environmental**: Loose solid waste, or waste deposited in uncontrolled conditions lead to a number of adverse environmental impacts that affect not just the environment but the health of those who live in the nearby region. Impacts include odour, leachate, and contamination by toxic materials. These impacts can degrade the environment, which has flow on impacts for agriculture, fishing and livestock. Appropriate storage and transport of solid waste ensures that the environment is protected, and remains safe for use and habitation.
- **Aesthetics**: The appropriate management of solid waste also results in a cleaner and more attractive community. While this is not strictly speaking a health benefit, cleaner and more visually appealing cities do contribute to improved states of mind, and local pride, which help improve the mental health of community members.

2.3.4 Typical Characteristics of a Solid Waste Scheme

A solid waste scheme is a comprehensive plan that covers a range of processes across a variety of stakeholders. In order for the solid waste management scheme to be effective and efficient, it is important that each of the processes and stakeholders work together and that avenues of communication exist between each. The key processes and stakeholders are discussed in detail below.

2.3.4.1 Processes of a Solid Waste Scheme

The processes involved in a solid waste scheme may be divided into three primary sections:

- Collection;
- Transportation; and,
- Disposal.

Collection

Collection processes relate to how the waste generated at households is retrieved. There are a range of collection options available based on the level of service and willingness to pay of the community (Tchobanoglous, Theisen, & Vigil, 1993):

- **Collection from inside the house**: Under this scenario, waste is received directly from the resident (that is, handed directly to the waste collector) or the collector enters the property to collect a bin. This provides a very high level of service to the resident, who is not required to do anything to facilitate the collection of their waste. This level of service also necessitates a high level of manual work on behalf of the collectors, and is typically a costly option to implement.
- **Collection from the kerb**: This option still sees waste collected individually from each property, but the resident facilities the process by putting their bin on the roadside for collection, and returning the bin to their property once emptied. This reduces collection costs and time, but requires the resident to be aware of and engaged with the process. If the bins are put out at the wrong time they will not be emptied, and if left on the street for extended periods, may be prone to damage of theft. Kerb collection may be undertaken using manual (whereby workers physically transfer the bin waste tot eh collection vehicle) or mechanical (where the collection vehicle lifts and transfers the waste). The mechanical option is more efficient, but requires increased maintenance costs to keep the machinery working.
- **Collection from the block**: Block collection is a further step along the continuum of resident involvement, with residents required to transport their waste to the collection vehicle. The collection vehicle travels a set route to a set timetable and residents bring their waste to the vehicle as it passes their home. The major challenge with this form of collection is that residents are required to be at home during the collection time. If they are out, or working, they will not be able to dispose of their wastes. To address this, a more frequent collection schedule may be required.
- **Collection from communal storage**: Under this collection scheme, residents place their wastes in a common receptacle, that could be located in the basement of a complex, in the alley behind a row of houses, or at a disposal site within a township. Waste collectors then retrieve the waste from this location when the receptacle is full, or to a set schedule.

All of these options are suitable for use in the Pacific, depending on the desires of the community. While the more manual options may have higher operating costs due to wages in developed countries, the lower wages in developing regions may make these options more suitable.

In addition to the collection method, collection frequency and the timing of the collection must also be considered.

The frequency of collection is primarily dependent on the generation rate of the waste. However, further considerations also play a role (Tchobanoglous, Theisen, & Vigil, 1993):

- **Composition of the waste**: wastes with high organic contents are likely to being decomposing if let too long in a bin. This is particularly true in the Pacific where warm weather and high humidity dominate. Decomposing and rotting waste poses a health risk, so collection frequencies may need to be increased in order to collect waste before it begins decomposing.
- **Cost**: more frequent collection result in higher costs for the waste scheme.
- **Resident expectations**: As referred to above, the residents play a critical role in the smooth operation of a solid waste scheme. They should also have some say in the collection frequency. Ensuring that the schedule meets their needs will make it more likely that they will undertake their tasks as part of the scheme.
- **Timing**: If residents are required to be personally involved in the collection process it is critical that collection takes place at a time that residents are home. Day time collection is safer and easier for workers, but may conflict with residents who work during the day.

Transportation

Transportation is required to move the waste from the point of generation to the point of disposal. It is required as part of solid waste scheme as disposal sites are typically located some distance from community centres. Whilst residents could transport their own waste, the burden placed on the community will likely result in increased rates of illegal dumping (Tchobanoglous, Theisen, & Vigil, 1993).

In small areas, where the disposal site is relatively close to the township, and there are not significant volumes of waste being generated, it is feasible for the collection vehicle to also double as the transportation vehicle, taking the collected waste directly to the disposal site.

For larger centres, with a greater volume of waste to be collected and a larger distance to travel to the disposal site, a transfer station may be required. A transfer station allows a number of the smaller collection vehicles to have their waste transferred to a single larger vehicle that then takes the waste to the disposal site (Tchobanoglous, Theisen, & Vigil, 1993). While a transfer station requires additional land to be available, and comes with capital and ongoing costs, it delivers a range of benefits such as:

- Reducing the number of long haul trips to the disposal site;
- Allows smaller vehicles to operate within the community;
- Provides a secure space for any sorting and processing being undertaken; and,

- Reduces the number of vehicles onsite at the disposal site.

Disposal

The final stage in the waste management scheme is the safe disposal of the collected waste. A range of disposal options are available, depending on the waste characteristics and the land, time and cost available for disposal activities. Common disposal options are:

- **Landfill**: Landfills may be either uncontrolled landfills or sanitary landfills (Ali, Cotton, & Westlake, 1999, p. 8). Uncontrolled landfills are simply a location where solid waste is dumped. It offers some advantages in that wastes are centralised, and some form of fence or separation from the community is possible. However, uncontrolled landfills are prone to causing adverse health and environmental conditions as a result of fly, mosquito and rodent breeding, leachate pollution of the water table, air pollution and contamination of the land, for instance, with heavy metals (Ali, Cotton, & Westlake, 1999). Sanitary landfills in contrast are fully engineered disposal solutions that are appropriately designed to control adverse health and environmental impacts through site preparation, capping of deposited waste and ongoing maintenance and monitoring. Due to their relative simplicity and low cost compared with other disposal options, landfills are the most common final disposal method adopted in developing regions (Tchobanoglous, Theisen, & Vigil, 1993). However, they nonetheless require a certain degree of engineer capability to construct and operate appropriately.
- **Landfill with methane capture**: Similar to sanitary landfill, but with additional systems in place to collect the methane that the landfill produces as a result of the anaerobic digestion of the organic component of the waste. The captured methane can then be used as a power source either for the landfill site or the regional power grid. The collection processes require additional technical skills and costs, both in the initial construction and throughout the life of the landfill. A methane capture system may be suitable if power generation for a region is also required, but would likely require some government subsidy to cover the additional costs. Generally, the methane collection option is too expensive and technologically intensive for widespread use in the Pacific (Sagapolutele & Rasch, 2008).
- **Incineration**: Incineration is a process whereby the solid waste is burnt in a controlled manner. The process results in waste being converted into combustion gases composed primarily of nitrogen, carbon dioxide and water vapour, and non-combustible residue (ash) (Tchobanoglous, Theisen, & Vigil, 1993, p. 618). Properly conducted incineration is a relatively clean process. However, if systems are poorly designed or not maintained, incineration can be a highly polluting disposal option. Incineration requires a high portion of paper and plastics to be effective. As solid waste in developing regions typically has a high proportion of non-combustible material, incineration is not generally suitable to developing regions (Eckelman, et al., 2014). Furthermore, incineration is a highly technical operation that requires a high capital outlay and funds available for ongoing maintenance. As such, it is generally only implemented where space is highly restricted and landfilling is not practical (UNEP, 1996).

- **Composting**: Composting is not a complete disposal solution, as it is only capable of treating the organic portion of the waste stream. However, it can be used as a supplementary disposal option to reduce the volume of waste going to landfill (Ali, Cotton, & Westlake, 1999). A composting scheme would collect organic matter from households (food scraps, garden waste, newspaper, etc). The heat generated by the decomposition of the organic material serves to kill any pathogens in the waste, and the resulting compost can then be used to enrich agricultural or garden soil. An advantage with a composting scheme is that the sale of the compost can contribute towards the cost of running the solid waste scheme. Composing is commonly practised at a household level in the Pacific, with biodegradable material being dug into the garden, or, in the case of food scraps, feed to livestock (Sagapolutele & Rasch, 2008).
- **Recycling**: Similar to composting, recycling schemes are not able to address the full solid waste stream, but are used to reduce the end amount that ends up in landfill. The recycling process collects materials from the waste stream that are then sorted, processed and resold and reused as raw materials in another process (Tchobanoglous, Theisen, & Vigil, 1993). Recycling can be used to collect and reuse a range of materials including metals, glass, plastics and construction materials. Recycling, and also composting, benefit from having households segregate their wastes prior to collection. The segregated waste can be collected at once, or with difference collections for different materials. Segregating the waste at the household level maximises the material collected, and removes the need for either manual or mechanical sorting down the line, both of which require significant costs. Similar to composting, the sale of the recycled material can be used to contribute funds towards the cost of the solid waste scheme.

2.3.4.2 Key Sectors Involved in a Successful Solid Waste Management Schemes

The development of an effective solid waste management scheme requires the successful cooperation across a range of sectors. A common issue for solid waste schemes is that even though a suitable scheme may be designed, a weakness in one of these sectors means that it is still not effective (Guerrero, Maas, & Hogland, 2013). The key sectors across which a solid waste management scheme must operate are detailed below (Ali, Cotton, & Westlake, 1999):

- **Technical**: Technical aspects relate to the design of the collection, transport and disposal of solid waste. Such concerns include the type of disposal option(s) adopted, the location for the disposal site, analysis of what is in the waste stream and the level of technology suitable for the scheme. It is important to note that the “best” scheme is not the one that is the most technically efficient. Any scheme developed also needs to meet the needs of the other sectors. Deciding on a scheme based purely on its technical components is a common source of later troubles in solid waste management schemes (Guerrero, Maas, & Hogland, 2013).

- **Institutional**: The institutional sector defines who is responsible for what, and what tasks various levels of the organisation perform. Institutional processes are also concerned with staff training, incentives and management targets.
- **Financial**: Financial concerns are primarily focused on ensuring that the scheme is economically sustainable; that is, the scheme collects sufficient income to cover the costs of implementing the scheme. Whilst is may be suitable to have grants or funding assistance for the capital component of the works, if the scheme is to operate on a long-term basis, it is important to ensure that the revenue collected manages the ongoing costs of the scheme. Being clear on what services users receive at various price points is an important piece of information for discussions with the community and end users (WHO, 1996).
- **Social**: The support and patronage of the community is a prerequisite for a successful solid waste management scheme. Engaging with the community early, and allowing them a real role in deciding on the final scheme is a key process in developing an effective solid waste management scheme. Another component of the social sector is ensuring that the scheme does not make sections of the community worse off. Waste picking may be a source of income for some families, and the development of a solid waste scheme has the potential to remove this source of income for these families. Ensuring that the final scheme
- **Environmental**: The environmental sector must be considered during both the construction and ongoing operation of the scheme. Disposal sites need to be selected in regions that environmentally sound, and the practise of disposal needs to be monitored to ensure that it is not resulting in averse environmental impacts.

2.4 Issues Facing Pacific Islands

While issues and challenges around effective solid waste management are universal, large developed nations, by nature of their increased wealth and available land area, have increased scope and opportunities to deal with these issues.

Pacific Island nations however, do not have these advantages in developing solid waste management schemes. Furthermore, as the Pacific region further develops, the issues they face with regard to solid waste management increase.

2.4.1 Community Awareness

A key issue faced by Pacific Islands in designing and implementing solid waste management schemes is that there is a significant lack of awareness amongst the public on the importance of solid waste management. As discussed in Section 2.2 the benefits of effective solid waste management are significant for both health and environmental reasons, but these benefits are not appreciated, and consequently the community are unwilling to bear the cost of solid waste management progress. A large part of this is that until relatively recently, the solid waste generated on the islands was, in the vast

majority, organic, with islanders utilising local materials to build structures, shelter, clothes, utensils and other items. When these items were no longer needed they were simply discarded and, being organic, decomposed into the soil (Mataki, 2011, p. 6).

This disposal practise however does not work with modern materials such as plastics, metals and glass. These products are not biodegradable, but rather build up in the environment, often with adverse health and environmental impacts. Furthermore, the disposal of these items can be hazardous when islanders attempt to use traditional disposal methods such as incineration. Whilst suitable for the organics that once comprised their waste stream, burning plastics and metals releases dangerous particles into the air that may be carcinogens, bio-accumulatory, or toxic.

2.4.2 Changing Nature of the Waste Stream

The issues surrounding safe disposal of these newly introduced materials is compounded by the fact that their presence and use is increasing rapidly in the Pacific. Increasingly large amounts of plastics in particular are being imported into the Pacific Islands each year. As a result of increased imports and a desire for more 'modern' goods, the waste streams of Pacific Islands Countries are becoming increasingly complex, with a greater proportion of the waste coming from packaged wastes from consumer goods (Mataki, 2011, p. 5). Infrastructure to recycle these wastes are often not available, with the result that they are either discarded directly to the environment, incinerated in unsafe practises, or take up space in landfills, which shortens the landfill operational life (WHO, 1996, p. 2).

2.4.3 Operation and Maintenance

When solid waste schemes are available, they are often faced with ongoing operation and maintenance issues, both for equipment and personnel.

Machine and equipment maintenance is a significant issue, particularly dedicated SWM machinery. Due to the remote nature of many of the islands, and the fact that large machinery must be sent by sea, delays in the procurement of new equipment or spare parts is common, resulting in equipment or machinery being forced to sit idle. As capital is typically limited for operators, storing additional spare parts locally is often not done, with orders only being placed once a part is broken (WHO, 1996, p. 2). This is issue is further exacerbated by the hot, humid climate, coupled with tropical storms, that can quickly result in machinery being worm down or damaged (WHO, 1996, p. 2).

Limited equipment also leads to machinery being over used, or used in a way that it was not designed for, leading again to shorter equipment lifespans. An internal presentation held in the Tongan Ports Authority proudly showed a picture of an excavator being operated in 750mm of salt water as a result of an incoming tide with the caption "*Still working strongly!*" (TPA, 2008). This slide was being shown not to demonstrate behaviour that could adversely impact Ports assets, but rather the opposite; to showcase the robustness of the machinery.

2.4.4 Technical Skills and Human Resources

In addition to mechanical issues, solid waste management schemes also suffer from Insufficient or untrained human resources, which makes it difficult to design and manage SWM processes and equipment (WHO, 1996, p. 2). The lack of human resources is compounded by the fact that as staff are trained, they are increasingly likely to move overseas where wages and living conditions are better. This resource drain is not restricted to SWM but is a common problem in a range of disciplines (Yee, 2007, p. 3;Firth, 2006, p. 108).

2.4.5 Geographic Constraints

Landfill is the typical waste disposal method adopted for Pacific Island countries, largely due to relative simplicity of the process and the lack of complex machinery required. The machinery that is required can also often serve a dual purpose in other areas (such as construction). Many landfills are effectively open dumps, with little or no sanitary or environmental controls. A major focus of the current 2010 – 2015 strategic plan is the improvement of these landfill sites (SPREP, 2010). Many countries are also implementing educational campaigns to reduce littering, which is a low cost and low technology approach to improving solid waste management. Pilot programmes for recycling facilities and organic composting facilities are also being trialled in a number of countries (Mataki, 2011).

While landfills are the most widely adopted method of final disposal, their construction poses some challenges within Pacific Islands. Due to island geography, there is often a lack of appropriate landfill locations. Many Pacific Island countries are coral atolls with restricted space (much of which is already utilised for agriculture or settlements), shallow water tables and a lack of the raw materials needed to construct a sanitary landfill.

Some larger islands may have appropriate locations available, but for smaller nations, or remote islands, satisfactory disposal sites may not always be available (WHO, 1996, p. 2). This creates a significant issue for these locations, as a poorly constructed landfill can have substantial health and environmental impacts, for example, through uncontrolled release of leachate that may impact groundwater (WHO, 1996, p. 12).

2.5 Current Actions

In recognition of these issues being faced across countries in the South Pacific, the Secretariat of the Pacific Regional Environment Programme (SPREP) developed the *Pacific Regional Solid Waste Strategy 2010 – 2015* (SPREP, 2010). The strategy was adopted by American Samoa, Australia, Cook Islands, Federated States of Micronesia, Fiji, France, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, United States of America, Vanuatu, Wallis and Futuna.

The primary aims of the strategy, listed in order of priority to stakeholders based on consultation, were (SPREP, 2010, p. 1):

- Sustainable Financing;
- Integrated solid waste management, covering the 4Rs (refuse, reduce, reuse, recycle), collection and disposal;
- Legislation;
- Awareness, Communication and Education;
- Capacity Building.

The five year strategy ended in 2015. It has recorded some success, such as the development of sanitary landfills in Tonga (Williams, Forbes, & Egis, n.d.), the removal of scrap metal from the Cook Islands (SPREP, 2010) and an increase in the recycling rates in the Solomon Islands (ADB, 2014). However, adequate solid waste management still remains a significant issue.

Whilst there is a range of research available on the impacts and consequences of poor SWM, such as adverse health conditions and pollution of local and regional environments (Gregory, 1999) there is relatively little information available on the contents of the waste stream at regional and local levels, particularly for the smaller PICs. This information is critical if appropriate SWM procedures and infrastructure are to be developed, and has been noted as a barrier to the implementation of SWM schemes in a number of locations (Eckelman, et al., 2014). Some information on waste volumes is available, but the source is dated (often over 10 years old). What information is available is also focused on larger countries and major centres and may not necessarily be applicable to smaller nations or regional and rural communities (Eckelman, et al., 2014).

2.6 Comparison to Other Island States

The Pacific does not hold the only small developing Island States. There are a number of other locations throughout the word that also fit this description. While outside the scope of a comprehensive assessment, some review was undertaken to determine if the issues identified with regard to the current state of solid waste management in the Pacific are applicable to small developing island states generally, of if they are of greater concern in the Pacific with regard to other, similar, regions.

A comprehensive review of solid waste management in the Caribbean was undertaken as part of the Caribbean Solid Waste Conference, held in Jamaica in September 2014. The review examined the situation of the solid waste sector in nine Caribbean countries (Riquelme, Mendez, & Smith, 2016). The review highlighted a number of issues that were also experienced by Pacific Islands:

- Lack of formal government policy with regard to solid waste management for some countries;
- Limited financial sustainability;
- Increasing waste volumes due to increased consumption and higher populations, at the same time as available land for waste facilities is shrinking as a result of development;
- Perception that waste management is less important or deserving than other governance areas;

- Lack of economies of scale due to dispersed populations; and,
- Re-use, recycling and composting schemes feasible but lack support and awareness.

In other areas of solid waste management however, other small island states can illustrate strategies that can help to effectively manage solid waste within the limitations imposed on island communities. Ukulhas is one of the islands of the Maldive group. The island is small; 1025m by 225m in size. On this island, nearly all organic matter collected by the waste operator (which is the vast majority of that produced on the island) is converted into compost, which is sold on to contribute to the costs of running the solid waste management scheme (Shadiya, 2016). This is further supported by a comprehensive recycling scheme that operates on the island. This demonstrates that size and geography do not have to be prohibitive in implementing successful waste management strategies.

2.7 Data Gaps

While there was a number of clear sources on the issues, challenges and concerns with solid waste management in Island States, there were key areas that demonstrated a notable lack of clear or current information.

A critical component in designing a suitable solid waste management scheme is a detailed knowledge of what makes up the waste stream for the region. In general, there is very little information available concerning the waste characteristics of Pacific Island States. What little there is, is typically old, and restricted to one or two sites within one or two countries. Although individual Islands States share many social and cultural features with their island neighbours, this does not indicate that the waste characteristics are going to be the same. Furthermore, given the large recent changes in terms of development and consumerism in the Pacific, it is unlikely that old waste characteristics are still accurate. This lake of data complicates the design of solid waste management processes, and introduces the risk that the schemes designed may not be suitable for the current nature and extent of solid waste present in the Pacific.

The other key data gap identified was the lack of detailed monitoring and evaluation data. While high level comment on existing schemes was available (for example, how long a scheme has been running for, or the volume of material being placed in a landfill) there is no detailed data on the ongoing sustainability or effectiveness of the project. While long running schemes suggest some level of financial sustainability, it could equally be possible that they are heavily subsidised by government, raising the risk that a change in government policy or direction could see this funding removed, and the scheme forced to close. There was also very little discussion on how much benefit the schemes are having local communities, and if the schemes are successful in reducing the incidence of illegal dumping or burning off. Again, some success may be implied by volume of material in the landfill, but it may be that he benefits are largely being accrued in affluent regions of the country, with little benefits being felt in rural, remote or poorer regions. Detailed monitoring and evaluation is important not just to ensure that the scheme delivers benefits to all, but to also learn important lessons that will assist in further improving the scheme, or other like it, in the future.

More generally, it was found that the majority of the data available was from larger, more populous, more affluent, countries and regions. The smaller Island States had substantially less information available with regards to their solid waste management challenges and current programs. While some lessons and data would be transferable to these countries from schemes and studies in their larger neighbours, this should not negate the need for local studies to inform local decisions.

3 Methodology

3.1 Introduction

This chapter details the methodology adopted for this project. It sets forth the reasons the approach was adopted and the methods used to undertake the data collection and analysis. Furthermore, the chapter discusses possible barriers to successfully completing the data collection, and any possible bias in the results, and how the project methodology has been structured to account for these issues.

3.2 Research Methods

Three primary research methods were employed in undertaking the study:

- Literature Review
- Electronic Surveys
- Case Study

Each of these processes are detailed below.

3.2.1 Literature Review

A literature review was undertaken to:

- Determine what information is available regarding solid waste management generally, and within the Pacific specifically;
- To gather an initial idea of what barriers are present to effect solid waste management in the Pacific, in order to tailor survey questions appropriately;
- To research what, if any, actions are being taken by other Small Island States with respect to SWM, and whether these lessons and actions are applicable to islands in the Pacific;
- To determine what constitutes effective SWM in order to be able to demonstrate the key issues faced in the Pacific; and,
- To determine the current state and expected future trends of solid waste in the Pacific.

The process of conducting the literature review is detailed in Chapter 2, along with the findings.

3.2.2 Electronic Survey

3.2.2.1 Background

Data was collected for this project primarily through electronic surveys, either hosted online, or in an email format. As the survey was the basis for the data collection, and an identified risk of the study is a lack of response (refer Section 3.4) designing an effective survey was an important project consideration.

In addition to the review of effective survey techniques, the survey was also pilot tested prior to being issued. The pilot testing allowed for review and revision of the survey based on the experiences of a small set of respondents, and seeked to determine:

- **How long it took to complete** – questionnaires should be as short as possible. Long questionnaires lead to response fatigue, where answers become shorter and less informative, and may lead respondents to quit the questionnaire (Denscombe, 2014, p. 172).
- **Were the instructions / questions / layout clear** – if instructions are unclear or overly complex, respondents may opt out of the questionnaire from concern about the time and effort required. Clear questions also help to ensure relevant and accurate data is collected. In laying out the questionnaire, the most straightforward and least contentious questions should be first, in order to make the respondents comfortable with the questionnaire and the process before asking more complex, personal questions (Denscombe, 2014, p. 175).
- **Were there objections to answering any questions** – questions on religion and personal practises may be confronting to respondents. These questions should only be asked if absolutely necessary, and be framed in such a way as to minimise respondent concerns (Denscombe, 2014, p. 173).
- **Any further comments** – pilot tested should also be offered the opportunity to provide general feedback and comment on the questionnaire in order to collect any further information on issues that were experienced during completing the questionnaire.

The pilot process, and the feedback from these questions, helped to ensure that the final questionnaire structure and layout was suitable, to increase the likelihood of collecting suitable and accurate data.

Following the pilot testing, two distinct surveys were prepared, namely:

- A survey for residents, which attempted to collect qualitative data on their experience and preferences with regard to SWM; and,
- A survey for service providers, which attempted to collect more quantitative data on the services they provide.

In both instances, existing professional and personal networks were leveraged to distribute the surveys. Connections were available through:

- Work networks (overseas offices and clients)
- Volunteer networks (who may be able to pass the surveys onto colleagues or friends)
- Personal networks (people known personally who either work in or have connections to PICs)

It was planned to start as wide as possible and send surveys to as many PICs as possible. There are likely to be a large number of PICs contacted, but it would be expected that many of these would return few responses. While some PICs may not return any surveys, it was hoped that four to five PICs would return enough surveys to allow analysis to be undertaken.

The aim was to collect 10 to 15 resident surveys from each of four to five different countries. Smaller returns from other countries would still be useful, although a critical mass from a smaller sub-set was the goal of the process.

For the service providers, it was attempted to collect data from those providers from the same countries that return the greatest number of surveys. Unfortunately, no providers responded to requests for information, and no volunteers were currently placed in these organisations to facilitate contact. As such, no surveys were able to be sent to service providers to complement the results from the community.

3.2.2.2 Revisions from Pilot Testing

Pilot testing of the proposed community survey was undertaken by a Tongan associate. The pilot testing was considered important to ensure that the survey was as accessible as possible to recipients. As the survey would also be distributed across different cultures, it was also desirable to ensure that it did not offend or result in any uncomfortableness on behalf on the recipients.

As a result of the pilot testing, changes were made to the survey questions. The major change was the removal of any request for personal information beyond country of origin. Original questions had included a more comprehensive set of demographic questions such as age, gender and whether the recipient lived in a city, peri-urban or rural area. Feedback from the pilot testing was that these questions may seem intrusive to some recipients who would not feel comfortable disclosing this information without first being more formally introduced to whomever is asking the questions. While this data would have allowed another way of interrogating the results, it was removed in an effort to encourage more people to complete the survey.

Some questions were also simplified to make them easier to understand for people for whom English is a second (or third) language. Sentences were trimmed to be made as clear and concise as possible, and answers were reduced to single works or short sentences.

Finally, some minor changes were made to the words used to ensure that they were understood correctly. The primary change was to replace the word “waste” with “rubbish”, based on the feedback that this was a more familiar expression, and more likely to be understood.

While the original survey, with the additional demographic information, took less than 10mins, the removal of these demographic questions also had the result of further shortening the completion time, which given internet speeds and reliability in some locations, was also a positive change.

3.2.2.3 Questions

The seven questions issued to the community, following revisions made as part of the pilot testing were:

Question	Allowable Response
What country do you live in?	Free text field
Do you think that rubbish and litter are a problem in your community, or in your country?	Multiple choice, single selection only ▪ No ▪ Yes, in my community ▪ Yes, in my country ▪ Yes, in both my community and my country
What types of rubbish does you household have? Please tick all that apply.	Multiple choice, multiple selections ▪ Food waste ▪ Paper ▪ Plastics ▪ Tin cans and other metal packaging ▪ Electronic waste (batteries, phones, etc) ▪ Garden Waste ▪ Other (free text field)
How do you dispose of your rubbish? Please tick all that apply.	Multiple choice, multiple selections ▪ In a rubbish bin that is collected from my house ▪ Composting or feeding to animals ▪ Burning of paper ▪ Burning of plastic ▪ Recycling ▪ Dumping at a landfill or tip ▪ Dumping in vacant land ▪ Other (free text field)
What do you think of the current rubbish management arrangements?	Multiple choice, multiple selections ▪ Very poor ▪ Poor ▪ OK ▪ Good ▪ Very Good ▪ Other (free text field)

Question	Allowable Response
Would you be willing to pay more money for a better system of rubbish collection and disposal?	Multiple choice, multiple selections ▪ No, I already pay too much ▪ No, I am happy with current systems ▪ Yes, a little bit more ▪ Yes, a lot more ▪ Other (free text field)
Thank you for your time in completing this survey. Your time and assistance are very much appreciated. If you have any additional comments, please feel welcome to include them here.	Free text field

3.2.3 Case Studies

A case study is a qualitative research approach that is used to analyse and describe a single unit, bounded by space and time (Hancock & Algozzine, 2006, p. 11). Case studies may be a suitable research method when (Yin, 2003):

- The focus of the study is to answer “how” and “why” questions;
- Manipulation of study participants is not possible;
- Contextual issues are relevant to the phenomenon under investigation; and / or,
- Boundaries between phenomenon and context are not clear.

A case study was considered suitable for this project as:

- A key question of the project is how and why specific barriers in the Pacific impact on SWM;
- Participants were not manipulated as part of the study, but were only asked for their opinion and experience; and,
- As discovered in the literature review (Chapter 2) individual circumstances at both a local and a country level have a large influence on the SWM practises adopted.

A case study is a useful tool in exploring the complex interactions that can arise between facets of the study (Zainal, 2007). In the case of SWM, these facets include, waste generators (residents), collection and transportation processes, service providers, disposal options, tariffs and governmental requirements. While the surveys may pick up on aspects of these issues, a case study allows for a comprehensive examination of how all these factors combine and affect each other in the design and operation of a SWM scheme.

In this project, the purpose of the case study is to examine how some of these barriers can be overcome, by exploring a real-world example of a new SWM initiative.

Based on the responses received, two case studies were undertaken.

The first case study examined a project in Fiji. The initiative selected is the creation of a plastics recycling scheme on the Fijian island of Taveuni. The scheme was set up in 2014 with the assistance of Australian Volunteers. The community was highly involved throughout the both the design, implementation and ongoing operation and management of the scheme. The case study examined the process and methodology adopted in setting up the scheme, and how this was tailored to address the constraints observed on the island.

The primary source was the volunteers who had the initial plan, and who worked with the community in setting up the scheme.

The case study provided additional context to the survey results, and to highlight some site-specific examples of SWM barriers, and how they have been managed in this region.

The second case study was a discussion with an Australian Volunteer who was working with the Tonga Waste Management Authority. They had also previously worked in Samoa, and were able to offer an insight into the different approaches taken to solid waste management in the two countries. Furthermore, the informant was able to provide information from the perspective of the service provider, which was an important perspective to collect, both in and of itself, and also to compare approaches and responses taken by the waste management authority against community expectations and desires.

Furthermore, as discussed in Section 3.3, one of the risks identified with the proposed methodology was that only a small number of surveys may be returned. The case studies also served to provide another source of data, whose collection is more assured.

3.3 Data Analysis

The data collected from the surveys would be compiled and analysed.

The final analysis process would be determined following the collection and review of the amount and type of data collection. At this preliminary stage, it is expected that the analysis would include:

- A comparison of the responses between residents of the same countries. That is, how much variation was there in the responses of people within individual countries.
- A comparison of responses between countries. Average / typical responses would be determined for each country, and compared against those received from other PICs to determine if different countries had different views on solid waste management.
- If possible, a comparison would also be made between the amalgamation of all Pacific Island responses against other Small Island States internationally (for example, the Maldives, or the Bahamas). This would attempt to examine if the solid waste issues facing PICs are typical of wider issues faced by Small Island States generally.

- Expectations of solid waste management from the community would be compared against services provided to determine if the services are providing what the community wants.
- The approaches of service providers in different PICs would be compared to examine if similar approaches are being undertaken, or if each country is implementing unique solid waste schemes.

Respondents would be asked if they would be happy to receive follow-up questions, and some additional respondents may be contacted at this stage to provide additional depth to the data.

3.4 Data Collection Risks and Bias

In order to maximise the likelihood of success of the data collection, an assessment of the possible risks and biases inherent in the methodology have been considered.

The risks and biases identified are summarised in Table 3-1 and Table 3-2 respectively, along with the actions taken to mitigate or minimise their impact on the data collected.

3.5 Ethical Considerations

The study was approved by the ethical board of the university (refer to Appendix A for further details). Participation in the study was entirely voluntary, and participants were made aware that they would be able to withdraw their responses at any stage. Information was provided to the participants prior to undertaking the survey so that the purpose, scope and use of the data being collected was understood.

3.6 Summary

Three research methodologies were utilised in the project:

- Literature review, to collect and analyse information relating to SWM in the Pacific
- Electronic survey, to collect data from both residents and service providers
- Case study, to explore more deeply an example of a recent SWM initiative.

The development of the methodology for data collection was informed by the result of the literature review. Consideration was also given to collection risks, bias and ethical considerations to ensure that the data collection was suitable for use, and collected in an appropriate manner.

Table 3-1 Identified Risks in the Methodology

Risks	Mitigation Strategies
Small quantity of returns	
The resident surveys will be submitted to people in-country via volunteers and not directly. This creates a second barrier to getting surveys returned as it requires both the volunteers and the residents to take some action.	In the first instance, surveys were sent to as many locations within the Pacific as possible. Having a wide distribution maximised the number of people who receive the survey, which should increase the number of returns.
Furthermore, people are generally busy at work, and it may difficult for people to find the time to respond	The survey was made as short and concise as possible in order to minimise the demands placed on recipients. Respondents were offered the opportunity to leave an email address to receive a summary of the final results collected.
Poor comprehension of the survey material	
The survey will be prepared in English, and will deal with issues related to solid waste management. Although English is spoken throughout the Pacific, for many it is likely to be a second language. This may complicate the comprehension of the survey, particularly if technical language or jargon is used.	In order to be confident in the data returned, it is important to ensure that the survey questions are understood correctly. Questions were kept as clear and as short as possible, with technical language and jargon kept to a minimum. Questions were also framed largely as yes or no responses to minimise misunderstandings.
Access to internet	
As the surveys will be returned electronically, it requires respondents to have access to the internet in order to submit surveys. Internet access is limited in a number of locations throughout the Pacific, and connection speeds are very low. Should the survey take too long to load or submit, potential respondents may opt out to avoid wasting their limited connection.	The survey was designed to be as small as possible electronically. This will mean no images, no complex formatting and concise wording. Two options were provided. The first via SurveyMonkey, which was the easier option to complete. The second option was in an email format, where respondents could either delete or highlight answers as appropriate. Although this option is more time consuming and prone to errors, it minimised the bandwidth requirements and allowed responses to be send quickly and easily.

Table 3-2 Identified Biases in the Methodology

Bias	Mitigation Strategy
Poor demographic spread	
It is expected that the survey will reach similar numbers of men and women, through sending the surveys to a range of employers. However, as the survey is being distributed via volunteers at workplaces, it is likely that results will be biased towards middle age, relatively wealthy (given average incomes) responders. Children, the elderly, or those with a disability are unlikely to receive the survey, despite being more at risk from poor SWM practises.	Given the focus of the survey, it is not considered critical to reach young children, as their experience in the SWM process is likely to be minimal. The greater concern is not reaching groups who don't or are unable to work such as elderly people, or those with a disability. It would add depth to the results to be able to get input from these groups. A request was made to volunteers to actively seek out these groups, but responses will remain dependant on internet access, and the ability of volunteers to reach these groups. It was expected that the greatest response will be made from adolescents and younger families who are more likely to have an internet connection and be more comfortable completing an online questionnaire.

4 Results & Analysis

Discussed below are the results returned from the data collection process, namely completed online surveys and two case studies.

4.1 Survey Returns

Surveys were distributed to Australian Volunteers in Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Tuvalu.

The surveys were made available for completion online for a period of six months, from May 2016 to November 2016. Most surveys were returned in the first month, and no surveys were received in the last month, suggesting that all who were in a position to make a submission were able to do so.

4.1.1 Question 1 – Country of Origin

Survey were returned from three countries – Vanuatu, Samoa and Tonga. The split of responses is summarised in Figure 4-1.

The figure shows that the greatest number of responses where from Vanuatu, with smaller, similar sized responses from Samoa and Tonga. Two respondents elected not to state their country of origin.

All three of these countries had responses in the target range of 10-15. All are relatively large countries (compared to some other States), have generally reliable, if slow, internet connections, and have a number of volunteers working in country.

It was expected that responses would also be received from Fiji, as it too has a large population, numerous volunteers and reasonable internet access.

Smaller States, such as Kiribati, have much higher barriers to completing the survey do to intermittent internet access, and relatively few volunteers in country to assist in distributing the survey. While somewhat understandable, it is disappointing in terms of data, as the smaller, remote States have much greater challenges in responding to solid waste concerns, and a contribution from these areas would have been informative.

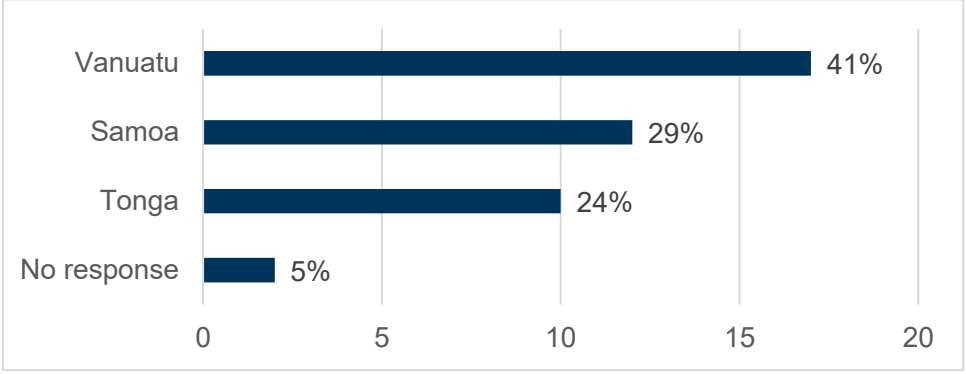

Figure 4-1 Country of Origin of Returned Response

4.1.2 Question 2 – Do you think that rubbish and litter is a problem in your community, or in your country?

The results from this question are presented overall, and by country, in Figure 4-2 and Figure 4-3 respectively.

The overall results demonstrate that the majority of respondents (77%) felt that solid waste management was an issue in both their local community, and their country overall. A reasonable number (19% of respondents) felt that solid waste was a concern in their country, but not in their community.

The opinion that solid waste was an issue in the community, but not in the country, or was not an issue at all, was only expressed by two respondents. Interestingly, as shown in Figure 4-3, both these respondents were from Vanuatu.

Examining the data based on country showed that there was some significant variability across the three countries. While overall, 77% of respondents said solid waste was a concern in both their community and country, the country breakdown shows that this opinion was held by 90% of Tongan respondents (13% higher than the overall average), and only 69% of Samoan respondents (8% lower than the overall average).

Samoa also had a significantly higher proportion of respondent's state that solid waste management was only an issue for their country, not their community, with 31% of respondents expressing that view, compared to 15% and 10% from Vanuatu and Tonga respectively.

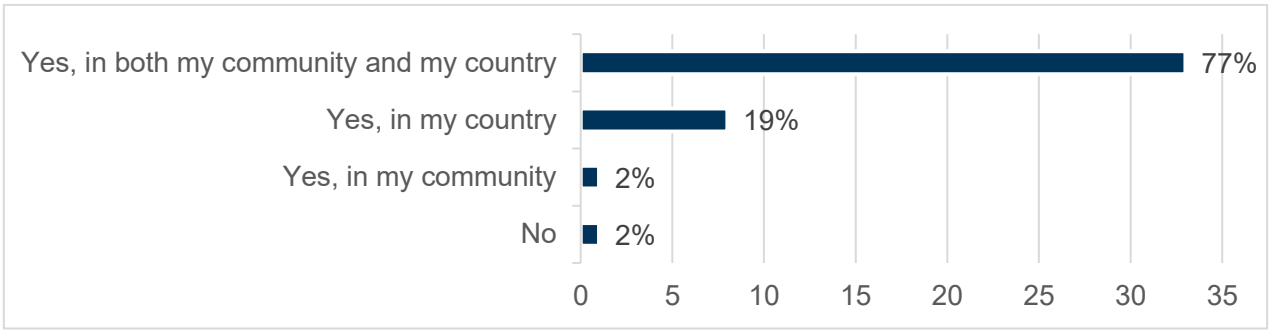

Figure 4-2 Perceived Extent of Waste Problem – All

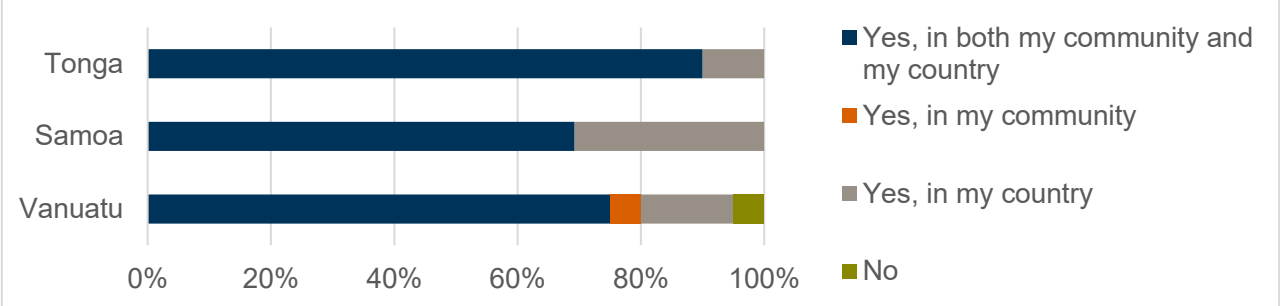

Figure 4-3 Perceived Extent of Waste Problem – By Country

4.1.3 Question 3 – What types of rubbish does your household have?

The responses for question three are presented overall, and by country, in Figure 4-4 and Figure 4-5 respectively.

Overall, plastics and packaging, closely followed by food waste and paper, where the most listed waste types, with very similar proportions. Garden wastes and electronic wastes were reported as being generated at about half the rate of packaging, food and paper waste.

Some respondents listed other waste items not captured in the fixed choices, such as old cars, machinery, soiled nappies and glass.

Broken down by country, there were only minimal differences in the makeup of the waste stream reported. The key points of difference between the three countries were:

- Samoan respondents reported a 5-6% higher incidence of food waste;
- Tonga respondents reported a 4-5% lower incidence of plastic waste; and,
- Samoan respondents reported an 8-10% lower incidence of electronic waste.

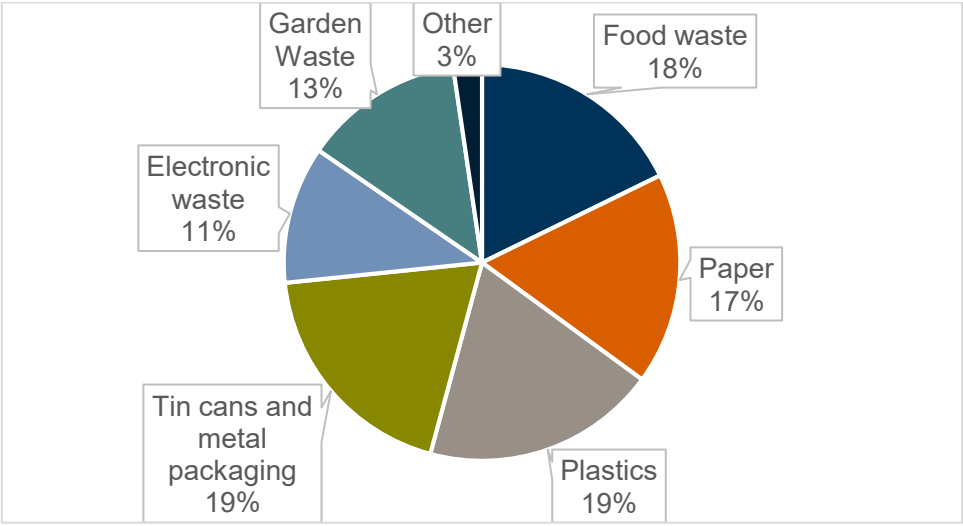

Figure 4-4 Rubbish Types - All

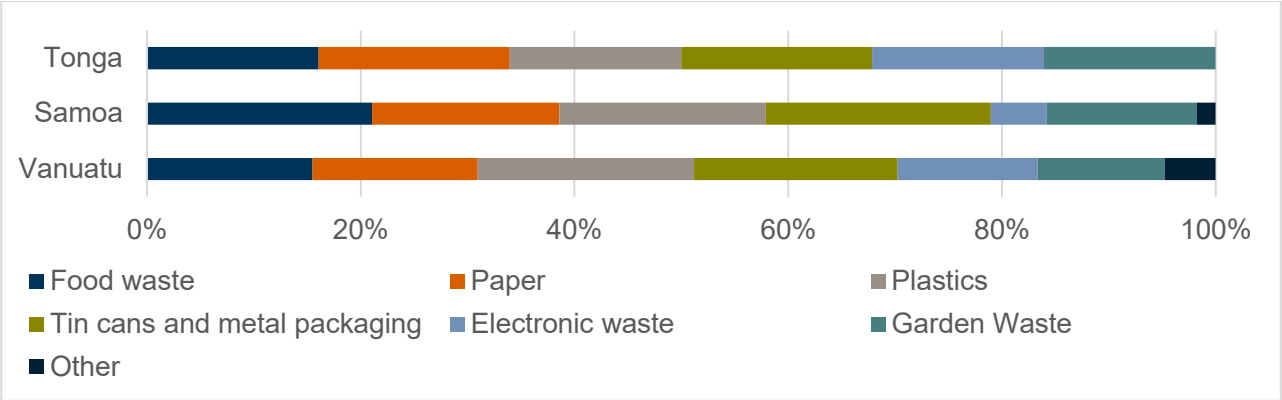

Figure 4-5 Rubbish Types – By Country

4.1.4 Question 4 – How is your waste disposed of?

The responses for question four are presented overall, and by country, in Figure 4-6 and Table 4-1 respectively.

Fully 50% of the waste disposed of was noted as being by rubbish collection or composting / animal food, with the primary disposal method being a rubbish collection service. Similar rates of disposal, 12%, were reported for burning of paper, burning of plastic and dumping in landfill. Recycling and dumping of vacant land were reported to make up 5% each of respondents' disposal practises.

An additional disposal method was noted by some respondents; disposal at a central, communal bin which is emptied and managed by the local authority or waste service.

The breakdown of disposal practises across countries shows that there are some noticeable differences in the disposal methods reported:

- Samoa has a significantly higher rate of household collection;
- Tonga reported a rate of composting or animal feeding nearly twice as high as other countries;
- No burning of paper and plastic, nor illegal dumping, was reported in Samoa;
- Vanuatu reported the lowest incident of recycling and the highest incident of illegal dumping; and,
- Tonga reported a significantly lower rate of disposal at landfill.

It should be noted that the sample size of the returned surveys is small compared to the number of residents in these countries, and that these results may not be indicative of wider practises. However, some of the above observations are supportive of one another.

While some forms of plastic burning and illegal dumping are likely to occur in Samoa, the low rates reported are supported by Samoa also reported the highest rate of household rubbish collection, over three times higher than Vanuatu and nearly twice that of Tonga. This high collection rate, which minimises the effort required by residents to dispose of their waste, suggests that residents are opting to use this service in place of other, more damaging disposal methods.

Similarly, the opposite trend was observed in Vanuatu. Vanuatu reported the highest incidences of burning off paper and plastics, as well as illegal dumping, while also reported the lowest incidences of recycling and household collection services. This suggests that residents, are disposing of their solid wastes in ways that are easiest for them (but at a cost to the wider community and environment) due to an inability to access collection services, whether due to such services not being available, or being too expensive / complex / demanding to make use of.

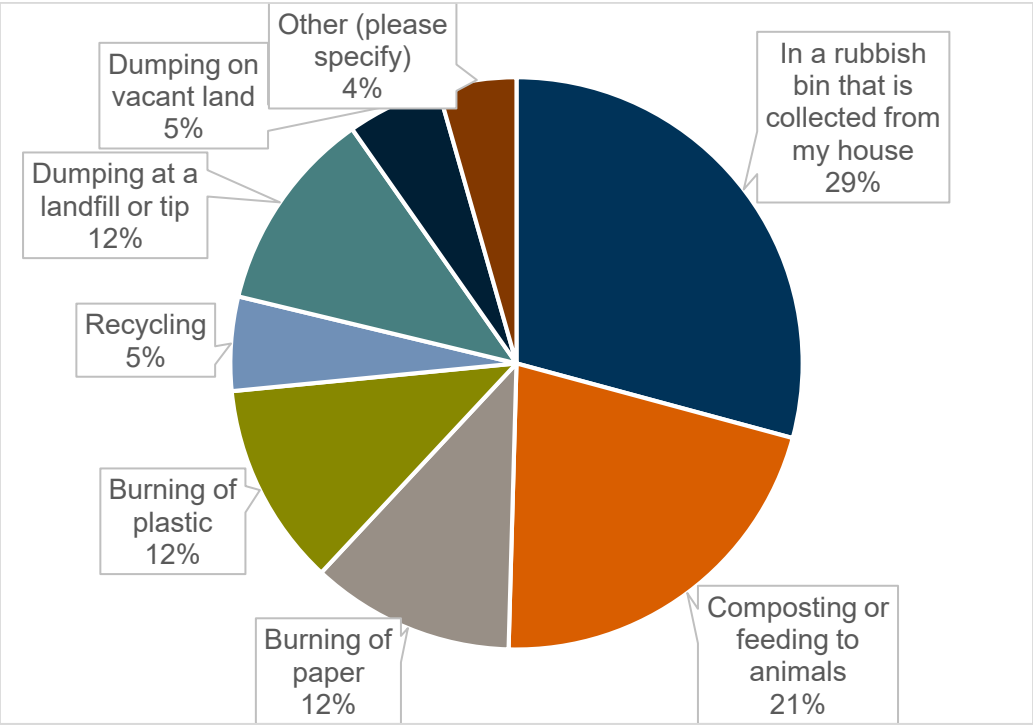

Figure 4-6 Disposal Methods - All

Table 4-1 Disposal Methods – By Country

Disposal Method	Vanuatu	Samoa	Tonga
In a rubbish bin that is collected from my house	15%	55%	30%
Composting or feeding to animals	17%	18%	33%

Burning of paper	19%	0%	7%
Burning of plastic	19%	0%	7%
Recycling	2%	9%	7%
Dumping at a landfill or tip	15%	14%	3%
Dumping on vacant land	10%	0%	3%
Other (please specify)	2%	5%	10%

4.1.5 Question 5 – What do you think of the current rubbish management arrangements?

The responses for question five are presented overall, and by country, in Figure 4-7 and Figure 4-8 respectively.

Overall, most respondents felt that their solid waste services were lacking, with 55% giving a poor or very poor rating. Only 12% felt that their services were good, and 33% thought they were satisfactory, but with room for improvement.

Comparing between countries, Figure 4-8 clearly demonstrates that attitudes are most negative in Vanuatu, and most positive in Samoa. Samoa had the highest rate of respondents reporting very good solid waste management methods, and had no respondents report very poor conditions. Conversely, Vanuatu had no respondents report a very good condition, and had the highest rate of respondents reporting a very poor condition.

This correlates with the responses the previous question, which demonstrated that Samoan respondents had much better access to household collection services than their Vanuatu counterparts. Both these responses also correlate with the results of the first question, which showed that Samoa had the most positive view of the current waste management situation, and Vanuatu the worst.

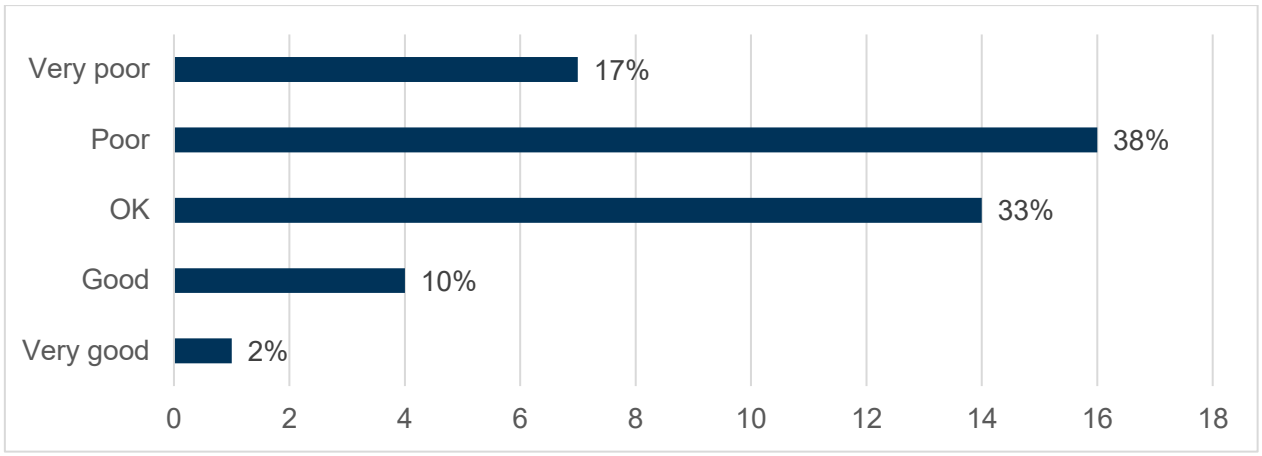

Figure 4-7 Satisfaction with Current Methods- All

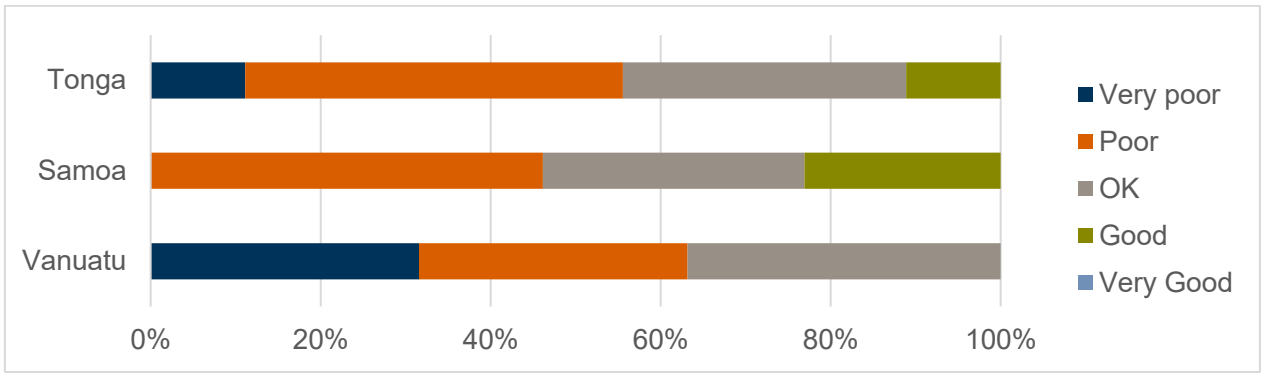

Figure 4-8 Satisfaction with Current Methods- By Country

4.1.6 Question 6 – Would you be willing to pay more money for a better system of rubbish collection and disposal?

The responses for question six are presented overall, and by country, in Figure 4-9 and Figure 4-10 respectively.

The combined results show that, overall, respondents are willing to pay more for better solid waste management services, with 48% willing to pay a little more, and 25% willing to pay a lot more. Approximately one quarter of respondents did not want to pay more, but were satisfied with the current cost. No respondents reported paying too much.

Breaking the results down to country showed that Tongan respondents were very close to the overall percentages reported above. However, as with previous questions, Samoan and Vanuatuan responders delivered opposite responses

Samoan responders were much more likely to be satisfied with current fees, with 54% saying they are happy with the current system, and 23% and 15% willing to pay a little, or a lot more, respectively.

Conversely, of respondents from Vanuatu, only 5% were happy with the current system, and 50% and 30% of respondents were willing to pay a little, or a lot more, respectively.

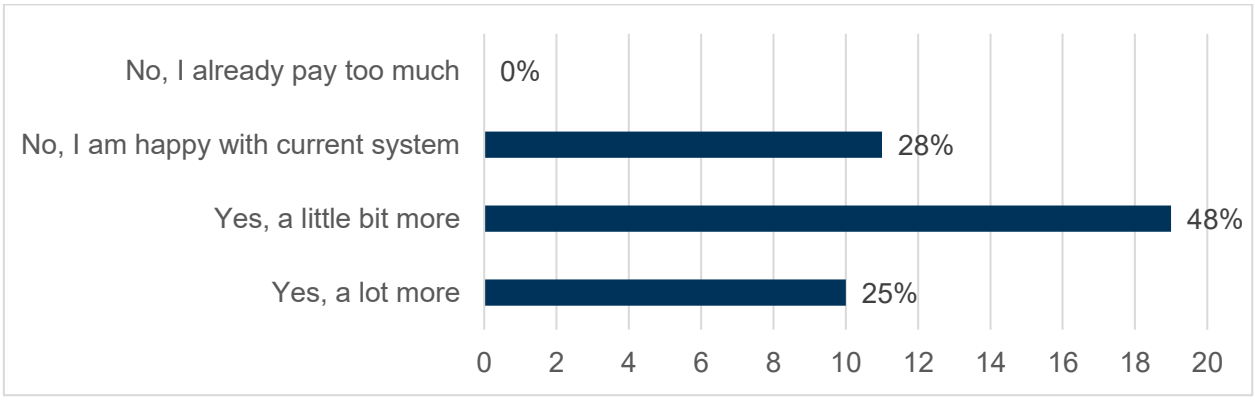

Figure 4-9 Willingness to Pay - All

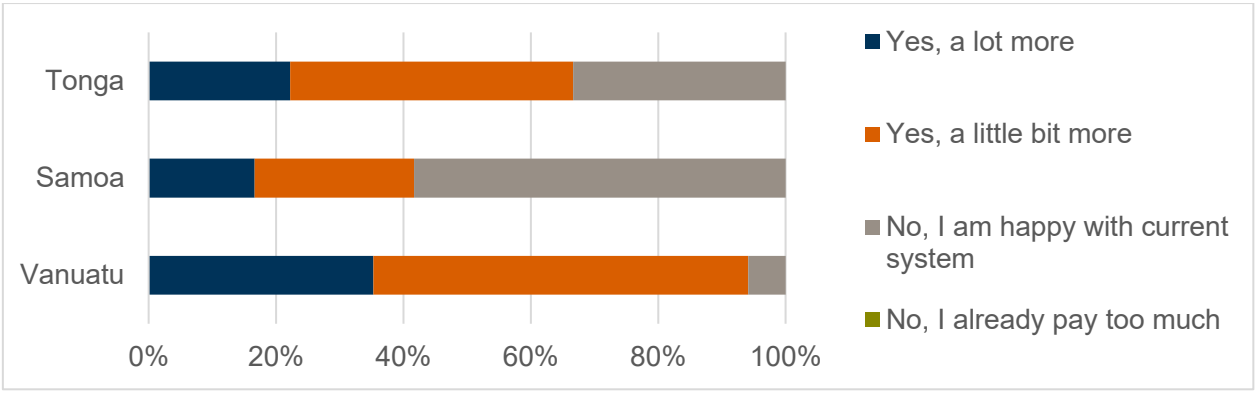

Figure 4-10 Willingness to Pay – By Country

4.1.7 Question 7 – Additional Comments

The final section of the survey gave respondents the opportunity to provide additional information or comment on solid waste management. Of the 43 survey responses received, 16 respondents chose to provide additional information. These responses, divided into countries, are summarised in Table 4-2.

The responses demonstrate a number of common themes, with respondents from every country noting that:

- Education and awareness are critical if behavioural change is to be made. One respondent suggested a school program to target children with these messages.
- Littering and burning off are very common, partly as a result of historical practise, partly as a result of lack of other, affordable options.
- There is a desire for recycling, but the means of doing so are not available.

Table 4-2 Additional comments by survey respondents

Samoa
▪ Aid programs have provided collection bins, but are in incontinent location ▪ Residents only see local township as responsibility, and littering elsewhere is seen as ok ▪ Garden waste disposed of at tip, when would be better used as compost ▪ Public littering is a problem. More education needed around this issue ▪ Need more recycling options, rather than rubbish to landfill ▪ Lots of burning off and disposal illegal dumping of waste in remote villages
Tonga
▪ Need more education and awareness. Suggest holding public clean up days ▪ Disposing of recycling material is a bit harder to arrange and ends up in the rubbish bin ▪ There is no recycling of plastic, cardboard or glass, this all goes into landfill. ▪ A large amount of garbage is burned or dumped in Tonga. ▪ Want a multi-recycle place where recyclable waste can be sorted and re-used
Vanuatu
▪ Privatise waste management so that it works better ▪ Implement an education campaign around recycling and composting ▪ Awareness program to reduce littering along roads ▪ Changes are being pushed at a grass-roots level, but lack government support ▪ Run awareness programs in schools to change behaviour of youth ▪ Need better government leadership ▪ An important concern, but Vanuatu has more pressing issues to spend money on ▪ Burning off and littering are common practise

4.2 Case Studies

4.2.1 Implementing a Solid Waste Management Scheme on Taveuni, Fiji

4.2.1.1 Case Study Source

The following case study was assembled from data collected via email and phone discussions with two key informants who, as Australian Volunteers, worked with local community groups to secure Australian Government funding for the implementation of the project detailed below.

4.2.1.2 Background and Objective

Taveuni is the third largest island in Fiji, and is home to some 18,000 people. Much of the population works in agriculture, which is the primary source of employment on the island. However, tourism is becoming an increasingly large part of the economy.

Currently Taveuni does not have a waste management or collection program on the island. Individuals manage their own waste, either burying it in villages or illegally dumping rubbish on roadsides or in the ocean. This has serious implications for both human health and the health of the marine environment. This was recognised by the community, who in their funding application for the project detailed below, noted:

> *Tourism is a major industry on the island, providing the majority of off-farm employment opportunities. Damage to the marine environment through pollution would has severe implications for future generations on Taveuni, with the potential to reduce food resources, and cause a decline in marine species. This would have flow on effects leading to declining health as well as impacting on tourism and marketability of produce from rural areas.*

From this community concern, a project was developed with the dual purpose of improving:

- Solid waste management on the island, with a focus on waste reduction and recycling; and,
- Creating sustainable income streams for the local villages.

The project aims were too:

- Increase awareness of the importance waste management
- Increase the use of compost as a natural fertilizer
- Groups to make cloth bags and diapers to reduce the use of plastic bags and synthetic diapers
- Produce and sell potted orchids and other cut flowers
- To initiate open garden and mat making scheme for tourists on Taveuni
- To promote the use of local fruit and vegetables for food security
- Produce a local Taveuni Cookbook

4.2.1.3 Project Approach

An integral component of the project from the outset was a high level of involvement from the local community, and the targeted engagement of women and children. As noted by the key informants:

> *I think the key to making waste management a workable option on Taveuni was broad community participation and also integrating a fun component of education in schools and with the community festival. It brought the community together for a common purpose. There started to be a momentum of cause-marketing too; companies were coming on-board supporting the program and enhancing their public image.*

The project aimed to deliver a range of social, health, environmental and economic benefits, through a range of connected initiatives:

- Training and supporting farmers to produce their own compost. Has the dual impact of both reducing the volume of solid waste requiring disposal, as well as reducing farmers reliance on

fertilisers, which has environmental and economic benefits. The goal ties in with the Fiji wide Plan of Action for Nutrition, which encourages kitchen gardens.

- Some compost would be diverted to growing local orchids. A complementary project is developing skills in horticulture to produce cut flowers at market; an identified niche following the recent creation of a monthly island market. Tying in with other projects was done purposefully to encourage update and the ongoing success of the proposed waste plan.
- A complementary project (undertaken at the same time, but he same groups) was design to replace plastic bags and disposal nappies, with reusable, cloth alternatives. Providing women's groups with the materials to sew cloth diapers and cloth bags will provide an opportunity to generate an income as well as benefit all individuals through reducing waste. Bags will be made by women's groups and sold, with the money financing the purchase of more materials to continue the making and sale of bags. Long term benefits for the families of the 82 women include increased capacity to earn an income by learning new skills and having the sewing machines operational to make saleable products.
- Implementation of an island recycling scheme, designed to feed into the existing scheme operating on Fiji's main island. There are three operators currently collecting and recycling glass bottles on the island. The project aims to encourage more people to recycle empty containers by providing incentives such as strategically placed recycling bins as waste-transfer stations. This waste would then be returned to Suva where Waste Recyclers Fiji Ltd will pay an amount per kg. This will increase the capacity to generate an income for all interested recyclers, and pave the way for business opportunities to emerge from this waste management initiative. Increased income generating benefits will occur for at least 3 waste-management operators on the island.

4.2.1.4 Project Implementation

The project was design to run over a period of approximately 12-18 months, progressing through a number of stages:

- Stage 1 – Planning: Meeting with groups to establish calendar of events and actions
- Stage 2 – Recycling: Sessions on compost making, develop and deliver school materials
- Stage 3 – Waste Reduction: Waste transfer stations, education campaigns, community festival
- Stage 4 – Sustainable Income: open gardens, mat making, sewing machine repair
- Stage 5 – Review: Reflect on learnings for input into future projects

The project was facilitated by the AVI Volunteer Food, Security and Inclusive Learning Mentor who oversaw the coordination of Tei Tei Taveuni's Women and Youth groups (TTT), as well as school workshops. There were eight TTT women's groups, who met regularly to discuss ways to improve lives of the Taveuni community. Existing linkages were present between women's groups and schools, which were utilised in drawing participants into the project and increasing community awareness of the project. The project aimed to build the capacity of these women's groups so that they can continue to facilitate these activities once the AVI position is completed.

Five schools were approached to participate in the Taveuni school projects, totalling approximately 400 students. All elected to participate. Dedicated school material was prepared and shared with students through a number of in-school- workshops. The workshops sought to inform students of the importance of waste management, and to encourage students to both implement these lessons themselves and to share them with their extended family. Students were also encouraged to participate in a fully community funded - group learning sustainability festival. The festival was planned to ensure that all students on Taveuni, included those in schools who were not participating directly in the program, had the opportunity to participate in and benefit from the project.

At the time of the project a small number (averaging 30) youth participate in Taveuni monthly village meetings. Through this project it was sought to increase participation by providing learning opportunities which support their age of enquiry and learning. The involvement of these youth was much appreciated by the wider community, and it was hoped that their involvement in spreading the message of responsible waste management will ensure these young rural leaders will bring other interested youth with them to create a healthy farming future.

The involvement of children and youth in the project was a clear, explicit goal from the start. The statement provided in the project grant application from the community groups further underlined the determination of the local community to engage with their children and youth:

> *Youth and children are our future, let's work together responsibly to create healthy and socially secure options for our families.*

4.2.1.5 Project Outcomes

At the outset of the project, a number of specific goals, with measurable outcomes, were prepared to assessed the effectiveness of the project. These goals and measures, and the outcomes of the final project, are summarised in Table 4-3.

Table 4-3 Taveuni Waste Management: Outcomes

Specific Goal	Measurement	Success?

Establish at least 6 waste transfer stations on Taveuni	Establishment of the stations	Partly – over the course of the project 4 stations were set up. All are working successfully
Reduce plastic bag usage by TTT members by 30%	30% of TTT members using cloth bags	Yes – 80% of members were using cloth bags
Reduce synthetic diaper usage by TTT members by 30%	30% of TTT members using cloth diapers	Yes – 32% of members were using cloth diapers.
Reduce the amount of bottles being dumped	Recycling of bottles by 30% of TTT members	Yes – 64% of members utilising recycling schemes.
Increase usage of compost as the main fertiliser source for kitchen gardens	Compost being made by 30 farm groups	Partly – composting being undertaken up 22 farms.
Repair sewing machines	At least 4 sewing machines repaired, with students acquiring knowledge to maintain and repair their own	Unsuccessful – aimed to have a specialist repairer come to island to repair and teach. Did not happen over course of project but still being sought.
Initiate village mat making and open garden scheme on Taveuni	Establish 1 women's group to host mat making tour. Establish 1 open garden host group.	Partly successful – mat making tour undertaken but gardens not sufficiently established for tour at completion of project.
Propagate orchids on Taveuni	Have 4 farm groups growing orchids	Yes – 4 farms successfully growing orchids for market sale
Value local knowledge and skills and share with the tourist community	Produce and sell "Taste of Taveuni" cookbook	Yes – cook book produced and selling well to both Fijians and tourists.

4.2.1.6 Long Term Viability and Lesson Learned

The key lessons learnt, and key aspects that both the informants and community participants felt were most important were:

- A high level of community involvement and ownership. This was felt to be crucial, both in terms of creating momentum throughout the project, but also ensuring its ongoing success once the grant funds are acquitted and the volunteer's placement period ends.

- Program designers showing respect for the community by earnestly listening to their views and opinions in order to design an appropriate project for their particular needs. Some community comments made to the volunteers suggested that previous project (both in solid waste management and other development areas) have simply presented a “solution” to the community without any prior engagement. Such “solutions” have often been found to be inappropriate for the community or region they are working in, and receive little uptake or endorsement from locals.
- Involvement of youth and children. The island places a high value of children, youth and education. It was also felt that children were effective promotors of change both within their families and in the wider community. The volunteers related a story of a young child calling out an adult littering in the middle of the village. I response the adult collected the waste and put it in a bin. The volunteers were not convinced that such a response would have occurred if another adult had called out the behaviour.
- Starting small in order to be able to demonstrate successes. The project aims, while important, were also designed to modest at the outset. This was done to create feeling of achievement and momentum within the working groups at successfully delivering these goals, as well as to allow a successful narrative to be delivered to other community groups and government organisations when the time comes to expand the size and scope of the waste management works across the island.

4.2.2 Solid Waste Management in Nuku’alofa, Tonga

The second case study examined current solid waste management programs being implemented in Tonga, and how successful they are / have been at addressing solid waste concerns.

The case study was sourced from a series of emails with an Australian Volunteer placed in the Tongan Waste Authority.

4.2.2.1 Current Services and Limitations

Currently only the main island of Tonga’tapu was serviced by the Waste Authority. Further expansion to other major centres is currently in the planning phase, but full role out to all Tongan residents is highly difficult as a result of the number of small inhabited islands. Consultation is currently underway with these communities to attempt to develop a viable solution.

There is a set weekly collection for all residential areas. The service is working well for businesses, which typically have more secure waste receptacles. Many villages have a stand on which rubbish is to be placed. However, a lot of bagged rubbish is still placed at the foot of this stand, or in containers without sealable lids, with the results that pigs and dogs often break into these bags and containers looking for scraps. Commercial waste removal is also provided at schedules determined with clients, with some premises being serviced daily.

May 2016, the waste management tariff was transferred to the electricity bill which basically makes it a compulsory payment. This has seen a huge increase in customers and has helped curb dumping/burning rubbish as people are starting to see the value and using the service they are already paying for.

The service costs 10TOP per month (£3.33) which is charged to the monthly electricity bill. This has caused some issues for those families who struggle to pay for the electricity. A subsidy scheme is currently being negotiated with the Waste Authority to assist these residents.

The main island of Tonga has a sanitary landfill site; an old quarry that was transformed into a modern waste facility and is expected to last 30-40 years. Sanitary disposal options on other large islands are limited, and are non-existent on many smaller islands.

There is also a small business that has recently started recycling paper into toilet paper. The business is trying to organise contracts with government agencies and schools for the supply of toilet paper, and the collection and recycling of their waste paper.

A private recycler manages the recycling of aluminium cans, batteries, e-waste and car bodies. These items are stockpiled on Tonga until market prices overseas (typically in Australia or New Zealand) warrant the shipping of these materials to those markets.

4.2.2.2 Current Issues

Throughout the week, and in particular on Saturday there is a huge burn off of garden litter and plastic waste. Legislation was passed in June 2016 making it illegal and a finable offense to burn, dump and litter. The Waste Authority is running an ongoing awareness campaign to promote spot fines that were recently introduced, and enforced from January 2017.

Recycling on Tonga has taken a backward turn in recent years. In the last 2 years, the plastic recycling scheme that was operating was discontinued as it was no longer economically viable. This was largely due to falling public participation, led by, in the eyes of the Waste Authority, the relative ease of burning plastics rather than taking the time, or paying the fee, for appropriate disposal.

There is no glass recycling on Tonga, nor has there been in the past.

4.2.2.3 Future Plans

Currently WAL (Waste Authority Ltd) are working with government ministries to produce a series of TV commercials, billboards and various other promotional material to educate the public on solid waste management issues, and to encourage the uptake of current schemes, and the support of future ones.

A key aspect of this is the “Clean Green Tonga” campaign, which, as defined on their Facebook page (CGT, 2017):

> *… is a campaign for change. It is a vision for Tonga to be an island nation famous for being clean and green. It is a campaign to change what we do on a daily basis – a campaign to reduce dumping, burning and littering, and enhance our public spaces so that we have a beautiful and healthy environment. Working with communities, schools and workplaces to make a difference - creating social change on the ground by our actions.*

The plan to start with education and engagement was a deliberate strategy. Previous schemes (such as plastic recycling) collapsed due to a lack of uptake and support from the community. The new plan aims to first build resident understanding of the solid waste issues facing their communities, before working collaboratively with both community and industry to development mutually beneficial solutions.

5 Discussion

5.1 Country Comparison

Throughout the responses from the survey, a common theme emerged in the attitudes of respondents from the Samoa, Tonga and Vanuatu. Across a range of questions, respondents from Samoa were consistently more satisfied and less concerned with the current state of solid waste management in their country, than Tongan or Vanuatuan respondents. Conversely, respondents from Vanuatu consistently reported the lowest satisfaction and the highest level of concern for solid waste across the three countries for which surveys were returned.

To provide some context for these outcomes, the country summary table from Section 1 is reproduced below with just these three countries. Table 5-1 indicates some notable differences between the countries that may provide some context, and also some support of the results that were received.

With respect to Vanuatu, Table 5-1 indicates that it has the greatest land area of the three nations. However, this area is spread over 65 inhabited islands – nearly double that of Tonga and over 7 times more than Samoa – resulting in Vanuatu having the lowest population density of the three. It is also the only country of the three that reports a falling rate of GDP over the last 2 years.

This creates significant difficulties for waste service providers. Overall population is low, while also being dispersed, which makes achieving economies of scale difficult. Furthermore, access between population centres is via water which is more complex than roadways. And in addition, large sections of the population are poor, which limited funds available for accessing solid waste schemes.

Conversely, Samoa has its population spread across far fewer islands, and recorded the highest annual GDP of the three nations. It's population density is three times greater than Vanuatu (though still significantly lower than Tonga's). In addition, Samoa is recording positive GDP growth.

While the above factors are not enough by themselves to determine if a population has good or poor solid waste management, they do provide some context, and some support, for the key results of the survey.

Table 5-1 Summary of Characteristics of Pacific Island States (CIA, 2016)

State	Land Area (km^2)	Population Density (ppl / km^2)	Population Growth (2015)	No. Inhabited Islands	GDP (Millions of $US in 2015)	Rate of GDP Growth (2015)
Vanuatu	12,189	20	2.2%	65	685	-0.8%

Samoa	2,842	63	0.8%	9	1,000	1.7%
Tonga	748	139	0.4%	36	414	2.6%

5.2 Waste Composition and Potential Opportunities

As part of the survey, respondents were asked about what makes up their waste. While it was not possible to determine how much of each waste category was produced by individuals, the relative numbers of each persons who reported generating a quantity of the at waste can be used to infer the relative amount of each waste type generated.

The results are reproduced in Table 5-2. The results show that typically, organic wastes make up around 45-50% of the waste generated, of which 30-35% are food and garden waste. The food and garden waste organic component are ideal candidates for a composting scheme. While the paper is also likely biodegradable, it is not suitable for a composting scheme, as it takes too long to break down sufficiently (Hoornweg, Thomas, & Otten, 2000). The percentage of suitable waste however is sufficient for a composting scheme to be feasible, and will also result in a significant portion of the waste stream being diverted from landfill. The case study from Taveuni also demonstrates that while such a scheme would have benefits for solid waste management, it also delivers economic benefit to participants, and can affect other positive environmental and social changes, such as the reduction in the use of fertilisers in the growing of crops.

The significant portion of waste that was classed as plastic also suggests that some recycling programs may be achievable. Such programs were frequently requested by survey participants. Unlike composting however, the recycling of plastics is a more complex and industrial process, they may not be suitable in all locations. It is noted from the Tongan case study that in Tonga, metal recycling is undertaken by a private contractor who stockpiles the material locally until prices in overseas markets are sufficient for transporting and selling the material in bulk. This approach allows for this waste to be collected, diverted from landfill, and reused, while also providing an income for the workers of the private firm. Such an approach may also be suitable for plastics. It is noted that Tonga also charges a fee per plastic bottle imported by companies. Such a process could serve to offset the costs of a recycling scheme if market prices are insufficient to return a profit after shipping and handling is accounted for.

This is not to say that a local plastic recycling industry is impossible in the pacific. However, the geographic issues that make siting solid waste management infrastructure complex in the Pacific, also relate to industry. Coupled with high power costs, unreliable power connects and additional costs in shipping spare parts and the like, it is likely that an outsourcing model would be more efficient. At least in the short to medium term; once significant volumes of plastics are being collected, it may become more cost effective to process the material in the Pacific and then ship the refined product for sale.

Table 5-2 Wastes Generated as Reported by Survey Respondents

Country	Food waste	Paper	Plastics	Tin cans and metal	Electronic waste	Garden Waste
Vanuatu	15%	15%	20%	19%	13%	12%
Samoa	21%	18%	19%	21%	5%	14%
Tonga	16%	18%	16%	18%	16%	16%

5.3 Indicators of Satisfaction

As discussed in the results, Samoan respondents were significantly more approving of their current solid waste management schemes than those of Tonga and Vanuatu, with the Vanuatuan respondents being the most negative. The survey also showed that this spread matches the extent of solid waste collection service operated by local authorities; Samoa had the highest percentage, 55%, of respondents who stated that their waste was collected via a regular collection service from or near their property. In contrast, Tonga and Vanuatu only recorded 30% and 15% respectively.

The level of satisfaction correlated strongly with the extent of household collection services provided. Such a service is easy for residents to make use of, and the results are highly visible – full bins go out on collection day and are brought back in empty – which is likely to increase user satisfaction. While a sanitary landfill were residents can deposit their waste is just as able to manage domestic waste as household collection, it places a much greater burden on the individual to package and transport their waste. When time is short, or other barriers such as weather or access are in place, it is likely to increase the incidence of roadside or vacant lot dumping (Ali, Cotton, & Westlake, 1999). Given this, a correlation between satisfaction and the extent of household collection is understandable.

It also implies that residents would see greater value, and have an increased satisfaction with, solid waste management services if a higher level of service was provided. This would require increased service fees, which is discussed in the following section.

Table 5-3 Satisfaction with Current Waste Management Processes

	Very poor	Poor	OK	Good	Very Good
Vanuatu	32%	32%	37%	0%	0%
Samoa	0%	46%	31%	23%	0%
Tonga	11%	44%	33%	11%	0%

5.4 Willingness to Pay

An inverse trend was observed between satisfaction and willingness to pay – the more satisfied a population was, the less inclined they were to pay further fees, and the less satisfied, the more inclined to pay additional fees.

While not unexpected, it is an advantage for these countries that a willingness to pay exists. It indicates that effective solid waste management is something that residents want, and that, provided of course

that the service is appropriate, that they are willing to pay for it. This is a large advantage in setting up new projects, as instigators can be confident that demand for these services already exist.

It should be noted however, that there is a likely bias towards urban dwellers in this survey. Responses from the Tongan Waste Authority suggest that a number of residents in per-urban and rural areas are struggling to pay the newly levied waste management fee, and that subsidies are being investigated for these residents.

A further study into the extent of the community's willingness to pay would be a strong resource for future solid waste planners. Quantifying the amount of additional funds people were willing to contribute was beyond the scope of this study, but would form an integral part in designing any future solid waste management scheme.

5.5 Importance of Awareness

With regard to the Tongan respondents, it was interesting to note that only 30% responded that that they had household collection services, while the Waste Authority stated that they serviced all of the main island, Tonga'tapu, with household collection. It is possible that some respondents live outside of the main island, but given that all Australian Volunteers are located on Tonga'tapu, it is expected that most respondents lived there as well. The waste authority noted that an increase in utilisation of the service was observed when fees were transferred from a separate payment to be charged alongside electricity, as residents began making an effort to use the service they were paying for. It suggests that while the majority of Tongans said their service was poor, this could be due to a lack of awareness of what services are actually on offer, and the process of accessing them.

The current undertaking of the Tonga Waste Authority in preparing and implementing a community awareness and engagement process is a reasonable next step given the above. Building community awareness of the issues, and the options available to address the situation is a critical initial step in designing a solid waste management scheme (Chang, Pires, & Martinho, 2011).

The positive outcomes of this approach were highlighted by the results of the Taveuni composting and recycling scheme. The scheme was designed by local residents, building on existing skills, and developing new, transferable skill sets to deliver social, environmental and economic benefits to the community, in addition to improved solid waste management.

5.6 Limitations on Access

Barriers to access were a common theme that arose in both the survey results and the case studies. Two key limitations to access were identified in the survey and case study.

The first was a limitation in access to services already provided. As discussed above, awareness plays a crucial role in this – residents are unable to access services of which they are not aware. A key reason for this access is that services are typically provided on the larger, more populous islands, with

service provision rapidly declining for smaller and more remote islands. This results in a large barrier to effective solid waste management for those communities more distant from regional centres. Both Samoa and Tonga offer household collected services, but only to those residents who live on the main island. Similarly, all three countries have landfill sites, at which residents are able to dispose of rubbish. Again, these are located on the main islands of each country. While the landfill is available for use by all, the logistics for remote communities to access them are often prohibitive. They require significant travel time by boat, which has a high fuel cost, as well as removing both the boat and its occupants from their usual duties in the community, such as fishing. As such, it is not surprising that remote communities still have a high incidence of burning off of plastics and other combustible material. Even if they are aware of the health implications, and many are not, they are left will few other options.

The second limitation on access that was observed was an inability to access desired services. With regard to desired services, a number of respondents from all countries stated a desire for recycling programs to be implemented in the region to assist with the control of plastic pollution. Residents desire the ability to utilise these services, but neither governmental nor private enterprise provides them. This does however demonstrate that there exists some low-hanging fruit with regard to improving the solid waste management practises and schemes in the region. It suggests that there are already a significant number of people who would elect to participate in a recycling scheme should one be made available. There may still be economic hurdles to implementing such a scheme, and the limitations on geographic access discussed above would be important to overcome. However, the fact that the need for this service is already identified in the community is an important first step in construction a successful scheme.

6 Conclusion

6.1 Conclusions

Solid waste management is a serious issue in developing countries, and small island states face even further barriers to being able to implement effective and sustainable solid waste management schemes.

Factors such as geographically diverse populations, lack of transport options between islands, space restrictions for the siting of any waste management facilities and a rapidly changing waste stream both in terms of quantity and makeup, create a highly difficult situation for communities and governments to manage.

The investigations undertaken have demonstrated that a number of barriers prevent communities in Pacific Islands participating in effective solid waste management schemes:

- **Geographical factors**: An overarching factor, the geographic nature of the Pacific Islands makes effective and efficient solid waste for all communities a complex task. Limited land areas, disperse populations, and the requirement for ocean travel between islands makes designing and implementing solid waste schemes difficult.
- **Access**: Communities within the Pacific struggle with access to existing services, as well as to those that are desired but not implemented. As noted above, the geography is a key driver of access restrictions to existing services, with schemes being implemented on the larger islands only. For those on the major islands, access can still be difficult for remote communities due to transport and time concerns, which limits their ability to partake in the currently operating schemes. There was also a high demand for recycling initiatives noted in the surveys, but communities are prevented from accessing these services as they are not being implemented by government or private operations.
- **Affordability**: While affordability did not arise as a serious concern amongst the survey respondents, the case study demonstrated that poorer families are struggling or unable to pay the costs leveed against them for solid waste management. Based on the likely bias of the survey responses towards urban dwellers, it is likely that this issue will increase with increasing distance from established urban centres.
- **Awareness**: The raising of awareness was noted in both case studies, as well as in some responses to the survey, particularly with regard to burning off waste. It was recognised as an area for investment by both Tongan and Fijian service providers, in order to ensure both uptake and the continued success of solid waste schemes. As demonstrated by the Tongan case study, previous recycling schemes have collapsed as a result of a lack of awareness.

Despite the above issues however, a number of opportunities were identified to further develop the solid waste schemes that are currently in place:

- **Awareness Raising**: Both the Tongan and Fijian case studies demonstrated that while there are some good regions of awareness (likely centred on major centres based on the survey results) there is still some misconceptions and lack of the importance of good solid waste management in rural areas. Such areas still practise a lot of burning off of wastes, including plastics and electronics that are hazardous when burnt. Capitalising on the current level of awareness to increase both the level and extent of understanding would assist in delivering better solid waste programs to these rural areas, by generating demand and increasing the likelihood of uptake.
- **Composting**: The case study from Taveuni, Fiji, suggests a good model for implementing composting schemes at village and community scale. Many villages, particularly those most in rural areas, still rely on locally grown crops for sustenance, as well as income. Encouraging these communities will assist in reduce the solid waste they have to manage, while also delivering health and economic benefits. These benefits were realised in Taveuni through better crop yields, and a reduction in reliance on fertilisers and pesticides. The advantage of such schemes is that they are particularly suited to rural villages who grow their own food, and it is these villages that are most likely to be unable to access larger island wide or national schemes.
- **Recycling**: There was a significant demand for recycling services from respondents from all countries. This is a significant opportunity as it indicates that both the awareness of this issues, and the desire to address it are already present in these communities. These are two substantial hurdles that many solid waste projects face, and allows the option to move straight into discussions with these communities about what structure of recycling scheme would be suit them, without first having to generate interest. Unfortunately, unlike composting above, such a scheme would require the support of government of private industry to make work due to the required transport and processing costs, but a recycling scheme could be targeted on major centres first, and expand to more remote areas once established.

6.2 Limitations

Due to the methodology of the investigation, which was in part governed by personal circumstance that prevented overseas travel as part of the project, the data collected and the results and discussion presented have some limitations worth noting.

The first was that, due to comments provided by the pilot tester, personal demographic information was taken out of the survey. The feedback was that such questions, without being at all acquainted with the recipient, ran the risk of being overly invasive into an individual's privacy. This in turn may have led to a reduction in the volume of surveys returned.

A consequence however, is that it is not possible to determine the demographic characteristics of the respondents, and more importantly, if they are a reasonable mix of the wider population. The participation of women, children and other minorities was not able to be quantified.

While effort was made to distribute the survey as wide as possible, it is still likely that the vast majority of the respondents would be from major centres, and likely more affluent than the average resident of the countries contacted. Residents in such a position are likely to have a greater ability to both afford and utilise solid waste management schemes that are in place. Without knowing where respondents live, it is unknown what portion of responses are from urban areas and what portion are from peri-urban or rural areas, where services are likely to be much more limited.

No direct personal contact was possible with residents of the Pacific Islands surveyed. Such a perspective would have been useful in delving further into the response made, and being able to ask follow questions to those posed in the survey.

The discussion also assumed that responses are accurate and true. There was limited ability to confirm or triangulate the results given.

6.3 Recommendations for Further Research

The results and discussion undertaken as part of this thesis suggest that further research into the barriers to solid waste management in the Pacific be further studied.

The key areas that are suggested for further research and examination are:

- Investigations to quantify the makeup of the waste streams. While the data collected as part of this study was relatively high level, it nonetheless indicated that there were significant differences reported between the waste composition in each country. Details on the constitution of the waste streams in Pacific Islands is limited, and these results indicate that what information is available is unlikely to be representative across the Pacific. A detailed knowledge of what is in the waste stream is important if appropriate management measures are to be implemented.
- A focused investigation into residents' willingness to pay is warranted based on the results of this study. The survey responses suggest that a significant proportion of the community would be willing to pay more for solid waste, if it delivered an effective system. It is worth noting here again the limitation that many respondents are likely to be professionally employed, and so may have a great income, and are more comfortable spending a portion of this on solid waste management schemes.
- A focussed study on small, more dispersed Island States. All the responses received from the survey were from larger island countries, with a greater proportion of the residents located in regional centres. It is expected that countries comprised of smaller, dispersed island would face additional challenges.

- Further discussions with women, children and minority groups, as well as rural residents, all of whom may have been less likely to have had an opportunity to respond to the survey in this study.

6.4 Reflections on Project Methodology and Outcomes

Overall, the project delivered on the primary outcomes of determining the key barriers to effective solid waste management in Pacific Island communities. These were found generally to fall into three broad groups of awareness, access and affordability.

However, changes to the methodology would have allowed a more detailed examination of these issues. While the scope and methodology were constrained by an inability to travel as part of the investigation, onsite research and discussions would have added a significant depth to both the data collected, and the subsequent analysis. The results provide a good overview, and have highlighted key concerns. Being able to talk to affected residents however would have opened additional avenues of investigation and discussion, and allowed some ability to confirm the results by feeding them back to key community members.

The broad distribution approach of having volunteers distribute surveys to people in their networks worked well. A good response was had from the three countries with the greatest number of volunteers. A more comprehensive assessment would have been possible if data were also returned for other islands, but this was limited by the method adopted. As above, a visit to these smaller countries would likely have yielded valuable data, but was unfortunately not possible as part of this project.

The outcomes were satisfactory, given the level of participation. While a higher rate of return would have been valuable, the fact that all returns were from only three countries, and each had a reasonable number of responses, was a fortunate outcome, as it allowed some comparison to be made between these nations with some level of certainty. A response from a greater number of countries, but with fewer number per country, would have introduced further risks of non-representation, which as discussed in the preceding section, are already substantial.

Were the study to be undertaken again, a number of key changes would be attempted, though there is no guarantee that they would be any more possible in a subsequent study than they were in this one:

- A site visit to one or more countries would be prioritised. For personal reasons this was not possible as part of this investigation, but there is no doubt that such a visit would be highly valuable for future studies in a similar vein.
- A longer survey would likely have been possible without adversely affecting the rate of return. Even another two or three questions, perhaps drilling deeper into those already asked, would have provided a significantly greater amount of data to work with, with only a minimal risk of reduced participation.

- The main failing of the investigation was that input from service providers was so limited. While this was a risk from the start due to the methodology adopted, and without any onsite time, a difficult issue to rectify, it does prevent one side of the issue being explored as fully as the other. A site visit would allow a chance to talk directly with service providers, and hopefully build a relationship that would allow additional communication to be undertaken once the site visit had been completed.

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Appendix A – Ethical Approval

Ethical approval was granted at the School Level on 30 July 2016 by Derek Thomson.

The Risk Assessment Number is 16/07-10.

The email received from Derek is copied below.

Derek Thomson <D.S.Thomson@lboro.ac.uk> 30 July 2016 at 02:31
To: "luke.r.evans@gmail.com" <luke.r.evans@gmail.com>
Cc: Julie Fisher J.Fisher1@lboro.ac.uk

Ethical update

1 message

Hello Luke,

This email confirms that your project entitled "Barriers to effective solid waste management in Pacific Island Countries" has received ethical approval at the School level. Its Risk Assessment Number is 16/07-10.

Regards,

Derek Thomson (cc'd j.fisher1@lboro.ac.uk)